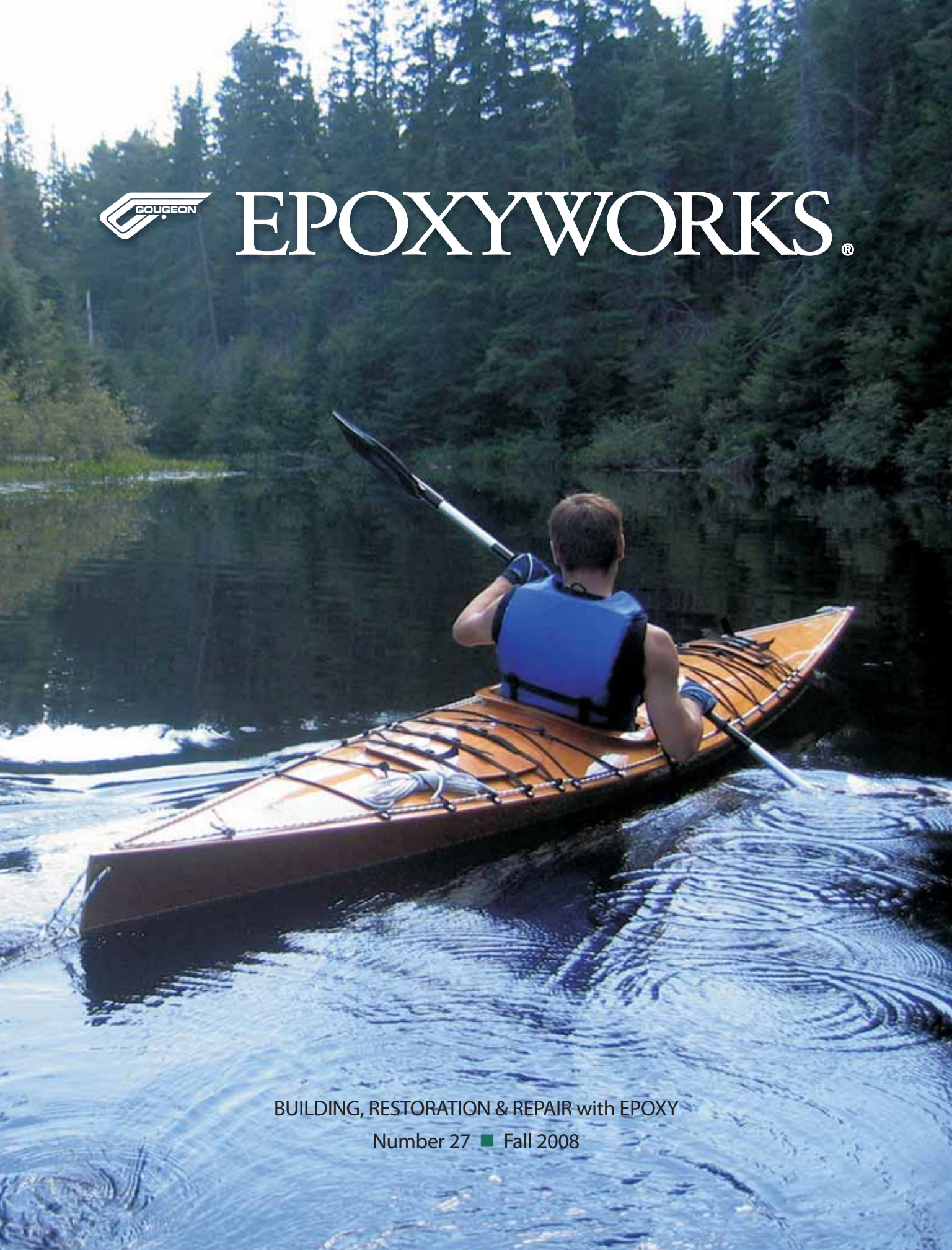

EPOXYWORKS®

BUILDING, RESTORATION & REPAIR with EPOXY

Number 27 ■ Fall 2008

In this issue

EPOXYWORKS®

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Epoxyworks is published twice a year by Gougeon Brothers Inc., Bay City, MI, USA.

Product number 000-605

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Building a pair of Chesapeake 16 sea kayaks

By Chris Jacobson

It all began when we went camping in Algonquin Park in 2005. We rented a couple of plastic kayaks and the kids loved it. We came home with the intention of buying a couple of kayaks but while on the internet we saw these stitch and glue make'm yourself boats. I purchased the books "The New Kayak Shop" and "Kayaks You Can Build." Both are available at Chapters or Amazon.com. We decided this was something we could do. We also discovered www.clcboats.com which would prove to be a tremendous source of encouragement during the project. We made a day trip to Toronto to purchase plans for a Chesapeake Light Craft 16 and some marine-grade plywood. The books have some great suggestions for worktables. We made a 17' one from some ¾" plywood and some stands from scrap 2×4's from a recent renovation.

What follows is the the step-by-step story of the construction of these kayaks—from basement worktable in September 2005 through launching in July 2006.


1

1 Scarfing the hull panels

After ripping two 4'×8' sheets of 4 mm marine plywood into eight 11" blanks on the table saw, I scarfed the strips together to make full length panels. I used clear packing tape on both sides of the scarf joints to prevent the epoxy from oozing out onto the panels.

2 Gluing the shear clamp

You can't have too many clamps for this job. We did one side at a time.

3 Stitching the hull

We made up some forms to hold the kayak at a comfortable height. The panels stitched together like a charm. We used 20-gauge copper wire from Home Depot. You can find it in 50-meter rolls in the picture hanging department. The kids cut it into 3" pieces. We spaced our stitches every 4".


2


3

Cover story

Paddling the south shore of Ontario's Lake of Two Rivers and into Pog Lake.

4 Checking for twist

We made up some stands and clamped the kayak to the worktable. We then checked for any twists in the hull.

5 Taping the seams

We applied masking tape to keep the epoxy glue neat at the seams. We made various rounded plastic tools to apply the epoxy fillets. It's not a bad job once you get the hang of it. Kind of like applying drywall compound only more expensive and permanent. One tip though—after making your fillets, wait a couple of hours before applying the 3" tape and wetting it out with clear epoxy—makes for an easier, less frustrating job.

6 Laying the cloth

The outside of the hull gets a layer of 6 oz fiberglass fabric.

7 First coat of epoxy

We brushed on then squeegeed the first coat of epoxy. We used WEST SYSTEM 207 Special Coating Hardener® for a nice bright finish. Mom is tipping out any runs with a dry brush. We'll add three or four more coats over the next few days. One of the books suggested using cardboard orange juice cans for the grunge while squeegeeing—great idea.

Hey! I thought I was going to be on the cover.

Annie's getting a little impatient with this epoxy business. It's been a few days since she's been on her walk. The kayak has it's fifth and final coat of epoxy.

8 Foot brace details

We made these fully adjustable foot braces from ¼" oak with an epoxy coating. They are easily adjusted by the paddler while sitting in the cockpit. The hardware is all stainless steel and they are fully detachable with no through-hull fasteners. The front bolt keeps the brace on track and the back wing bolt tightens down after adjustment is made. The deck beam was clamped in place and fillets applied—again, no through-hull fasteners for this either. The foot braces have proven to be extremely rugged.


9


10


11


12

9 Fiberglassing the Deck

We covered the decks with 4 oz fiberglass and clear epoxy. Mom mixed the epoxy and I applied it. It's a good team job.

10 Got Clamps?

You can see we used lots of clamps for this job. Once the ooze was cleaned up, I removed the masking tape from the spacer stack. It received a coat of clear epoxy when we glassed over the coaming rim with 4 oz cloth. It might sound strange, but I found shaping the coaming enjoyable. It did not take long with a spokeshave and sandpaper and the result, with epoxy and varnish, was like a piece of fine furniture.

11 Hatch Openings

I applied some wide masking tape to the deck and strung a center line. I then traced the hatch openings from the templates we made earlier. I carefully cut the openings out with a sabre saw. You can see our digital scale on the floor. I periodically weighed the kayaks to monitor the weight progression. In the end they came in at 42 lb each.

12 Making hatch covers

The hatch covers were cut from 4mm marine plywood. The frames were router cut from poplar. Not a great wood, but it will be encapsulated with epoxy.

After sanding the kayaks, we applied five coats of Z-Spar Captain's varnish with an epoxy roller and tipped out the bubbles with a foam brush for a coffee-table finish.

We started this project in September 2005 and pushed the kayaks out of the basement and carried them to a reservoir down the street for sea trails on July 22, 2006. ■

Taking a break on Canisbay Lake in Algonquin Park, August 2006. We paddled the entire shoreline of the lake before moving on to Smoke Lake the next day. The kids leisurely paddled the kayaks. My wife and I busted our asses trying to keep up in a rented 15′ fiberglass canoe.

The lighthouse project

By Tom Pawlak

Marblehead lighthouse located on the southwestern shore of Lake Erie.

Bob, my brother-in-law, has a beautiful yard that he has set in a nautical theme. He had been looking at lighthouse plans and asked if I was interested in helping build one with WEST SYSTEM® epoxy. All the plans that he looked at were for flat paneled six or eight-sided lighthouses built with plywood. I was interested in a project that was a bit more challenging and unique, so I suggested we build a stripped plank version. That way the tower could be round and tapered like many of the popular lighthouses around the world and it would differ from the flat-sided variety often seen in people's yards. Bob liked the idea, so he went online and found photos of lighthouses that he liked. In the end, we based our design on Marblehead lighthouse located on the southwestern shore of Lake Erie.

As Bob became more excited about the project, he thought he might like a second lighthouse for the backyard. With that in mind, we decided to build a mold so we could easily make multiple towers if desired.

The Mold

Our mold was a series of semicircles made of ¾" particle board that defined the shape and taper of the tower at 12" intervals. These were attached to a piece of OSB board that was supported by a flat table that served as our mold strongback. Here's the process used to set up the mold:

Bob covers the mold frames with tape so glue used to hold the wood strips together will release from the mold.

Lay out a centerline for the mold stations on a flat sheet of ¾" plywood or OSB. To stabilize the mold, use a flat table or an old hollow-core door supported by sawhorses.

Attach 2"×2" cleats (used later to support the semicircle mold frames) to the plywood base at 12" to 16" intervals along the centerline. Be sure they are mounted at 90° to the centerline. You can vary the taper of your tower by moving the mold frames closer together (more taper) or farther apart (less taper) if you wish. Attach the mold frames to the cleats with wood clamps or with drywall screws. Make sure the frames are centered on the centerline.

Check the mold frames for proper location by laying a straightedge along the length of the mold. This is best done on each side of the mold and along the centerline. If necessary, adjust individual mold frames side to side and up or down on the 2"×2" cleats or back and forth along the centerline to achieve the best fit. Low spots on individual mold frames can be built up (faired) with strips of masking tape.

Cover the mold frames with electricians tape or duct tape so glue used to hold the wood strips together will release from the mold later.

Strip Planking the Tower

Our lighthouse towers were made with wood strips resawn from 2"×10" construction lumber, which yielded strips ⅜" thick by 1½" wide. These were eventually tapered on the table saw so we would spend less time fitting individual planks.

The planks were temporarily attached to the mold frames with 18-gauge brads driven in with a pneumatic brad gun operating with low air pressure. This assured that the brads would remain proud of the surface for easy removal after the glue holding the planks together cured.

Left—Tapered 3/8" thick strips are tacked to the mold. The gaps were then filled with epoxy thickened with 410 Microlight.

RIght—After the fasteners were removed the tower half was faired smooth and a layer of 4 oz glass was applied.

We initially attached all of our planks to the mold without glue and intentionally left small gaps between planks. This made the planking process go quickly. The gaps between planks were filled with WEST SYSTEM epoxy thickened with low-density filler. Once cured, the brad nails were removed and the planking was faired with a low angle block plane and a hard sanding block with 60-grit sandpaper. Low spots were filled in with epoxy thickened with low-density filler. I used 410 Microlight® on one lighthouse and 407 Low-Density Filler on the other. The outside of the tower was covered with one layer of 4 oz fiberglass cloth.

Once the epoxy/fiberglass cured, the tower half was removed from the mold and the inside of the planking was sealed in epoxy and reinforced with a few bands of unidirectional fiberglass tape that were applied across the width to strengthen the laminate and hold the shape until the other tower half was built.

Finishing the Lighthouse

We painted the insides of the tower halves with a latex primer, which allowed us to apply the paint while the epoxy was partially cured. White paint reflects light from a single low voltage light inside the tower. This in turn illuminates the etched glass windows that were attached inside the tower with a flexible silicone sealant.

Eventually the two halves were glued together and the seams were glassed over with a layer of 4 oz fiberglass cloth and epoxy. The seams were faired with epoxy thickened with low-density filler.

The base of the lighthouse was made of 3/4" AB grade exterior plywood. Outside surfaces and glued seams were glassed over with a layer of 6 oz fiberglass and epoxy. Inside surfaces were sealed with two coats of epoxy.

879 Release Fabric was applied over the fiberglassed exterior to minimize surface prep later when I planned to glue on pieces of quartzite flagstone for a decorative effect. The flagstone was glued in place with epoxy thickened with 406 Colloidal Silica and dry thin-set mortar. We filled the seams between stone slabs with the colloidal silica/dry thin set powder mix to eliminate maintenance on at least that part of the lighthouse. The color of the epoxy grout can be modified by choosing dry grout mix with the color of your liking. As a last step, we sprinkled dry bright white thin-set powder over the epoxy while it was still uncured. This leaves the grout seams looking uniformly white and appealing. Excess powder was brushed away with a stiff bristled brush after the epoxy cured. Burying the uncured epoxy grout with the thin set powder provides UV protection that will last many years.

The insides of the completed tower halves were painted with a white latex primer so that a single low voltage light bulb would reflect inside the tower.

The window and door trim and baluster supports for the catwalk at the top of the tower were made with scraps of 5 lb density foam, but they could just as well have been made with stable softwoods like cedar or redwood. The trim was glued on with G/5® Five-Minute Adhesive thickened with 403 Microfibers.

Left—The base of the lighthouse was made of ¾" AB grade exterior plywood. Outside surfaces were covered with 6 oz fiberglass and epoxy. Inside surfaces were sealed with two coats of epoxy.

Right—The base was attached to the tower and fillet was applied to the joint.

Quartzite flagstone was glued around the base with epoxy thickened with 406 Colloidal Silica and dry thin set mortar.

The light at the top of the tower was purchased at the local home building center. It is a solar powered lamp intended for use as a yard accent light mounted on top of a post. We considered purchasing a light kit online that rotates the light and flashes, but we thought better of it after considering the neighbors.

The lighting inside the tower is a low voltage light that is spliced into the existing circuit for accent lighting in the yard.

The door at the base of the tower, which allows access to service the light, was cut from the original strip planked laminate. The edges were sealed with a couple of coats of epoxy. The door is held in place with industrial Velcro mounted on the back of the door and on tabs that project from the inside edges of the doorway. The door handle is made from a very small stainless steel rope cleat.

The bottom of the eight-sided tower base was covered with a piece of ½" plywood that had several drain holes incorporated around the edges. It received three coats of epoxy and special attention was paid to sealing the edges of the drain holes. After it was glued in place, the bottom was fiberglassed over with 6 oz cloth. The base was eventually filled with river gravel to provide ballast so the lighthouse would stand up to high winds and to foil half-hearted attempts by vandals to remove it from the yard. We debated anchoring the lighthouse with screw in anchors often used to secure children's playground equipment but opted for this easier but possibly less secure method instead.

We put a bit of detail into the catwalk support, balusters, and chain railing surrounding the base of the main light to give it some personal flair. People go to great lengths to build scale models of boats and planes, but neighbors rarely see them because they are usually stored away in a showcase. If you have a favorite lighthouse, you can make an exact scaled model of it down to the smallest detail and showcase it in your front yard. ■

Our version of the Marblehead lighthouse showcased in Bob's front yard.

G/5 Uses and Tips

Spot prime metals with G/5 in place of slower drying paint primers for indoor applications prior to applying latex paints. Latex paint can be applied to G/5 about ten minutes after the epoxy is applied and while the epoxy is still soft. G/5 provides a thin barrier and prevents rust that otherwise forms in latex paint when it dries over bare steel or iron.

Model Railroad set builders create natural looking surfaces by applying a film of G/5 adhesive, and then sprinkling small objects onto the surface while it is still uncured. These objects include pebbles, sand, dirt, twigs, dried grass, flocking powder, sawdust, natural grains, nut shells, straw, glass chips, glass or plastic beads, metal filings, cotton balls and spun polyester.

Furniture repair

G/5 is ideal for simple furniture repairs when you don't need much working time. For example, I used it on our 30-year-old rocking chair when the mortise-and-tenon joint connecting the spindle leading from the armrest to the seat came apart. (The armrest connects into the seatback with a wood screw.) Probably the most important step in this repair was surface preparation. The saying "You're only as good as what you are attached to" applies. In this case, the original glue that had failed needed to be removed from both the mortise and tenon. After both surfaces were sanded, the joint was slightly loose. Since G/5 is a bit viscous, it easily bridges gaps. The chair was back in service about 30 minutes later. ■

An epoxy clean up tip

WEST SYSTEM® Epoxy cleans up easiest before it has cured. The problem is, because of its clarity uncured epoxy can often be difficult to see. By the time you notice it, it's already cured and is much more difficult or impossible to remove. Cured on leather or carpet, it's permanent. Cleaning up epoxy drips before they cure is crucial. Mixed epoxy resin and hardener fluoresces under exposure to a 'black light'—the common name for a lamp that emits electromagnetic radiation in the soft, near ultraviolet range while providing very little visible light. After completing a task with epoxy, expose the area to a black light. You'll be able to see epoxy drips, runs or smudges you can easily wipe away with a little denatured alcohol and paper towel. —*J.R. Watson*

A quick fix to a broken spinnaker pole

By Meade Gougeon

Adagio, our 35' trimaran was already off to a bad start in the 100th anniversary of the first running of the Chicago to Mackinaw race with an over-early call by the race committee. Everything went downhill from there.

Less than an hour into the race the luff wire in our number one genoa parted, putting our crucial 360 sq ft light air weapon out of business. Attempts to use it to leeward on our spinnaker pole resulted in more loads than the pole was designed to handle. It collapsed with a bang!

In an instant, our inventory of five sails was reduced to two: the main and the working jib. No spinnaker, no screecher and no genoa. In effect we were out of the competition—a huge blow to the crew who'd looked forward to this prestigious race all season. Fortunately, we were still sailing to weather with the fleet, but without the use of our genoa we lagged behind most of our competitors. Thoughts turned to a pole repair, but could we do this quickly enough to get us back into this race?

Within five hours of the breakage, the modified epoxy blend had cured on the pole splice. With the spinnaker pole fully restored we were back in the race.

With nothing to lose we started to prepare the remains of the pole by squaring off each broken end about six inches in from the break point, effectively reducing our pole length by one foot. To realign the halves, we fit the two ends using a spare sail batten, making two 18" splints that we stuffed into the hollow ends. We then sanded the sharp edges smooth.

In the main cabin we set up a gluing operation complete with Handy Packs of WEST SYSTEM 105 Epoxy Resin® and 205 Fast Hardener®, and two small bottles of G/5® Five-Minute Adhesive. We laid out lengths of 1½" 702 Unidirectional Carbon Fiber Tape for wet out on a sheet of thin repair plywood (an item we always carry when going offshore). We first wet out two 20" lengths, which we then cut in half and applied to the pole leaving 5" on either side of the butt splice, with the four layers just covering the pole circumference. We applied four more layers like these, each two inches shorter than its predecessor.

The key to success of the operation was mixing 105 Resin/205 Fast Hardener with G/5 resin and hardener in a two-to-one blend.[1] This mixture vastly sped the cure time of 105/205 to 15 minutes working time and a tack free cure of about one hour. With two separate batches we got the job done in about 40 minutes using only a plastic spreader to apply the epoxy and to remove air while the cure progressed on the layers of carbon fiber tape.

At one hour (while still in the green stage) we wrapped the entire carbon splice area with light cordage under tension, both to consolidate the various layers and increase hoop strength.

Meanwhile, our navigator and chief rigger Butch Babcock was busy figuring out how to replace the broken wire in our number one genoa with a ⅜" diameter spectra rope. He incorporated an ingenious method that lim-

ited our boat shutdown to less than an hour to complete the operation.

Within five hours of the breakage, the hopped-up epoxy system had cured on the pole splice. With our weapons fully restored we were back in the race.

Our new enthusiasm was tempered by the fact that we were now at least 20 miles behind our class leaders. We knew this because all 432 boats in the race were equipped with transponders that updated every boat's position on the hour with immediate display on the internet. With good cell phone reception on Lake Michigan, every contestant—for the first time in history—could tell where they stood in relation to their competitors.

Up to this point our frustration was so great that all we wanted to do was sail the hell out of *Adagio* all the way to the finish line, which was still over 200 miles away. We had little hope of catching up to our fleet.

Perhaps Murphy decided to give us a break or we just got lucky, but we managed to work our way through the fleet over the next 30 hours to become the second multihull to finish, coming in behind the 60' trimaran *Earth Voyager*. Even though we corrected out to fifth place on rating, this was a moral victory; we were proud of our seamanship, response to adversity and drive to keep old *Adagio* in the hunt in her 39th season. ■

[1]For a number of years we've been juicing up WEST SYSTEM 105/205 with G/5 to speed cure. Initial test data shows little loss of physical properties at the 2-to-1 ratio we used on the pole repair. When blending 105/205 with G/5 Adhesive, it's important to meter the G/5 resin/hardener mix at the correct ratio and the 105/205 at the correct ratio before blending all together. Contact the technical staff if you have any questions about blending WEST SYSTEM epoxies. We will of course, continue to break things, experiment, do our research and publish articles on the subject.

Meade preparing the boom for repair while underway. 1—Squaring the broken end with a hacksaw. 2—Fitting a batten in the broken end. 3—Connecting the broken ends before completing the repair with a WEST SYSTEM Handy Pack, two small bottles of G/5 and some lengths of 1½" Unidirectional Carbon Fiber.

The bowsprit is back in action as *Adagio* approaches the Mackinac Bridge.

A fresh face

Pat Dammer boosts lab productivity

Lab Technician Pat Dammer joined Gougeon Brothers, Inc. in March 2008. Previously, he worked for three years at Dow Chemical in foam and plastics research and development. He'll complete his associate's degree in Chemical Technology at Delta College this fall and continue his education at Saginaw Valley State University.

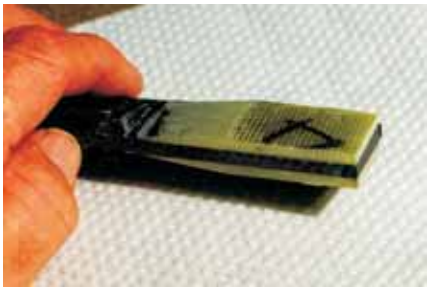
Always on the go and juggling multiple projects in our formulating and materials testing labs, Pat is a quick study who continues to impress us with his excellent work ethic and cheerful demeanor. He spends his free time riding his motorcycle, playing in a heavy metal band, fishing and helping his father restore a 1958 Corvette.

Reinforcing fiber tapes

By Captain J.R. Watson

Composites are a blend of resin (in this case mixed epoxy) and reinforcing fiber. Folks often ask, "How strong are they?" It is difficult to answer this question due to many variables including resin type, fiber type, fiber orientation, and resin/fiber ratio. To give a value for a laminate, we reduce the variables. Values shown in this article were done with test samples using WEST SYSTEM 105 Epoxy Resin®/206 Slow Hardener® at room temperature (70°F). Reinforcing fibers are Episize™ materials. Laminates made for the test had fibers oriented in one direction (unidirectional) and were laminated using simple contact pressure yielding consistent resin/fiber content (*below*).

Test samples were prepared with reinforced ends (*below*) that could be gripped by our MTS™ test machine. Testing then exposed the samples to tension and compression.



WEST SYSTEM unidirectional carbon tapes

Carbon fiber is typically produced in an inert environment at temperatures above 1,800°F. The process of producing carbon fiber accounts for its high price and classification as an exotic fiber. Carbon fibers are known for their light weight, high strength, and high stiffness.

702 and 703 Unidirectional Carbon Tapes are designed to be used with WEST SYSTEM Brand epoxy. The hardener choice is dependent on laminate thickness (dimensionally), the time required to perform the operation, and ambient temperature when cure will take place.

702 and 703 carbon fibers are in tow form. A tow is like a ribbon. The tow of this material consists of 12,000 fiber bundles per inch of width, so it is referred to as 12K material. The tow is continuous, and unidirectional on the '0' axis (along the tow length). The fibers are not twisted or woven. The white strands running on the 90 (degree) axis are polyester threads that hold the fiber bundles in place and are non-structural. This 12K material is on the order of 11 oz (per square yard) material and measures .025" thick. Carbon fibers are electrically conductive and have a specific gravity of 1.75.

When applying carbon fiber, assess the anticipated load path and orient the fibers in that direction. For example, a vertical flag pole is a cantilevered structure which is subjected to bending forces. Fiber orientation would be along the pole's length to stiffen it. Carbon fibers are effective in compression or tension, but it's best to apply fibers equally to both sides of a structure to maintain balance. Carbon fibers can be introduced into wooden laminates, to augment between laminates, but they are most effective placed furthest from the neutral axis.

Off-axis plies result in a rapid loss of strength and stiffness. A depression in a lay up (such as a wrinkle or bump) will attract forces and jeopardize the laminate. If off-axis fibers cross one another, it is best if the laminate is resin rich (on the order of 50%). A resin rich laminate helps keep the fibers from contacting each other, which we don't want.

Wet the substrate with epoxy. It's best to place the first layer of carbon fiber into the coating while that coating is still wet as it will transfer best to the reinforcing fiber. Keep the fibers straight (in columns) as best you can.

Locking sheet metal pliers with sandpaper adhered to the flange allows you to pre-tension as well as align the fibers precisely. When working with long objects, such as spars, we will cut our tape to length and attach the grips to both ends so the tape can be pulled taut and then lowered into position (*below*).

Once they are in place, wet the fibers with epoxy using a brush and squeegee. Hold the tool at a low angle and thoroughly wet the carbon fiber. If the laminate requires more layers, continue to apply layers, wetting the fibers as you proceed. As a rule, don't apply more than six layers at a time or you may experience excessive exothermic heat from the epoxy as it cures.

A method to determine how thick a laminate will be is to take a number of laminations (say four), place a coin on the top and bottom of the dry laminate stack and press lightly together with thumb and index finger. Offset the coins slightly (*below*).

Pass a sewing needle through the stack until it touches the coin. Place a piece of tape on the needle on the other side of the laminate so you can measure the dimension.

When all layers are applied, a good approach is to place release fabric or polyethylene plastic over the last layer and squeegee firmly to remove excess resin and trapped air bubbles. Leave in place until the laminate cures. Remove the release fabric or plastic by pulling it back on itself as close to 180° as possible. Pull steadily and avoid jerking as you peel this film from the laminate.

Cured mechanical properties of 702 and 703 Unidirectional Carbon Tapes with WEST SYSTEM 105 Resin and 206 Hardener at a 60/40 resin/fiber content are as follows:

Modulus(tensile)	13.9×10^6 psi
(compressive)	9.5×10^6 psi
Tensile strength	200,000 psi
702 (1.5" wide tow)	7,500 lb
703 (3" wide tow)	15,000 lb
Compressive strength	64,000 psi
Poisson's ratio[1]	.35

WEST SYSTEM unidirectional glass tape

713 Unidirectional Glass Tape is electrical grade fiberglass referred to as E glass. 713 fibers in tape form are continuous, unidirectional on the '0' axis. They are not twisted or woven. The white strands running on the 90 axis are polyester fill threads that hold the fiber bundles in place and are non-structural. This material is on the order of 11 oz per square yard, measures .018 inches in thickness, and has a specific gravity of 2.54.

You would apply fiberglass tape in the same manner as described above for carbon fiber.

Cured mechanical properties of 713 Unidirectional Glass Tape with WEST SYSTEM epoxy at a 60/40 resin/fiber content are as follows:

Modulus (tensile)	3.7×10^6 psi
Tensile strength	78,000 psi
Poisson's ratio[1]	.35

WEST SYSTEM woven fabric tapes

Woven Fabric Tapes is electrical grade fiberglass that come in various widths: 729 (2"), 731 (3"), 732 (4") and 733 (6"). They weigh 9 oz per square yard. These woven tapes have a selvaged edge that prevents fraying. Tapes are ideal to toughen and protect corners as well as for a myriad of other applications. Corners must first be rounded about like the radius of a dime (minimum) because the tape will not make the turn of a sharp corner. I take a short sample of the tape, fold it in half to find the center and then mark it. I center the mark over the apex of the corner. I then mark where the edges lie (*below*).

Now, I'll take a combination square and mark the two edges along the entire length of the corner (*above*). I wet the substrate between the marks with resin/hardener mix along the entire length. Then I roll the tape, placing the edge on the mark and smooth it down. Usually, I'll place just one surface (the easiest) down first. Once its entire length is in place, I press the remainder down. As the glass tape is negotiating the corner, it may not want to stay put. I've found if I just let it set for half an hour, the epoxy gets stickier as it begins to cure and then the glass stays down. I'll re-wet the glass tape as required (it will be white if it is not wetted properly).

When covering the corner of an arc shape, the edge may still not stay down. In these instances, I'll slit the edge, producing a dart, until it cooperates. I'll wait a few more hours and then apply another coat to fill the weave of the tape as well as to inspect for wrinkles or bubbles which can be resolved at this time.

Sand the cured tape with 50-grit sandpaper on a sanding block to feather the selvaged edge. If the edge has got to blend, thicken a mixture of epoxy with 410 Microlight® and apply it with a wide putty knife.

WEST SYSTEM biaxial tape

727 Biaxial Tape is 4" wide, 15 oz (per square yard) electrical grade fiberglass referred to as E glass. Biaxial is essentially two layers of unidirectional fiberglass placed 45° to the '0' axis off the roll. The layers are held together with a light stitching, thus it is referred to as a stitched tape. It should not be confused with braid, which is woven. Biaxial has good utility as the strands are oriented to allow the tape to pass over a tighter corner. Biaxial is generally stronger on a per thickness basis than a woven fabric. 727 is .018" per tow in thickness and has a specific gravity of 2.54. Woven tape has half its fibers taking the full brunt of the bend whereas with biaxial they pass as a more gradual 45° angle. However, Biaxial materials will take more filling with resin or fillers to finish smooth. ■

[1]Poisson ratio is the ratio of the transverse contracting strain to the elongation strain when a rod is stretched by forces which are applied at its ends and which are parallel to the rod's axis.

From Judd Hubbard of Modesto, California: My 18.5', 70 lb cedar strip canoe on Utica Lake in the Sierra Nevada Mountains in northern California. I haven't seen too many projects from California, thought you might want something from the west coast. No kits, milled from scratch, WEST SYSTEM® (105 Epoxy Resin®/207 Special Coating Hardener™) worked great.

Samoset Boatworks is a full service boat shop in Boothbay, Maine that blends traditional Maine boatbuilding craftsmanship with the newest technologies and engineering. Their "Gentleman's Day Boat," the Samoset 30, is a cold molded, center console sport fishing craft powered by an efficient inboard diesel. Visit www.samosetboatworks.com.

Readers' projects

Photo Billy Black

Carl Nigi is a designer and maker of fine furniture and specialty boxes in Ottawa, Canada. This table is one of the pieces he has created. The legs are made from laminated and carved White Oak. The top is veneered with six pieces of European Burl Walnut. Visit www.carlnigifurniture.com to see more of his work.

Chris Corrente has been studying the effect of polymer dyes from Eager Polymers of Chicago. He mixed these dyes with small quantities of WEST SYSTEM® epoxy in this proportion: ¾ tsp. 105 Resin, ¼ tsp. 207 Special Coating Hardener and 45 drops of tint (for all given colors and batches). The key is to ensure the parts are well mixed as the tint has a very low viscosity. Chris is pleased with the results. He says, "these boards look so good I want to call them the 'Lick-a-Licious Epoxy Series'."

The orange board has "Bright Orange" tint over orange stain. For the green board he used Eager Polymers' "Kelly Green Transparent" tint over natural maple sanded to 1000-grit. The Red board is a red stained maple veneer with "Hi-Bright Red Transparent" top coat.

The Glenn Curtiss Museum

Glenn Curtiss is recognized as the "Father of Naval Aviation." He trained the first Navy pilots and built their first aircraft, the A-1 Triad Amphibian. It was "Curtiss Pushers" in 1910 and 1911, that demonstrated capability to take off and land on a ship, leading to the development of aircraft carriers.

Curtiss factories employed tens of thousands of people during the first World War earning him recognition as the "Founder of the American Aircraft Industry."

The Glenn H. Curtiss Museum is dedicated to the memory of this pioneer aviator. The museum contains a priceless collection relating to early aviation and local history. It also includes a Restoration Shop that restores historic aircraft.

WEST SYSTEM® Epoxy is used in the current construction of the Curtiss *Albany Flyer*, (right). In 1910, the *Albany Flyer* made the historic 150 mile flight from Albany to NYC completing the third leg of the Scientific American trophy competition and winning Curtiss permanent possession of the trophy. The Scientific American Trophy competition was established in 1908 to encourage aviation by bringing flying out into the public domain. Up to this time the Wright Bros. had been operating in seclusion. Curtiss won all three legs of the Trophy competition.

"Although Curtiss used animal glues in the original construction, we have the advantage of using much stronger, more reliable WEST SYSTEM epoxies in building our flying reproductions of early Curtiss Aircraft," says Jim Lally, a volunteer at the Curtiss Restoration Shop.

The museum is located on Route 54, one half mile south of the village of Hammondsport, New York, hometown of Glenn Curtiss.

Visit www.glennhcurtissmuseum.org to learn more about the museum and Glenn Curtiss. ■ —*MB*

The 1910 *Albany Flyer* is the current construction project. Instead of the animal glues used in the original, this reproduction uses WEST SYSTEM Epoxy.

A 72' wingspan reproduction of the 1914 Curtiss flying boat *America* was completed by the museum's Restoration Shop crew in early September 2007.

New Product

WEST SYSTEM® introduces

Six10™

A two-part epoxy adhesive in a convenient, self-metering cartridge
For permanent, waterproof, structural gap-filling and gluing

Six10 Adhesive gives you the strength and reliability of a two-part WEST SYSTEM epoxy with the convenience of a single part product. Six10 is dispensed with a standard caulking gun. Non-sagging Six10 bonds tenaciously to wood, metals, fiberglass and concrete. It cures in temperatures as low as 50°F. Working time is 42 minutes at 72°F. Cures to a solid in 5–6 hours and will take high loads in 24 hours. Cure time is faster at warm temperatures and slower in cool temperatures. The Six10 cartridge holds 190 ml of resin and hardener.

To use Six10 Adhesive, replace the retaining nut and plug on the West System Six10 dispensing cartridge with the 600 Static Mixer that comes attached to the cartridge. Dispense mixed 2-part epoxy adhesive using a standard caulking gun. The efficient internal geometry of the 600 Mixer thoroughly blends resin and hardener in a short mixing length for good application control and a minimum of waste. Place high-strength, non-sagging epoxy exactly where it's needed in less time and with no mess. Additional 600 Static Mixers are available in packages of two or twelve.

Understanding Six10™ properties

By Jeff Wright

WEST SYSTEM® Six10 is a two-part, pre-thickened epoxy adhesive formulated with properties that make it perfect for many adhesive applications. Compared to other ready-to-dispense adhesives, its particular physical properties makes it ideal for such applications as stitch and glue boat construction, fiberglass laminate repair and general bonding. This new formulation has a good balance between the elongation and toughness of G/flex® and the strength and stiffness of our 105 Resin-based epoxies. You can use it with as many materials as possible including wood, metals and composites. The long working time with fast thru-cure and unique shear thinning are additional characteristics formulated into Six10 that contribute to it's ease of use.

With the 600 Static Mixer attached to the Six10 cartridge, it's easy to lay down a bead of thickened epoxy adhesive right where you need it.

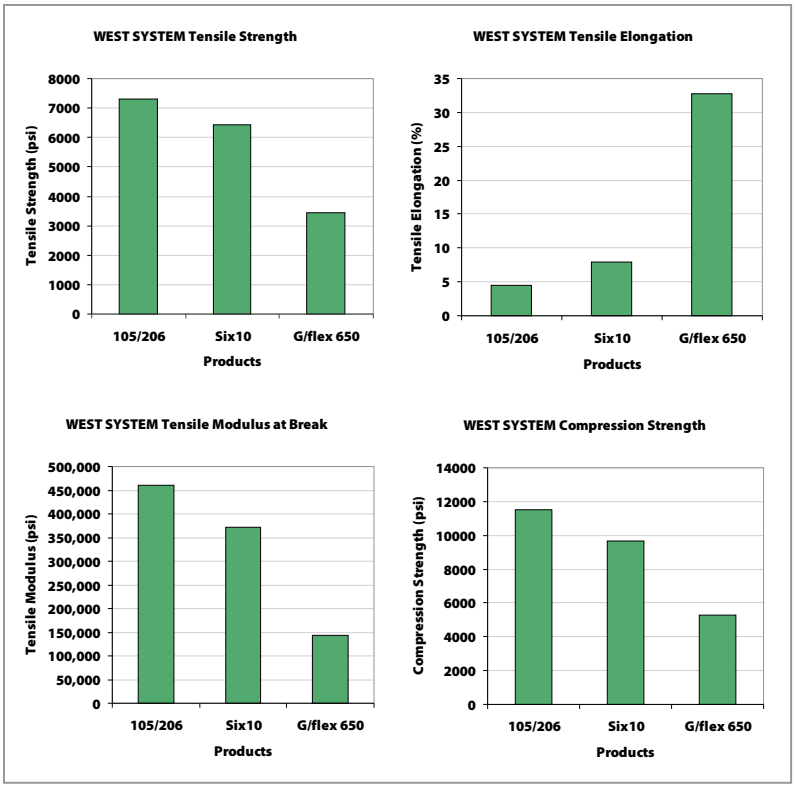
The consistency and of Six10 Adhesive is perfect for fillets.

WEST SYSTEM® Six10 features explained

Experienced WEST SYSTEM users are familiar with the handling characteristics of 105 epoxy thickened with 406 Colloidal Silica Filler that allow it to be non-sagging, yet trowel easily. Six10 adhesive provides the same handing properties right out of the cartridge, but achieves it with shear thinning, a property that allows the viscosity of the adhesive to become lower when a shear force is applied. A shear force is applied when the epoxy is mixed or spread out over a surface, which causes the viscosity of the Six10 to become lower resulting in a "thinner" consistency. When you are done applying or mixing Six10 and it is no longer being worked, or "sheared," it will start to increase in viscosity and develop a thicker consistency. This shear thinning property enables Six10 to be easily dispensed out of the coaxial cartridge and through the static mixer and then tooled smoothly into a fillet that won't sag during the cure cycle. The shear thinning property also enables Six10 to be used for wetting out light to moderate weight reinforcing fabrics such as fiberglass and carbon fiber. This feature makes the product convenient for performing small fiberglass boat repairs. If you use a stiff plastic spreader, Six10 can wet out any fiberglass fabric lighter than 12 oz per square yard as a result of its shear thinning characteristics.

Six10's cure profile also has some handy features. Our chemists developed the hardener to provide a long open time but fast thru-cure. With a pot life of 42 minutes, WEST SYSTEM Six10 will provide over an hour of working time in a thin film but will achieve an initial cure in just 5–6 hours. An additional characteristic of Six10's cure profile is that sufficient working time is maintained in warm temperatures. The long open time also means that the epoxy will stay workable in the static mixer for 42 minutes, which is very practical for long or complicated assemblies.

All adhesives rely on good surface "wet out" and saturation to achieve a good bond to the substrate. Six10 has a viscosity high enough to resist sagging but can still saturate and wet-out a surface without pre coating, thanks in part to shear thinning. Our chemists ac-



A comparison of the physical properties of WEST SYSTEM G/flex, Six10 and 105 Resin/206 Slow Hardener® epoxies at room temperature.

complished this formulation by using an ingenious filler package in both the resin and hardener components.

The physical properties of WEST SYSTEM Six10 were developed to ensure good adhesion in many applications. The charts above, illustrate the properties of our G/flex and 105 Resin-based epoxies compared to WEST SYSTEM Six10 and illustrates how Six10 fits in nicely between the high strength of 105 Resin-based combinations and the toughness of G/flex. As we discussed in *Epoxyworks* 25, G/flex was formulated to be flexible enough to work in many unique situations but 105 Resin-based epoxies are still recommended for applications where a stiff laminate is required. WEST SYSTEM Six10 has a modulus slightly lower than a 105 Resin epoxy, making it appropriate for many applications where a filled a 105 Resin-based epoxy would be used. When G/flex is used to laminate lightweight fiberglass cloth, the result is a flexible laminate. Six10 will create a fiberglass laminate much closer to 105 Resin epoxy laminate properties. Six10 will wet out fabrics up to 12 oz per sq yd. For heavier fabrics a 105 resin epoxy with its low viscosity should be used to ensure thorough fabric wet out.

WEST SYSTEM Six10 convenience

Six10 can be used for many of the same jobs where a thickened 105 Resin-based epoxy is appropriate, it is a useful adhesive that adds convenience to the versatile WEST SYSTEM product line. It is completely compatible with all other WEST SYSTEM products so that it can be used on top of or underneath any 105 Resin-based epoxy, whether cured or uncured. We carefully formulated it for use in many applications where strength and adhesion are important.

Our Technical Advisors are available to answer any questions about WEST SYSTEM Six10. You can reach them at 866-937-8797 (toll free) or through email (technical@gougeon.com). We will look forward to hearing your comments about Six10. ■

Two parts—One cartridge

WEST SYSTEM® Six10 Thickened Epoxy Adhesive is packaged in specially designed, self-metering cartridge. This innovative container provides many useful features:

- It separates the resin and hardener for long term storage
- It accurately meters the proper 2:1 resin/hardener ratio
- It dispenses the amount desired
- It fits into a standard caulking gun

The cartridge works by utilizing the movement of the piston to simultaneously dispense the resin and hardener from separate chambers. The molded chambers and passageways accurately control the ratio and prevent the resin and hardener from contacting each other until they are outside the cartridge.

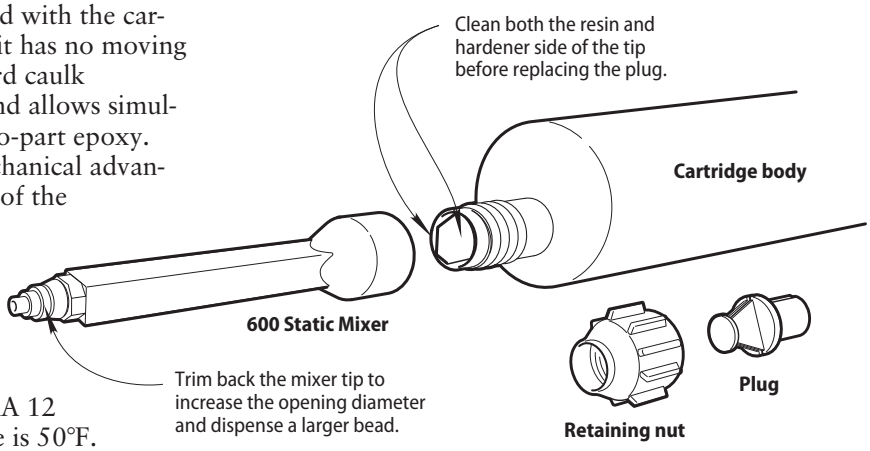
Our technical advisors and chemists extensively tested the performance of the cartridge and 600 Static Mixer to ensure accurate metering and thorough mixing of the Six10 resin and hardener. The reliability of WEST SYSTEM Six10 in the self-metering cartridge meets the high standards our customers expect from a WEST SYSTEM product. ■

Practical tips for using Six10™

By Captain J. R. Watson

The WEST SYSTEM® Six10 cartridge is comprised of the cartridge body, removable nose plug and a threaded retaining nut. A 600 static mixer is included with the cartridge. (It's called a static mixer because it has no moving parts.) The cartridge fits into any standard caulk gun—manual, cordless or pneumatic—and allows simultaneous dispensing and mixing of the two-part epoxy. Manual caulking guns are graded by mechanical advantage (MA) in relation between the travel of the pistol grip and the plunger. When using the static mixer, resistance is increased. Low MA guns 3 to 8, which generally cost less, are adequate to dispense Six10 with the mixer at temperatures over 60°F. If it is cooler than that, you might want a gun rated MA 12 to 26. Minimum application temperature is 50°F.

Six10 cartridge components



Remove and save the retaining nut and plug to reuse if you are storing the unused adhesive. Be sure the plug is replace in the original orientation to avoid cross contamination. Mark the plug and cartridge to avoid confusion.

Extending working time

The WEST SYSTEM 600 Static Mixer blends the resin and hardener as it passes through the device. Often, you'll apply some epoxy to your work surface and proceed with assembly. While you're working, adhesive in the mixer will eventually begin to cure. You should have about 42 minutes at 70°F before you need to dispense more epoxy. If you need more time, here is a simple method to extend working time and prevent curing in the mixer, as well as loss of a static mixer. Cut a 1" to 2"-diameter PVC pipe to about 6" long. Install the PVC cap on one end of the pipe, then pass the pipe through a hole the same size as the pipe in a square of plywood. This will keep all upright. With the cap facing downward, place this device in a cooler with a little ice in it. Place the cartridge with mixer attached in the tube. The cold temperature will double or triple the working time of the material in the mixer.

Reducing waste

The static mixer is a great tool that blends the resin and hardener thoroughly and automatically as it is dispensed. When you're involved with a big gluing job you can use successive tubes, transferring the same static mixer from the emptied tube to the fresh one. But the mixer consumes a small percentage of the total amount of epoxy in a tube. If you're doing a small job, it is good to know that you don't have to use the static mixer. Simply squeeze out what you'll need (maybe even a little less—you can always mix a little more if short) onto a piece of poster board or plywood and stir thoroughly. The resin and hardener are slightly different colors; use this color difference to gauge the thoroughness of your mix. All should be a consistent color with no streaks.

Storing unused adhesive

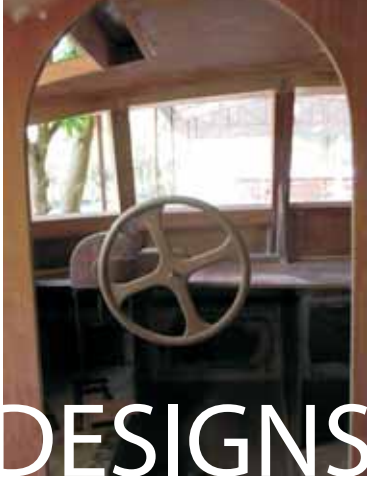
The nose plug covers the two separate ports that emit resin and hardener and prevents leakage and contamination. Remove the plug before use and replace it afterward. As resin is emitted from one side and hardener from the other, the plug will get residue of resin and hardener on it. For best results, clean the tip before replacing the plug. Try using a stir stick, paper board or poster board with a slot cut into it. Use this to swipe over the divider.

When you replace the plug be sure it is oriented the way it was when it was first removed, otherwise resin and hardener on the plug will contaminate opposite side of the port and cure. To prevent this, before you use the product remove the retaining nut and put one magic marker dot on one side of the removable plug and a corresponding dot on the same side of the cartridge. When replacing the plug, you'll always be able to orient it properly.

Replace the plug, aligning the dots as described earlier, then replace the threaded cap. The tube will be ready for use next time you need it. Always replace the retaining nut, as hydraulic pressure may force the plug out.

Store the Six10 tubes away from sunlight in a cool, dry place. But don't refrigerate them. On a boat, store the tubes in a plastic zip-lock bag so they stay dry. When properly stored, Six10 will remain useable for years. ■

For many decades Gougeon Brothers Inc. has kept in contact with multihull designer James Wharram. Wharram, of Cornwall, UK, has sailed and designed Polynesian-style catamarans for 50 years. Amateurs and professionals have built his boats and sailed them to all corners of the planet. The designs he creates with his engineer and artist partner Hanneke Boon have evolved over the years, but remain unmistakably, Warram Catamarans.



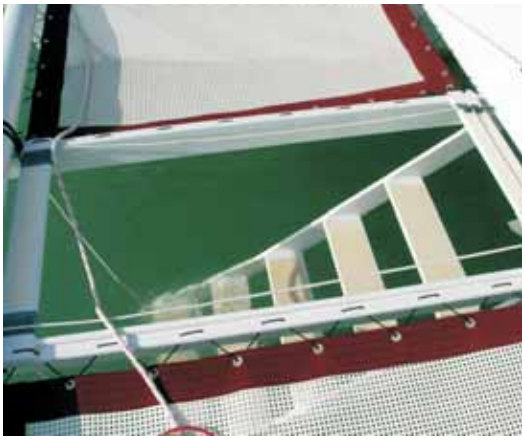
James Wharram DESIGNS

By Captain J.R. Watson

Wharram boats are sailing, sea-going, cruising catamarans ranging from small day boats to 60' habitats. Many sailors have undertaken successful voyages in Wharram-designed boats. These Wharram catamarans have one thing in common, they were all built with WEST SYSTEM® Epoxy.

The Tama Moana

The Tahiti Wayfarer



These boats are constructed of modern materials: plywood, epoxy and synthetic fibers. The drawings are simple, streamlined and clearly explained resulting in a high boat completion rate among buyers of Wharram plans. This is reassuring to the amateur builder undertaking the "unknown" of building such a craft.

The V-shaped hulls typical of Wharram designs can carry a lot of extra weight without deteriorating sailing performance.

The hull structure in most of the designs is a slightly stressed skin bonded with epoxy, fillets and fiberglass tape over a simple plywood/stringer framework. This results in a rigid structure. The hulls are joined to wood/epoxy structural beams via a flexible lashing system originally employed by the ancient seafarers of the Pacific, but with modern synthetic fibers proven reliable and seaworthy. Absence of a deck cabin reduces windage and lowers center of gravity, thereby increases stability and safety at sea. ■

The Tiki 30

The flexible lashing system of the ancient seafarers of the Pacific, a signature of Warram catamarans, has been modernized with synthetic fibers.

The Pahi 63

The *Woodville Queen*

By Ken Stewart

My father, Glenn P. Stewart, instilled in me an interest in steam engines. He frequently talked about his early experiences (about 1930) working in a sawmill powered by a steam engine.

A thought went through my mind: "here I am a graduate mechanical engineer and I don't even know how a steam engine works." So I went to several steam engine shows in the area and got more interested in them while learning how they operate.

My wife and son Mike bought me a steam launch kit with a boiler and engine kit which I enjoyed building and operating with radio controls.

The completed *Woodville Queen* with a full head of steam.

Since I am a sailor it was only natural to look for a marine steam engine. My search ended with Mel Lugten of Hamilton, Michigan, who sold me a steam launch and an antique marine steam engine. It was double acting with a 3" bore and 3" stroke. It didn't have a nameplate. About 100 years ago any city or town that had a good foundry and machine shop also had someone building steam engines. For fear of being sued for patent infringement they didn't put nameplates on their engines.

I joined the International Steamboat Society and read all the material I could about boilers and engines. Around 1977, I designed and built a vertical fire lube boiler in my shop. I built a wooden base for the boiler and engine mounting, everything as it would be in a boat. This allowed me to test the boiler and engine, running them under load (with a prony brake) to determine horsepower, RPM, pressures, temperatures, water consumption and the amount of wood used. The major revision I made was adding a water leg to cool the fire box, preventing the lagging from burning.

Satisfied with the boiler and engine performance, my next step was to find a suitable hull. I'd spent a couple of years looking, when in 2002 someone told me about a steamboat stored in a back yard. The boat was outdoors but covered, and was filled with junk. The owner had passed away about 20 years earlier and his widow was happy to sell it. The boat was a 21' double-ended ship lifeboat made of ribbed galvanized steel. The engine was missing and the former owner had built a wooden canopy with a windshield, sort of like a cabin cruiser. It looked pretty rough but I liked the lines and the fact that it was steel. My shop is much better equipped to weld steel than for working with wood and fiberglass.

I bought a boat trailer and with the help of our sons, Jim and Mike, we loaded the boat and put it in the shop. My sons were embarrassed to be trailering it, but they did it for me.

I worked on the boat only during winter months because I have a sailboat to care for and sail throughout summer.

2003

I discarded the collected junk (mostly car parts) and stripped the hull by removing the cabin, seats, boiler, prop and shaft. The parts I salvaged were a ⅜" Penberthy injector, a 20"×27" three-blade propeller, a large steam whistle, a brass six-spoke steering wheel and a 1" brass stuffing box with outboard bushings.

I carefully measured the hull in order to make reasonably accurate AutoCAD drawings of it. The only wooden members left were the gunwales, keel (3"×6"), stem and

stern. The stem and stern pieces were covered with galvanized metal and had rotted. I decided to build a new tubular steel keel (3"×10"×3/16") and stem and stern (2"×6"×3/16"). The deeper keel would eliminate the need for a skeg and allow the addition of ballast for increased stability.

The hull was attached to the wood keel with two ¼"×2" bars and seventy ¼" bolts which I chiseled off. Under the bars were about a thousand rusty nails I had to remove by hand. I fabricated the stem, stern and keel including the prop shaft tube and shaft thrust bearing support. Then I welded continuously inside and outside to the keel (hull and keel flush). All the supports for the boiler, engine, floor and bulkheads I also welded in place. The hull had over one-hundred ¼" bolt holes which I plugged with rivets.

With the welding complete I sand blasted the hull and painted it with ZRC, a cold galvanize coating. I built a storage building that included a 30'×20' boat shop, a two-ton overhead crane and a large wood stove. After I moved the boat into the boat shop and I spent my spare time in the winters there for the next four years.

2004

I bolted the existing oak gunwales to the steel hull and removed all protruding nails, bolts and screws. Then I rough sanded the gunwales for gluing with WEST SYSTEM® Epoxy, as well as the cabin coaming and the new oak covering the old gunwales. For bending the coaming, which has an 18" radius at the corners, I built a steam chamber and a clamping/bending fixture. I made the coaming of red oak and glued it to the inside of the original gunwales, which I covered with new oak. Next, I painted the hull inside and out with two coats of industrial white epoxy paint.

I built the fore and aft decks with curved ¾" pine deck beams, ¼" fir plywood and ¼"×1½" oak strips epoxied to the plywood. So the deck could receive mooring cleats, I reinforced it with 2×4s. Then I drilled oversized screw holes for the cleats and chocks and filled them with epoxy. Finally, with everything finish-sanded, I applied four coats of Sikkens™ finish.

2005

For the interior I selected beaded oak veneer. However, all I could find was ¼" thick so I glued ¼" plywood to each piece. I bolted the fore and aft bulkheads to a ⅛" angle iron

The anonymous double acting marine steam engine with a 3" bore and 3" stroke.

(previously welded to the keel and hull) and epoxied it to a deck beam and the hull. I trimmed the doors and openings with ¼"×1½" oak.

To install the boiler and engine I used bolts threaded into holes in angle steel welded to deck and hull. Directly under the boiler engine I placed a stainless steel plate.

I machined a 1¼" galvanized pipe for the brass stuffing box at one end and coupled it to a 1¼" threaded stainless steel tube welded into the 6"×2" stern post. This tube I machined to receive the cutlass bearing. I installed the 1" diameter polished stainless steel prop shaft with the thrust bearing and machined the adapter to receive the propeller. The rudder is ⅛" stainless steel welded to a 1" diameter stainless steel shaft. I keyed a 10" diameter V-belt pulley to the shaft for steering.

2006

From a local boat builder I bought ¾" teak and holly veneer plywood for the cabin sole. I cut the five pieces and fastened them with machine screws in tapped holes in floor angles.

For the seats, I repurposed plyform restaurant booth seats. I cut these to about 24" long and cut the backs to match the bottom of the coaming. From the bottom of the coaming to the edge of the cabin sole, I glued seat boxes of beaded oak and ¼" plywood. Firewood is stored under the seats.

I glued a steering console of the same beaded oak and ¼" plywood to the hull, adjacent to the boiler, then installed the steering wheel

with cable steering. An aluminum grooved rope drum and the 10" V-belt pulley allows 1½ wheel-turns for 45° rudder travel. Delrin™ pulleys turn the cable and Delrin guide blocks installed along the underside of the gunwale get the steering cables to the aft cabin and the rudder.

I was a little apprehensive, but since everything was operable I put the boat in the water on clear, cool spring morning. I went over a check list and determined everything was in order, then built a fire and went for a ride. I had three other 200 lb men on board. Everything went well and I was very happy.

2007

I removed the cabin sole (floor boards) to install the electrical wiring. In the stern cuddy I mounted a 12-volt marine battery. All the wiring would be hidden under the floor and terminated in the console. I installed overhead lights in both cuddy cabins. The instruments mounted on the console were a Delco™ AM-FM radio/MP3 player, a Raymarine™ Tri-Data (speed, depth, log), a West Marine™ DC fuse panel, a tachometer (bicycle speedometer) and a compass.

Before reinstalling the floorboards I gave them four coats of Sikkens finish. I glued a two-step ship's ladder to the starboard side of the hull. To form a "soundcoat" I covered the remaining exposed portions of the steel hull with an 8" baseboard strip of cushioned black floor tread, and up to the gunwales with gray perforated ½"-thick vinyl foam.

I designed the canopy on AutoCAD using a square 1" aluminum tubing support frame and a vinyl covering. Using ⅜" stainless steel threaded studs epoxied into the oak, I attached the 14 gold anodized vertical tubes to the oak coaming. I hid the wiring for the two cabin overhead lights, the navigation lights and the radio antenna in a 1½" brass tube between the console and the overhead canopy frame.

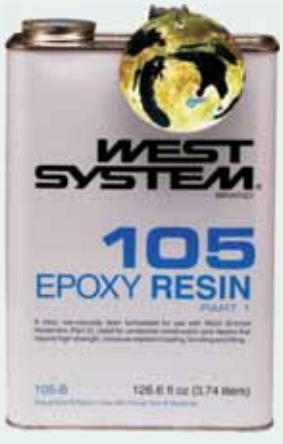
Muskegon Awning Company sewed the canopy at their shop. It's navy blue vinyl with 14 zippered windows. To install it, I had to remove the smoke stack.

With the stack reinstalled, cabin lights mounted, and navigation lights mounted to the exterior of the canopy, the *Woodville Queen* is now ready for excursions. But keep in mind that the boat is only an excuse for running the steam engine. ■

105 B tags—Have you noticed?

Our most popular product, WEST SYSTEM 105 Epoxy Resin® in the "B" size can is sporting a little something extra this year: a colorful hang tag mentioning that we're donating 2% of the proceeds from sales of 105 B cans to the non-profit Alliance for the Great Lakes.

We manufacture WEST SYSTEM products in Bay City, Michigan —the heart of the Great Lakes region — and were impressed with the Alliance's track record. They've halted major industrial polluters, prevented invasive species from disrupting freshwater habitats and organized thousands of volunteers to clean up hundreds of miles of Great Lakes beaches. Theirs is the oldest citizens' group protecting the Great Lakes. Originally formed in 1970 as the Lake Michigan Federation, in 2005 they broadened their scope to cover all five Great Lakes and adopted their new name.



The Alliance for the Great Lakes works hard to conserve and restore the world's largest freshwater resource through policy, education and local efforts. They also work with the region's teachers, scientists, economists, legal specialists, government representatives, communities and individuals, teaching them how they too can help. Year-by-year, individual-by-individual, they're restoring a healthy Great Lakes environment.

Alliance for the Great Lakes programs focus on:

Water Quality: eliminating toxic and bacterial pollution, which cause beach closings

Water Conservation: promoting sustainable water use to keep the Great Lakes great

Habitat Recovery: restoring and enhancing habitat, especially in urban areas, and eliminating invasive species

Land Use: protecting lands that drain into the Great Lakes and their natural features

Clean Energy: protecting the Great Lakes from harmful effects of energy use

Education & Outreach: providing education and volunteer opportunities for adults and children to build an appreciation for the Great Lakes

Governed by about 20 volunteers from around the region, the Alliance also coordinates a network of community organizations which gather annually to develop basin-wide solutions with a local emphasis.

We feel their mission, to "conserve and restore the world's largest freshwater resource using policy, education and local efforts, ensuring a healthy Great Lakes and clean water for generations of people and wildlife" is well worth supporting. To learn more, visit www.greatlakes.org. ■ —*GO*

Unveiling of UK's biggest ever rocket ship

Courtesy of Wessex Resins & Adhesives Ltd.

A Salford University academic with ambitious plans to send tourists into space by 2013 unveiled the UK's largest ever space rocket on Tuesday, July 1, 2008. The project, sponsored in part by WEST SYSTEM'S UK Distributor, Wessex Resins &Adhesives Ltd., used WEST SYSTEM® Epoxy in the rocket casing and for fairing the body. Steve Bennett, who heads the University's Space Technology Laboratory, presented his 58' Nova 2 rocket at the University and discussed how his company, Starchaser Industries Ltd. (Starchaser) plans to launch it next year with the help of school children from across the UK.

Starchaser created the Nova 2 for the testing of a number of systems which, if successful, will form the basis of an even bigger rocket to carry travelers into space.

In September 2009 the Nova 2 will be launched from a UK launch site in order to test the vessel's safety systems. The unmanned capsule will be ejected mid-air and is designed to land safely by parachute.

Once validated, the safety system will be integrated into the rocket that will send fare paying passengers into space—so that travelers can be safely returned to earth even in the unlikely event of a major rocket malfunction.

Steve said, "Early next year we will set out on a nationwide tour with the rocket that will visit 100 schools where we hope to involve as many children as possible. We want to inspire a future generation of scientists, engineers and astronauts."

"Our ultimate aim, though, is to carry people into space and our latest rocket takes us another step closer to realizing that ambition."

Starchaser Industries' space tourism initiative will enable the public to purchase flights where they can spend 20 minutes in space and experience three to four minutes of weightlessness. Starchaser astronauts will travel at 3,500 miles per hour, see the curvature of the earth and join the likes of Yuri Gagarin and Neil Armstrong as real space pioneers.

Starchaser Industries Ltd. created the Nova 2 for system testing. It is scheduled for launch in September of 2009.

The unmanned capsule will be ejected mid-air and is designed to land safely by parachute.

About Starchaser

Starchaser Industries (www.starchaser.co.uk) is a privately held, high technology company that specializes in the development, operation and commercialization of space related products and services. Starchaser Industries enables new space related business opportunities by providing safe, reliable, affordable and reusable access to space for both the space tourism and micro-satellite launch markets.

Starchaser Industries also has an established and highly successful Outreach Program that engages with both the general public and education. Starchaser's educational activities complement the UK national curriculum and help inspire and motivate students at all levels to pursue careers in the fields of Science, Technology, Engineering, and Mathematics (STEM). Starchaser provides students with opportunities for involvement in research and development projects to actively promote the STEM subjects and encourage them to pursue higher education at the graduate and doctorate levels. ■

The Landing School presents the Arundel 27

Layers of marine plywood and Western Red Cedar laminated with WEST SYSTEM Epoxy form a stiff and quiet hull.

The Arundel 27, designed to the highest standards by Steve Dalzell, is a handsome day-tripper. Her traditional appearance is the result of cold-molded construction with WEST SYSTEM® Epoxy. Laminated layers of marine plywood and Western Red Cedar form the hull, and the transom is built with mahogany. This construction makes the hull stiffer than fiberglass boats but just as easily maintained.

The power is provided by a fuel-efficient, quiet, freshwater-cooled diesel with the lowest emissions in the industry. This boat cruises up to 30 knots and features a hull design that allows owners to safely access shallow waters.

It has a well-equipped galley and a comfortable berth for overnight visits along the coast.

The Arundel 27 was built this year by students of The Landing School in Arundel, Maine. This accredited, post-secondary school blends modern yacht design, boatbuilding and marine systems technology under one roof and has an international reputation of excellence.

Just two of The Landing School's Arundel 27s are available annually. The base price is $143,900. For more information, visit www.thelandingschool.org. ■

Arundel 27 Specifications

LOA	27′ 5 ½″
LOW	25′ 0"
Beam	8′ 5 ½″
Draft	1′ 2 ½″
Displacement	5490 lb
Speed	34 knots
Range (at 23 knots)	200 nm

WEST SYSTEM® Epoxy used on LEED® projects

Over the course of past couple of years, WEST SYSTEM® products have been used increasingly by builders seeking LEED (Leadership in Energy and Environmental Design) certification for their projects. LEED is a voluntary, consensus-based national rating system for developing high-performance, sustainable buildings. Developed by the U.S. Green Building Council, LEED addresses all building types and emphasizes state-of-the-art strategies for sustainable site development, water savings, energy efficiency, materials and resources selection, and indoor environmental quality.

WEST SYSTEM Epoxies are high-solids, non-solvented materials and ultimately have a very low volatile organic content (VOC). They are often desirable on LEED projects because they provide a high rating in the LEED point system because of their low volatile emissions when being applied and after application.

When tested to ASTM 2369-07, mixed WEST SYSTEM105 Epoxy Resin® and 205 Fast Hardener® has a combined VOC content of just 9.75 g/L (0.08 lbs/gal), or less than 1%. It's not uncommon for paints, coatings and adhesives to contain as much as 25-40% VOC content. Go to www.usgbc.org for more information on LEED certification.

—Glenn House–E, H & S Manager

Information/contact

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.

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.

Publications for sale at WEST SYSTEM dealers

Also available from the WEST SYSTEM Info Store at www.westsystem.info, or by calling our order department, 989-684-6881.

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.

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Browse back issues or find articles on specific topics by clicking on *'Articles by Subject'.* Articles are arranged under *Epoxy Techniques & Materials, Boat Repair & Restoration, Boat Construction, Epoxy's Non-Marine Uses, Readers' Project Gallery, and the Project Directory.* ■

Thunderbird

A little history lesson. Last year a cousin of the Gougeon Brothers, David Huskins and his family, visited the Thunderbird Lodge on Lake Tahoe. He sent us a couple photos of *Thunderbird*, the legendary commuter yacht designed by John L. Hacker in 1939. It was commissioned by George Whittell and built by Huskins Boat Works in Bay City, Michigan.

David found out from her captain that WEST SYSTEM® Epoxy is used in the maintenance and restoration work on *Thunderbird*. What the captain did not know and what David was happy to point out was that WEST SYSTEM Epoxy is manufactured at the same location where *Thunderbird* was originally built.

Many years after *Thunderbird* the Gougeon brothers started their boat building careers working for Ben Huskins and bought the Huskins Boat Works to start their own business. The rest is history. David Huskins, by the way, is third cousin to the Gougeon brothers because Ben Huskin's son, his grandfather, married a women named Betty Gougeon. Small world.

To find out more about the interesting history of *Thunderbird* visit www.thunderbirdlodge.org. ■

—MB

***Thunderbird* as she looks today, one of the most elegant wooden boats of the twentieth century. Mahogany and brushed stainless steel never looked so good.**

Two of Ben Huskins great, great, grand children, Ben and Ana Huskins onboard *Thunderbird* while on tour at the Thunderbird Lodge.

A faded photo of *Thunderbird* on Lake Tahoe from the 1960's Outfitted originally with twin V-12, 550 hp Kermath engines, the vessel was capable of 60 knots. It was refurbished1962 when the flying bridge was added and the engines were replaced with two 1,100 hp V-12 Allison aircraft engines.

The Huskin Boat & Motor Works as it looked in the early to mid 1930's, a few years before *Thunderbird* was built and a few decades before WEST SYSTEM Epoxy came to be on the very same spot.