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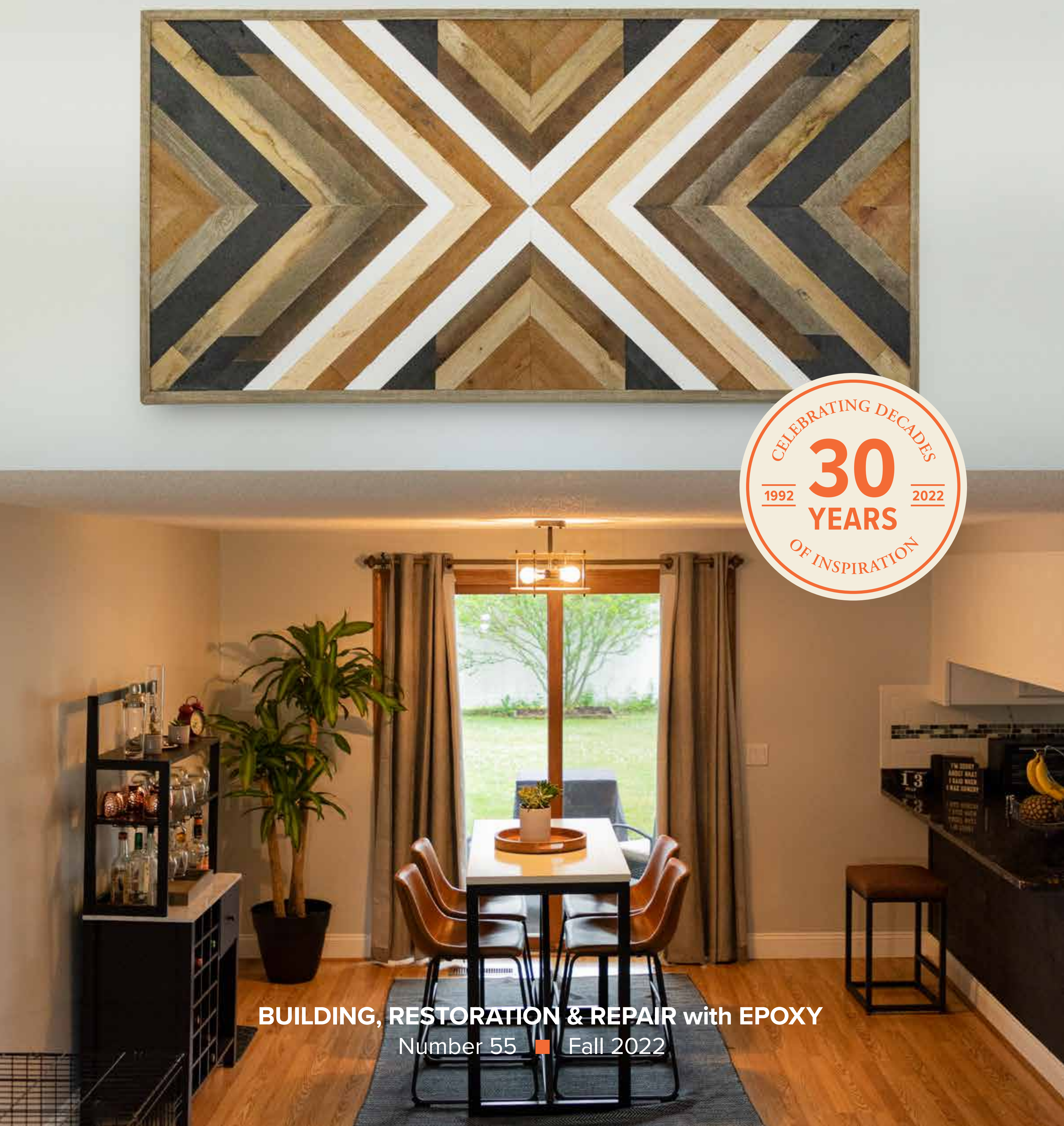

CELEBRATING DECADES
1992 **30** 2022
YEARS
OF INSPIRATION

BUILDING, RESTORATION & REPAIR with EPOXY

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In This Issue

EPOXYWORKS®

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Rustic Wood Wall Art

A Pinterest® Success Story

By Jenessa Hilger – GBI Marketing

If you've ever used Pinterest, you know it is filled with projects that give you a false sense of confidence in your own artistic abilities. Hence, the wildly entertaining "Pinterest fails". Mindlessly scrolling one day, when I probably should have been doing something productive, I stumbled across a rustic wood wall art piece. A little epoxy, some scrap wood, and I can build that. No problem.

The first step was to source some wood. It just so happens that at Gougeon Brothers we have lots of pallets coming and going daily, and they were just about the right size for the wood I needed. Feeling clever, I asked one of our operators to alert me next time he stumbled across a broken pallet that I could "help him dispose of." To my surprise, he took me to a stack and asked if I could take all of them. Well, that turned out way easier than I thought.

The next step was to break down the pallet. Maybe it was my confused face trying to figure out the best approach, but our technical advisor, Don took pity on me and volunteered to break down the pallet. Little did he know, he had just volunteered for the bulk of the labor on this project. Thanks, Don!

Using the shop bandsaw, he cut the pallet's top boards away from the frame. This created a stack of boards 3" x ½" that were generally about 2' long. Then he ripped each board in half lengthwise on the tablesaw, resulting in 1 ½"-wide boards. Now it was time to address the thickness. He ran them through again, ripping them down to a thickness of ⅛". This yielded four finished boards each, two of which had a natural patina on one side and two of which were freshly cut wood on both sides.

With a mountain of lumber at my fingertips… okay, well maybe more like a knoll, it was time to let the creativity flow. Taking a cue from my Pinterest inspiration, I started by establishing a couple of accent strips. For these I used the strips with two freshly cut faces that I would later paint white. After sorting the strips into piles according to the patina color, I started laying out a design based on the variation in colors I was looking for. I marked each board with the length I wanted it to be so that all the ends were staggered. Once I was satisfied, I began laying out the filler pieces around the design. These pieces would be painted black and act as the background. Again, these were the freshly cut boards.

My design complete, I now needed something to epoxy it to. I got a ½" sheet of plywood and rolled on two coats of WEST SYSTEM® 105 Epoxy Resin®/206 Slow Hardener® tinted with 502 Black Pigment. The pigment was to better hide the inevitable gaps that would occur due to my lack of fine craftsmanship and the rough boards of this rustic project. I coated the backer board in epoxy to provide a more secure bond than painting the surface.

If I had painted the board, I would be relying on the strength of the paint's adhesion to the wood to hold my piece together. Paint adheres strongly enough to hold itself to the wood but not enough to hold the weight of the wood plus any stresses that


The original sections of pallet board.


The pallet boards after being ripped down.


Rough layout not trimmed.

might be applied to that wood. An epoxy-to-wood bond is much stronger. Though this piece would eventually just hang on a wall, I was concerned with how resilient it would be as I wrestled it into the trunk of my car and it bounced over the 500 potholes on the way to my house.

With my final pigmented coat of epoxy cured, I used an abrasive pad to scuff the surface, then struck my grid lines for the design. A silver marker showed up nicely on my black backer board. It was important that these lines were precise, ensuring everything fits as perfectly as possible.

Time to paint. For the white accent strips, I sprayed one coat of spray paint. I liked that the paint didn't quite fill all the grain of the wood, providing a rustic nod to help tie the piece together. However, I wanted the black strips to recede into the background, so I sprayed the heck out of them.

Work got busy, so I had to let my project sit idle in the shop for a week. Low and behold, when I returned, an elf had helpfully trimmed all of my pieces to fit together perfectly, exactly how I had left them laid out. The pieces covered the entire backer board with just a little extra material hanging over the sides to be trimmed flush later. I suspect it was Don, but he has yet to fess up to it, so magical shop elves get the credit!

Finally, it was epoxy time, one of my favorite parts. I wanted to epoxy all of the pieces down in one day. The Technical Department needed my table for developmental work, and I was beginning to overstay my welcome. My plan was to epoxy down the first four white strips and let them cure, providing a secure edge to tightly fit the subsequent pieces against.

How did I manage this feat? It was G/5 Five-Minute Epoxy Adhesive® to the rescue. One at a time, I applied a light coating of G/5 on the back of each of the four accent strips to use as anchors for the rest of the design. As I went, I cleaned up any squeezed out epoxy so the neighboring pieces would lie flat and flush when butted up to the anchor pieces. By the time I had placed the last strip, the first had cured, and I was ready to assemble all of the filler pieces.

I wanted to use G/flex® for bonding the remaining pieces. I didn't know what types of wood the pallet had been made of, so I figured G/flex was the best bet in case any of the wood types were oily. Plus, the trunk of my car and the 500 potholes would surely introduce some stresses that the G/flex could easily absorb. As I mixed my batch of G/flex, Don came by looking curious, so I put him to work. Using the smallest notch size (⅛") of an 809 Notched Spreader, we applied the epoxy to a section between the anchor pieces. We used the Notched Spreader to apply a consistent coating thickness across the entire section to help ensure a more consistent board height across the entire piece.

Carefully, we set the pieces in place, working from the anchor pieces outward. We started with this small section to limit damage if we ran into issues. Here's what we learned:

- It was easiest to rest the new strip on the edge of the previously installed strip to line it up and not get epoxy everywhere. Then, when it was just about perfect, we would slide it off the edge down onto the epoxy. We didn't want to be sliding the pieces around on the epoxy, because it would force squeeze-out up onto the top of the project. Though squeeze-out is good for the most secure bond, for

The surface scrubbed with an abrasive pad.

Dulled the backer board and marked grid lines for alignment.

The final wall art hung in our living room.

this decorative style of project, we did not want to do any sanding after the epoxy cured. It would wreck the patina on the surface of the wood.

- We needed to double, triple, quadruple-check our gloves before picking up or touching any of the pieces. We didn't want epoxy on the finished surface of the wood. We were not always successful at this, but we were able to clean/absorb the mess satisfactorily by rubbing the epoxy prints off with clean, white paper towel.
- Numbering the pieces was crucial. Everything was cut to fit together in a specific order. Messing with the order could have created major alignment issues, ruining the aesthetics of the piece. Numbering the pieces with tape kept them in order, even when we got distracted by a chatty co-worker.
- Due to the abuse of the wood in its previous life, many of the pieces were warped. Since the strips were only about ⅛" thick, they were easy enough to weigh down flush until the epoxy cured. We were sure to have some weights at the ready.

Knowing our unofficial rules of the project, we were ready to tackle the other sections. All went swimmingly.

The next day, when the epoxy had cured, we trimmed the edges flush (you didn't think I was going to lift that big, heavy board and cut it by myself did you?) To finish the edges, I found some L-shaped, rounded vinyl edging strips to match the rustic aesthetic. I used these to frame the wall art.

The finished piece ended up being pretty heavy. I wanted to be sure the piece was mounted to studs when I hung it up at home, so I determined the hanging mechanism should be a cleat. I found one on Amazon® that would do the trick. I mounted half of the cleat to the back of the board with a thin coat of epoxy and a couple of screws. I checked that the screws were long enough to bite into the backer board but short enough that they couldn't poke through the face of the art before drilling. After all that work, a screw poking through the front really would have wrecked my day. The other half of the cleat went home with me in preparation for installation.

The project was now ready for transportation over the 500 potholes to its new home. I'm in love with the outcome of this project! Instead of being relegated to the guest bedroom where no one will see it, I'll proudly display in my living room so I can brag about how well I did, with the help of an elf… okay, okay, let's be honest, it was Don. It was pretty much all Don. Even still, this is one project that won't get marked as a Pinterest fail.

Scan the QR Code to watch a time-lapse video of the assembly process.

Swim Platform Rebuild

By Don Gutzmer – GBI Technical Advisor

The finished swim platform newly reinforced with balsa core and plywood.

The wooden core in fiberglass boats will rot unless properly sealed to prevent water intrusion. Holes drilled for wiring or to mount hardware commonly expose wood's grain, absorbing water and leading to rot. This happens frequently in areas like wooden stringers, cockpit soles, balsa-cored decks, and transoms. Swim platforms are one area that typically suffers water intrusion but are often overlooked. They are drilled into for mounting and are constantly wet. This is the perfect combination for rot.

A 1986 Carver swim platform made its way to our shop. I wish I could say it came off my 50-foot boat—maybe someday. I guess I better start playing the lottery. The deck of the swim platform was spongy. Upon inspection, it was obvious the core was rotten near the multiple holes drilled for mounting the davits for a dinghy and other hardware. This swim platform repair is a good example of how to replace a rotten balsa core and provide reinforcement to support the davits.

To determine the extent of the damage, I used a moisture meter to gauge the moisture content of the core across the entire swim platform. Despite the boat having sat in dry storage all winter, the readings were all above 20%. When moisture concentrations of this level are prolonged, rot and fungi will begin to grow. It was obvious that the entire core needed to be removed.

Water seeped into the swim platform causing extensive rot in the balsa core.

The owner wanted to adhere new synthetic teak deck material to the existing non-skid surface after I completed the platform repair. The non-skid texture would provide a good substrate for the synthetic teak's adhesive to key into, and the teak would cover any cosmetic imperfections. Our plan was to save the non-skid topside of the laminate and remove the rotted core from underneath.

To start the project, I used my vibrating multi-tool to cut the thin fiberglass laminate around the perimeter of the swim platform. With the laminate removed, it was obvious the majority of the core was at some stage of rot. In areas where the core was extremely rotted, you could just wipe your hand over wet balsa to remove it. In areas where the balsa was still in decent condition, it took more effort to remove.

Removing the rotted balsa with a pneumatic chisel.

A flat pry bar and sledgehammer were good tools to remove the rotted balsa, relieve some personal stress, and still accomplish the job… for a while. It did not take long to realize there must be a better way to remove the core than swinging a sledgehammer. A pneumatic chisel was the answer. The key was keeping it at a low enough angle to hit the balsa and not cut through the thin top laminate of chopped strand mat with its gelcoat non-skid.

After removing the balsa, I sanded the fiberglass surface with 60-grit sand paper on an orbital sander. This flattened the area and created a level profile to start the rebuilding process. The chopped strand laminate was very thin, and since this platform would need to support a dinghy, it needed reinforcement with a couple additional layers of fiberglass.

Using a template to trace the fiberglass.

Thinking ahead, I knew I would need to cut the same shape for these initial layers of fiberglass, the balsa core, and the layers of fiberglass that would ultimately cover the core. It was well worth my time to make a template of the inside of the swim platform with thin cardboard. Tracing the template's shape onto my materials improved my cutting accuracy and made the subsequent layers go much faster.

Fiberglass cut and dry fit.

For my initial reinforcing layers of fiberglass, I cut two layers of 737 Biaxial Cloth (a total of 30 oz.) to be applied over the chopped strand mat. I used WEST SYSTEM® 105 Epoxy Resin® with 206 Slow Hardener® to provide adequate working time for me to move at a steady pace and not rush. I saved time by pouring the epoxy by volume rather than using the 300 Mini Pumps.

The Mini Pumps are excellent for small to medium batches of epoxy. However, for the amount I needed, it was faster to measure by volume than to do the required number of pumps.

I covered half the length of the swim platform with a heavy coat of 105/206. Then I laid the first layer of 737 Biaxial Cloth into the wet epoxy and ran an 808 Plastic Spreader over the surface at a low angle, forcing the epoxy through the fabric. I applied more epoxy, saturating the fabric, then immediately applied the second layer of fabric in the same manner. The last step was covering the surface with 879 Release Fabric. I did this for three reasons:

- To keep the surface clean as it cured
- Minimize surface preparation
- Provide texture for adhering the new balsa core

Wetting out fiberglass with epoxy.

Release Fabric is simply peeled away after the epoxy cures, leaving a surface that won't need washing or sanding before applying more epoxy.

For boat repairs, I try to match the original fabrics and cores used in the boat's construction. The swim platform originally had ¾" balsa core, which I duplicated. I made an exception for the middle of the swim platform where the davits would be positioned to hold the dinghy. Here, I used marine-grade plywood. This provides better strength preventing the core from being crushed over time by the weight of the dinghy.

Using template to trace the new balsa core.

Before beginning the epoxy process, I wanted to cut all of the core materials. First, I laid the plywood and balsa core side-by-side in the order I planned to install them. The plywood section would be in the middle to support the davits, and the balsa core would be on the outer ends of the swim platform. I centered my cardboard template on the assembly and traced around it with a felt-tip marker.

The plywood was cut into smaller sections to make it easier to install.

I cut the balsa and plywood down to size, and then further cut the plywood portion into nine smaller square sections. This makes them easier to install and minimized air entrapment (Air trapped between the wood and epoxy could significantly weaken the swim platform.) I numbered each core piece as I cut to ensure I'd installed them in the correct order. I dry fit them before proceeding to prevent struggling with shaping wet, epoxy-coated pieces during the layup process.

I removed the Release Fabric from the previous layers of fiberglass and started the installation on the left end of the swim platform. I thickened a batch of 105/206 with 406 Colloidal Silica Filler to a non-sag consistency. With the ⅛" side of the 809 Notched Spreader, I spread the thickened epoxy where the first section of balsa core would go.

Following the Baltek® balsa core processing guidelines, I coated each kerf of the balsa core with unthickened epoxy. Pre-coating this way allows the epoxy to flow into the kerfs more easily during installation. This is important because the epoxy compartmentalizes the balsa core, therefore limiting the spread of moisture in the event of moisture intrusion. It also adds a little extra strength to the balsa core.

Many production builders don't take the time to perform this extra step, but I felt it was important for this project. I worked row-by-row, coating the kerfs in one direction, and then rotating the core 90 degrees to coat each kerf row in the other direction. It was time-consuming work, and I needed to mix multiple small batches of epoxy. I found it helpful to have someone open the kerfs in the balsa while I quickly brushed on the epoxy.

Coating balsa kerfs with epoxy.

As each piece was coated, I firmly pressed it into the thickened epoxy base to ensure the balsa core and epoxy made good contact. Excess epoxy squeezed out of the kerfs. I ran a plastic spreader over the surface to spread the squeeze-out into any remaining voids. Then I coated the surface of the balsa with unthickened epoxy before moving on to the plywood.

I mixed another batch of the 105/206/406 and applied it to the center of the platform with the notched spreader, as I had done for the balsa core. To ensure all of the end grain was sealed, I coated the edges of the nine sections of plywood with neat epoxy before setting each into the bed of thickened epoxy. I applied a layer of Release Fabric over the core I'd already installed, and worked it into the wet epoxy with a spreader. The following day, I repeated this process to install the remaining balsa core section.

Oversizing holes for the thickened epoxy.

Once everything cured, I drilled oversized holes for mounting the hardware and filled them with thickened epoxy. This ensured that moisture wouldn't intrude into these holes again. I started this process by removing the Release Fabric and then flipped the platform over to work from the non-skid side of the platform, the top. I found each of the original holes and drilled them out with a ⅛" bit. This was to mark the location for drilling the oversized holes. I flipped the swim platform over, so I was working from the bottom again, to prevent the oversized holes from being visible on the top of the swim platform once I finished the repair. I used a ¾" flat paddle bit to drill into the balsa. When the bit hit the fiberglass, I stopped. A shot of compressed air helped to remove any debris from within the hole. I briefly turned the platform top-side-up again to tape off all the holes before returning it to the bottom-up position. Time for epoxy.

Applying thickened epoxy with an 810 Fillable Caulking Tube.

I coated each hole with unthickened epoxy before filling them with thickened epoxy. This was because the neat epoxy has a lower viscosity, so it bonds to the core more effectively than thickened epoxy. With the epoxy still wet, I filled an 810 Fillable Caulking Tube to easily inject the thickened 105/206/406 mixture into each hole. When the epoxy cured, I flipped the platform again, top-side-up, removed the tape, and re-drilled each hole to its finished dimension.

Now it was time to close up the bottom of the swim platform. To avoid forcing the fiberglass into a 90-degree corner at the sides of the swim platform, I applied a fillet of thickened epoxy around the perimeter. While that was curing, I prepared the final layers of laminate. To replace the laminate with a thickness similar to the original, I used two layers of 737 17 oz. Biaxial Fabric and one layer of 742 6 oz. Fiberglass Fabric. Each layer of fiberglass was cut approximately 3" larger than the template, allowing extra material to wrap up onto the sides, just as it had originally.

I sanded the entire cured surface well with 80-grit and was ready to apply the fiberglass. The process was similar to installing the initial layers reinforcing the top of the swim platform. I only mixed enough epoxy to coat half of the swim platform. I applied the three layers of fiberglass, one after the next. First were the two layers of 17 oz. Biaxial Fabric. I applied the 6 oz. Fiberglass Fabric last because I knew it would give me a smoother finished surface and would easily wet out with the excess epoxy from the previous two layers. I then mixed another batch of epoxy to wet out the remaining half of the fabric.

Release fabric is installed over the new balsa.

I applied a layer of Release Fabric and made sure that it was smooth with no air pockets. After the epoxy cured, I removed the release fabric and touched up any flaws with thickened epoxy. I removed any amine blush from the touch-ups with water and an abrasive pad before sanding the epoxy dull in preparation for paint.

To finish the surface, I painted it with white Interlux® Brightside® one-part polyurethane, applying a couple of coats over the entire bottom and edge.

If you're willing to put in the work, you can fix things better than they were new. The swim platform is now structurally sound and can properly support the dinghy davits. The steps I took will ensure the new plywood/balsa core will remain dry for years to come.

This poor swim platform had lost a battle with a dock piling.

Swim Platform Corner Damage

Besides the rot damage, the corner of the swim platform had been crushed. Since I'd torn the swim platform apart to remove the rotten core, it was an excellent opportunity to rebuild the corner.

I cut away the damage and ground the fiberglass to a 12:1 bevel using an angle grinder with 36-grit sandpaper. To maintain a uniform curve while rebuilding the corner, I fabricated a mold with thin cardboard and covered it in Teflon™ tape to act as a release agent. Spring clamps held the mold in position. I needed eight layers of 737 Biaxial Fabric to rebuild it to the original thickness.

I wet out each layer of Biaxial Fabric in the mold, one after the next, using WEST SYSTEM® 105 Resin® and 206 Slow Hardener®. Once the epoxy cured, I trimmed the excess fiberglass and ground it fair with the original laminate on the inside and outside. Then I removed any additional material on the inside that might interfere with installing the new balsa core.

To finish smoothing the outside of the corner, I started with 60-grit on an orbital sander and worked down to 180-grit.

The swim platform's damaged corner now looks good as new. This repair will last for many years to come.

Scan the QR Code to watch the Swim Platform Repair from start to finish.

Preparing & Epoxy Provisioning for Circumnavigating Antarctica

By ATL Composites

Lisa Blair on bow of her 15.25-meter Hick 50, Climate Action Now.

Lisa Blair sailed her 15.25-meter Hick 50 into the record books this year as the fastest, non-stop, solo sailor to circumnavigate Antarctica. The wild, demanding nature of the Southern Ocean required Lisa Blair to ensure her vessel was in the best possible condition before undertaking her voyage. Equally important was provisioning the proper materials and spare parts to cover every kind of repair job on her epic voyage.

Setting the Record

On her first attempt at circumnavigating Antarctica in 2017, she made history as the first woman to sail solo around Antarctica—with just one emergency stop to repair a broken mast in Cape Town, South Africa. The dismasting in a violent storm prevented her from beating Russian sailor Fedor Konyukhov's record of 102 days. Her memoir, *Facing Fear*, recounts the life-threatening challenges she overcame on that 104-day odyssey.

In 2017, she led an all-female team to compete in the Sydney to Hobart Yacht Race, the first in 16 years. She set another World Sailing Speed Record for the fastest non-stop solo circumnavigation of Australia in a monohull in 2018. She completed that voyage in just 58 days. In 2019, she entered as part of the first female double-handed team in the history of the ORCV Melbourne to Hobart Yacht Race.

Lisa Blair still had Antarctica on her mind. In January 2022, she made her second attempt at the record to circumnavigate Antarctica. Sailing between 45° and 60° latitude, her journey took her to little explored areas of the Southern Ocean. She collaborated with many scientific organizations, collecting data during the voyage aboard her vessel *Climate Action Now*. After 92 days, 18 hours, 21 minutes and 20 seconds, she successfully completed her goal of being the fastest sailor to circumnavigate Antarctica.

Preparing Climate Action Now

To prepare for her second record attempt, Lisa spent three months at Rivergate Marina & Shipyard in Brisbane, working with marine professionals and tradespeople on-site to overhaul *Climate Action Now*. They tested the hull and repaired weaknesses, replaced deck hatches, rigging, rudder bearings, fuel and water systems, safety rails, electronic gear, and navigational equipment.

"I've been very hands-on, working alongside the specialists at Wright Marine who have replaced the boat's carbon fiber and fiberglass shrouds and changed them from inboard to outboard. We've changed the location for the pick-up of the rigging to allow double-spreader rigging. This gives the boat a 30-percent increase in strength and confidence in the safety margin," Blair explained.

Shipwright John Stevens at Wright Marine worked on the hull and interiors, relying on WEST SYSTEM® Epoxy products and ProBalsa® end-grain balsa. He said they've used WEST SYSTEM 105 Epoxy Resin® with 206 Slow Hardener®, unidirectional carbon fiber, reinforcing fabrics, and vacuum bagging techniques.

WEST SYSTEM Epoxy is an industry standard for boat restoration and repair because it creates an effective moisture barrier and provides superior secondary bonding strength. Vacuum bagging the reinforcing materials further enhances the laminating process, ensuring even clamping pressure over all repair areas regardless of the size, shape, or number of layers.

"It's a simple choice," Stevens said about specifying WEST SYSTEM Epoxy products and working with ATL Composites. "We always know what we're getting and we've never had a problem. This is our first time using carbon fiber and we're very impressed. It's beautiful! It stayed together brilliantly. We'll definitely use them again. We always turn to ATL for support, especially if we have something that stumps us. The experts at ATL provide great advice."

Epoxy Provisioning

Ahead of embarking on the Antarctic circumnavigation in January, Lisa Blair met with Lorraine Duckworth from ATL Composites to stock up on WEST SYSTEM products to keep her yacht ship-shape during her odyssey. Along with the Wright Marine specialists at Rivergate Marina & Shipyard, Blair completed a structural upgrade on *Climate Action Now*. Blair carried out much of the refit work herself.

The sailing yacht is laden to the gunwales with materials for scientific research projects on the water and the seabed, and spare parts to cover every kind of repair job on her epic voyage. Blair discussed her upcoming voyage with Lorraine Duckwork of ATL Composites.

ATL: What do you anticipate will be your major challenges during your Southern Ocean and Antarctic quest?

LB: This is my second voyage, so I'm not being over-confident. It's a long trip and I can't go too hard too soon. My goal is to complete the circumnavigation in 102 days and beat the current record. I need to pass Cape Horn and Iceberg Alley and do it safely. I have trained hard for this, both physically and to ensure that I'm strong mentally as well. I have found that getting to the starting line is harder than the trip. Preparation is key. The weather is always a variable, so I keep an eye on that.

ATL: What kinds of challenges will your yacht face in those waters?

LB: The boat will do a lifetime's worth of work in three months. By the time it is halfway around, things start to wear out and you have to start "re-building" the boat. There's constant movement and stresses, but I'm confident in *Climate Action Now* and know it's capable. I have 16,000 nautical miles of experience [on the boat], so I feel well prepared

ATL: How have you prepared your onboard kit to carry out repairs underway?

LB: It's important to have spares and replacements for every part of the boat from engine, through to the galley, and having the right products for onboard repairs is imperative. It has been great to have ATL as a sponsor. The composite products will cover everything from strenuous fiberglass repairs at sea, to patch repairs with WEST SYSTEM Six10® Thickened Epoxy Adhesive.

ATL: What do you like about Six10?

LB: It is clean and efficient. With the static mixer, there is no concern about dispensing the correct mix ratio. I find it simple to use because it fits in a standard caulking gun. With Six10, I can complete repairs quickly with less mess. Its fast cure-through is ideal for small repair and reinforcing projects, so I can make repairs in less time with less mess.

Advantages of Six10

ATL is supplying Lisa Blair with several WEST SYSTEM products, including Six10. This epoxy is packaged in a specially designed, self-metering cartridge. This innovative container provides many useful features:

- Separates the resin and hardener for long-term storage
- Accurately meters the proper resin-to-hardener ratio
- Fits into a standard caulking gun
- Precisely dispenses the desired amount
- Using the static mixer dispenses the epoxy properly mixed
- Fast cure-through

All adhesives rely on surface wet-out and saturation to achieve a good bond with the substrate. Six10 has a viscosity high enough to resist sagging but can still saturate a surface without pre-coating, thanks in part to shear thinning. This property also enables it to wet out light-to-moderate-weight reinforcing fabrics like fiberglass and carbon fiber.

Crucial Epoxy Supplies

Other epoxy products ATL provided for *Climate Action Now's* trip include WEST SYSTEM 105 Resin and 200-series hardeners, 300 Mini Pumps to ensure easy and accurate dispensing, and select WEST SYSTEM Fillers for filleting and fairing. Reinforcing materials donated include fiberglass tapes and full-width fiberglass rolls. Release Fabric (peel ply) was included to limit the need for sanding ahead of secondary bonding.

"To ensure efficient and safe use of epoxy, we've included a selection of application tools, gloves, mixing containers, 808 2 Flexible Plastic Spreaders for wetting out fiberglass, 800 2 Roller Covers for coating applications, and 804 8 Reusable Mixing Sticks," Lorraine Murray of ATL Composites said.

An Ambitious Mission

Climate Action Now is named to convey Blair's core message: Manmade climate change impacts our environment. The yacht is covered in a digital vinyl hull wrap showcasing a collage of thousands of different Post-It note messages, like "I ride to work for climate action now" or "I recycle for climate action now." It's a simple and effective way to share ideas for cutting back on emissions in everyday life and inspire others to take action.

Since taking up sailing in 2005, Blair has witnessed the declining health of the oceans, prevalence of storms, and the real risk of collision with ice as glaciers melt at a rate never before observed.

"These are all symptoms of man-made climate change," she says. "What we know is that action needs to be taken and a greater awareness needs to be reached."

Blair's campaign encourages people to commit to actions as individuals, such as taking public transport, riding a bike or carpooling to work, and recycling as steps towards climate action and a better future.

"People are so conditioned to be limited in our goals and views," she continued. "Until we put ourselves in uncomfortable positions, we don't know what we're capable of. I went from no sailing experience to 10 years later holding three World records."

"I really want to show people that you can achieve anything you set your mind to. Whether that's to run a successful business or go on an adventure—to live their dream, whatever it is. Life's too short not to."

SCAN ME

To learn more about Blair's campaign, visit

lisablairsailstheworld.com

or **westsystem.com.au**

TOP:

Carbon repair made with West System Epoxy. The vinyl wrap on the hull is a collage of thousands of messages sharing how people cut back on emissions in their everyday lives.

BOTTOM:

Lisa Blair at Sea aboard Climate Action Now.

Using WEST SYSTEM to Make Appropriate Structural Changes to Your Boat

By Jeff Wright – GBI Vice President of Technical Services

Boats can be complicated structures. Sailboats endure multiple loads from the rigging as the shrouds are pulled in tension and the mast is compressed into the hull. Inboard powered boats must transfer the thrust from the engine mounts into the stringers while outboard and sterndrive boats place substantial loads on the transom. Even the steering wheel at a stand-up helm can undergo high loads when the boat moves fast through large waves — the security of which many go-fast boaters may take for granted. While we always encourage people to take on their own fiberglass repairs and boat modifications, I wanted to discuss a few projects and areas that require special attention.

Relocating Thru Hulls

When breathing new life into an old boat with an updated engine, it is very possible that your existing thru hull locations will not work. "Repairing Machined Holes in Fiberglass" in *Epoxyworks 21* is a detailed article on this subject. Patching unused holes, particularly those above the waterline, may not require a full repair as described in the WEST SYSTEM® *User Manual & Product Guide*.

Figure 1 and 2 illustrate approaches to patching unused through holes above the waterline. Note the rounded or chamfered edges in Figure 1. This reduces the chance of a cosmetic "ring" appearing around the filled hole. Figure 2 shows how you can bevel out even farther to further reduce the chance of a cosmetic issue under high-gloss paints.

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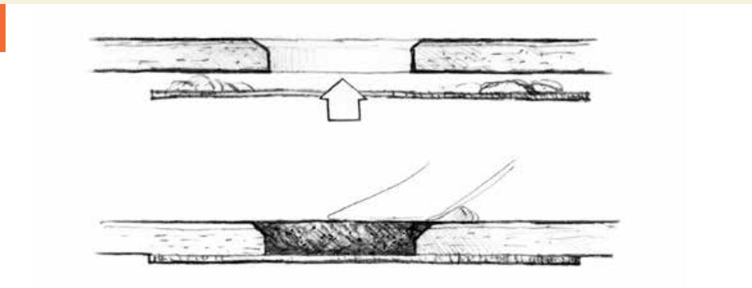

Filling unused hole with thickened epoxy.

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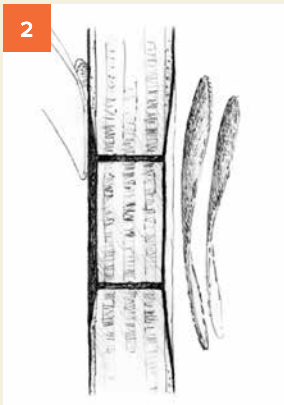

Filling unused hole using core material.

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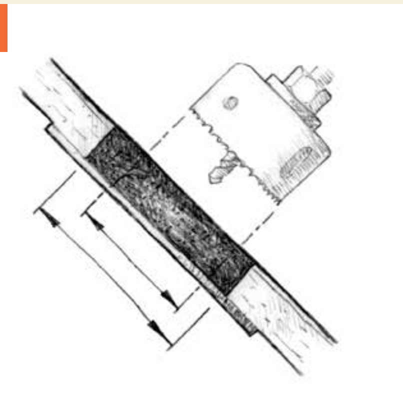

Reducing the hole size by filling with thickened epoxy and redrilling.

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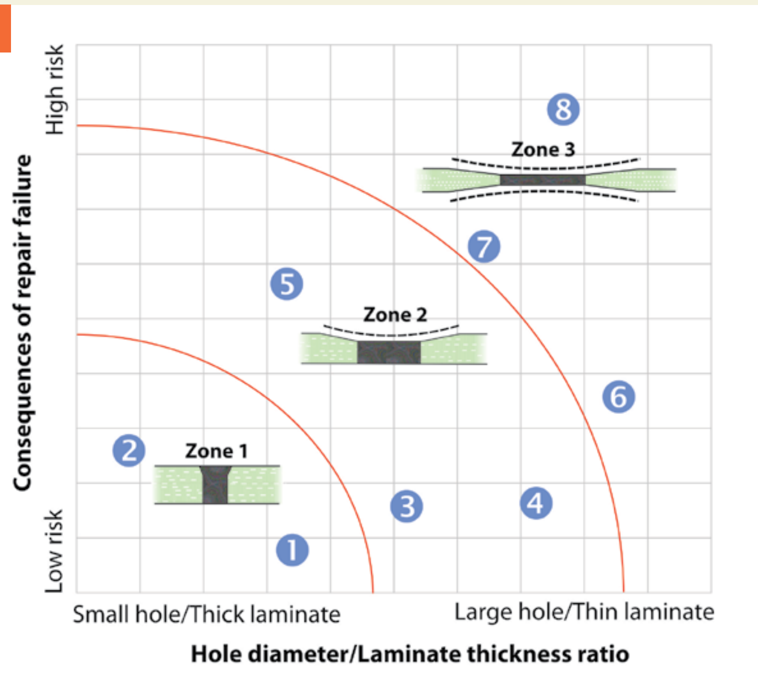

The repair zones to consider when repairing machined holes in fiberglass boats.

When filling holes under the waterline, use a more conservative approach. If an existing hole can be used but needs to be smaller, you can fill the hole with thickened epoxy and re-drill it to the correct size as seen in Figure 3. Figure 4 is a chart from the previously mentioned article that explains how the consequence of failure and the thickness of the laminate will influence the repair method.

Stringer Changes

A new inboard engine may not have its engine mounts and vibration isolators located in the same place as the old engine. If the height of the stringer needs to be increased, be sure to add the height in such a way that the stringer has a smooth profile. Abrupt profile changes create stress concentrations and can cause a crack to start. If reducing height, an engineer may need to be involved. The height of the stringer has a major impact on the strength and stiffness of the stringer. Reducing height will require additional fiberglass overlay to maintain the strength and stiffness. Figures 5 and 7 show stringers with smooth profiles that avoid stress concentrations.

Stringer spacing should not change unless an engineer is involved. Increasing the distance between stringers will increase the span of the unsupported hull shell panel resulting in higher deflection and stress. Notching the stringers may be required to avoid changing the spacing.

Figure 6 demonstrates how to address interference with an engine and the stringer by using a tapered block to reinforce the rounded notched area and avoiding moving the stringer. It is also important to understand how the keel loads are transferred into the stringers when working on sailboats. As I mentioned before, consult a naval architect or engineer if you don't understand the effect of the changes.

If completely replacing the stringer, review the WEST SYSTEM *User Manual & Product Guide* for best practices. Using thickened epoxy to create a fillet and staging the tabbing fabric is an improvement over the installation methods used by many production builders. This technique is shown in Figure 8 and 9.

Production boats will often not have the stringer core touching the bottom of hull to avoid a "hard spot." Bonding the stringer in epoxy with a nice curve on each side will distribute load very well. This technique is used by custom boat builders on a regular basis.

Rigging Changes

Moving or replacing chainplates may require holes in new locations or expose deteriorated plywood. Oversized or deteriorated holes can be filled with thickened epoxy and re-drilled. Rotted plywood (Figure 10) should be addressed by scarfing in a new piece (Figure 11).

Take advantage of the removed hardware. Encapsulate the core material around any deck penetrations with epoxy (Figure 12). The constant flexing and potential sealant failure can expose the core to water over the life the boat. The thickened epoxy will protect the core for the life of the boat.

If installing new backing plates, aluminum plates should never be installed in the laminate the way plywood is often used. If any moisture, particularly saltwater, contacts the plate (and it corrodes), it will expand and blow apart the laminate. Aluminum plates should always be outside of the laminate.

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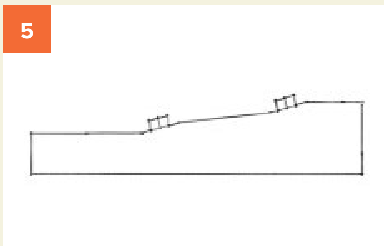

Common stringer profile.

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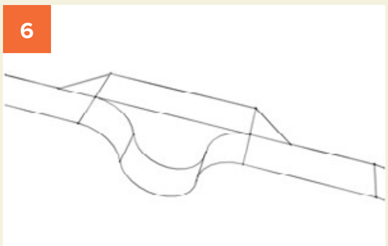

Example of how to properly notch a stringer.

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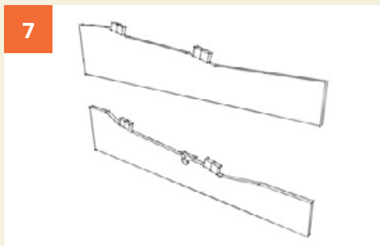

Lower engine mounts with smooth profile.

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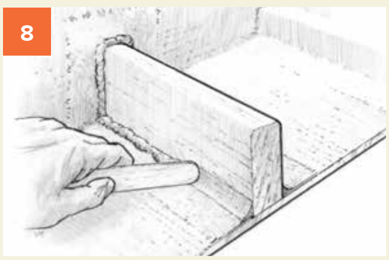

Applying a fillet creates a more even load distribution.

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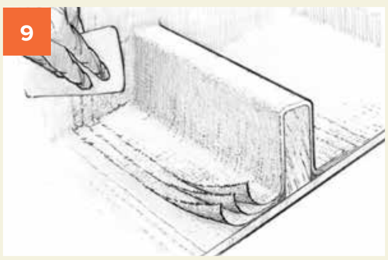

Staggering fiberglass tabbing layers minimizes concentrated stresses.

10

Rotted plywood should have the compressed section replaced.

Changes to the Helm

Instrumentation for engines has advanced significantly. Multiple gauges can be replaced by a single touch screen. On the other hand, what used to be small bracket-mounted electronics have become very large flush-mounted screens. Both of these upgrades can require major changes to a helm station. Figure 13 illustrates how significant these changes can be.

When filling holes on a helm station, it is critical to use a good backing surface to laminate against. Since these surfaces are often flat, consider laminating from the backside with your temporary form/lamination surface attached to the finished/outside surface of the helm. This is another situation where all edges should be chamfered to reduce the risk of "lines" appearing after paint is applied. It is common for the reinforcing plywood to be ¾" thick in instrument areas. Because so much of the area is cutaway for the instruments, the strength can be greatly reduced requiring a thick laminate for the material that is left to support everything. Keep in mind, as I mentioned in the opening, grab handles and steering wheels need to have a secure base if making changes in those areas.

Transoms

The current trend of repowering obsolete sterndrive boats with modern outboards requires critical attention to the structure of the boat. With all of the thrust and weight of the engines supported by the transom, it is without a doubt considered a highly loaded area. It is important to consider both the strength of the transom and the attachment to the boat.

Figure 14 illustrates how the gussets in both cases stiffen the transom, but the example in the forefront securely attaches the transom to the stinger and distributes the loads. The image in back would have a very stiff transom but would flex away from the hull. It is import that the entire load is evenly distributed into the hull to prevent the transom from excessive flexing.

The core material in the transom is often a high-strength material such as marine-grade plywood. It is important to use a strong material. Some people are resistant to using plywood for fear of rot weakening the transom. We believe a properly laminated transom, with care taken to epoxy-seal all penetrations, will last the life of the boat. Unfortunately, the addition of hardware such as transducers, or not resealing holes as a maintenance task, can greatly reduce the life of the plywood. Even with proper maintenance, we still recommend taking the time to epoxy-seal all of the penetrations. Water inside of any laminate can cause damage, especially when exposed to freeze/thaw cycles.

Act Locally, Think Globally

This article is a just a brief review of how to address structural changes to your boat. Remember that even though a modification may be as simple as relocating a winch or an engine mount, it is important to understand where the load is being transferred into the boat's structure. Was a winch located over a bulkhead that prevented the deck from flexing? Is the stringer made of a low-density core while the original motor mount area had a high-density insert? Should a high-density insert be installed in the new location for secure fastening? Involving an expert is a good idea when changes may affect the integrity of the boat.

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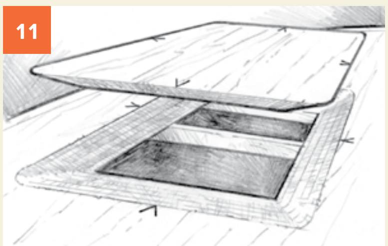

Scarfing in a new section of plywood.

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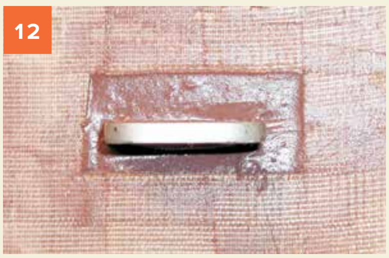

Surrounding hardware that penetrates the deck with epoxy, prevents moisture from reaching the core.

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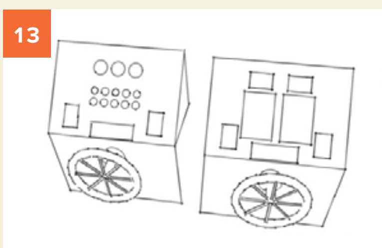

Upgrading to larger instrument holes in a helm station requires reinforcing!

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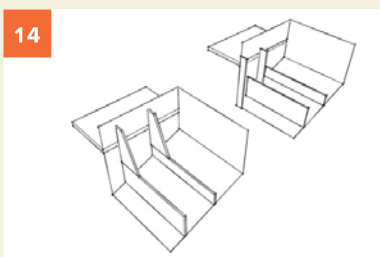

Having angled gussets, like the front image, more evenly distributes the loads from the transom into the hull.

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Feel free to contact WEST SYSTEM Technical Service to discuss your project and help make it a successful one.

Proper Fastener Bonding

for a stronger, more moisture resistant bond

By Terry Monville – GBI Technical Advisor

Typically, when a fastener fails on a boat, it pulls out of the wood or fiberglass that it was screwed into. There are many causes for this failure: shock loading, fatigued from being pulled on one too many times, or moisture softening the wood. Let's take a look at how using WEST SYSTEM® Epoxy can improve the holding power of a fastener in wood to give you fewer troubles on the water.

Saturating the Wood

Saturating the wood with epoxy is the simplest way to improve your fastener's holding power. You start by drilling a standard pilot hole, just as you would have to do even if you were not using epoxy. Using an 807 Syringe, fill the hole to the top with your chosen 105 Epoxy Resin® and 200 series hardener combination. Allow the epoxy to saturate the wood. For 206 Slow Hardener® at room temperature, I typically wait about 20 minutes. Then coat your fastener threads with epoxy and screw your fastener in by hand.

In warmer weather, the epoxy will cure faster, so do not wait too long. In cooler weather (40°F-60°F), use 205 Fast Hardener® so it will cure in the cooler environment.

Saturating the wood is a very simple method to get some added moisture resistance and additional holding power without any additional drilling. This makes it a great technique for quickly replacing existing hardware. When the hole is drilled into a horizontal surface, this method works very well, but if you are coating a hole in a vertical surface, it can be tricky. Use a piece of packing tape or duct tape over the opening to prevent the epoxy from running out of the hole.

Wetting out the fastener.

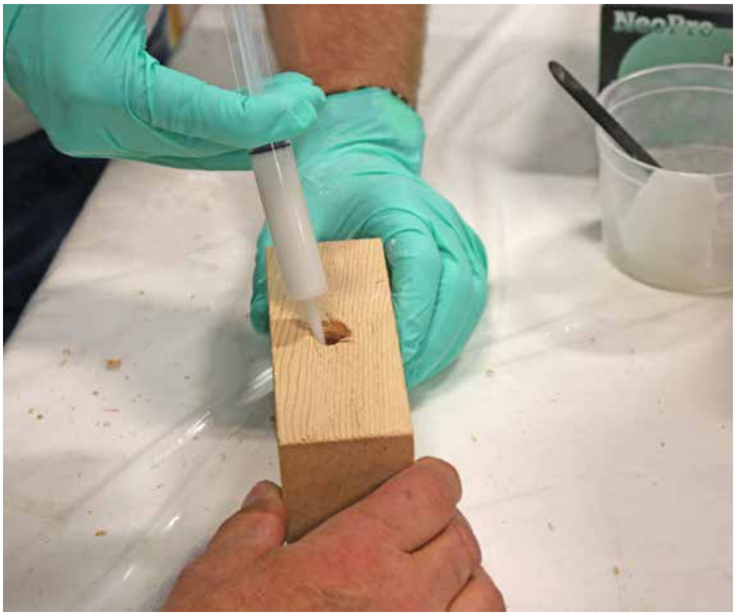
Wetting out the oversized hole.

Oversized and standard pilot hole sizing.

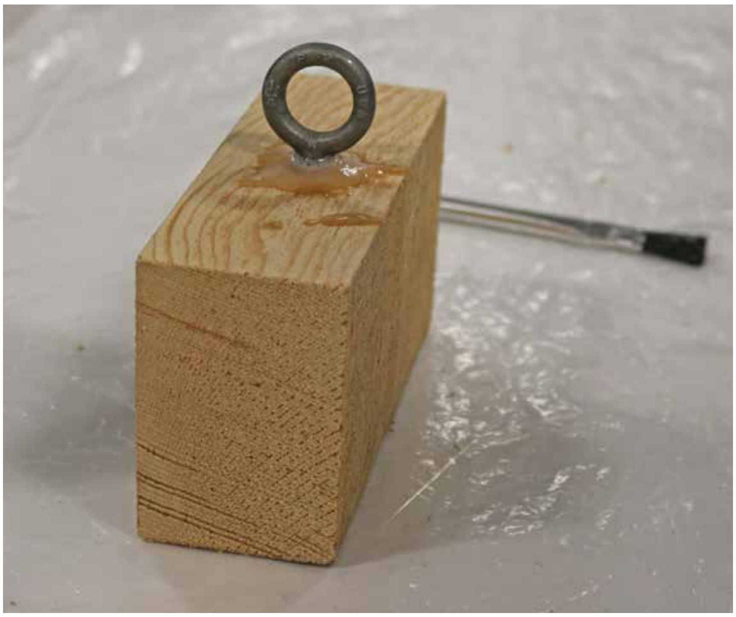
Drilling the oversized hole.

Thickening the epoxy with 404 High-Density Filler.

Filling the syringe with the thickened epoxy.



Filling the hole with the thickened epoxy.



Added the fastener to the pilot hole.

Oversizing the Hole

You can further improve the load-carrying capability of the fastener by increasing the amount of epoxy that surrounds the fastener. This takes advantage of the fact that WEST SYSTEM Epoxy has much higher density and strength than the wood fiber itself.

Start by drilling an oversized hole for the fastener. For fasteners larger than ⅜", this should be about ¼" larger than the shaft dimensions. For smaller fasteners, the hole should be about twice the diameter of the shaft. Your hole should be drilled between ⅔ and ¾ of the depth you plan to embed the fastener. At the bottom of the hole, drill a normal size pilot hole to the full length of the fastener. This allows the threads to bite into the wood so the fastener stays in place while the epoxy cures.

Fill the hole with a mix of 105 Epoxy Resin/200 series hardener. Allow the epoxy to soak into the wood/core. After 5 to 20 minutes, remove any liquid epoxy that has not soaked in with an 807 Syringe.

Fill the hole with a mix of 105 Epoxy Resin/200 series hardener thickened with 404 High-Density Filler to a non-sagging consistency. You can reuse your syringe to dispense the mixture. The mix should be thin enough to go through the syringe, but you may need to cut the tip slightly larger. Using the syringe allows you to fill the hole from the bottom to the top to prevent air voids. Coat the fastener with the 105/200/404 mixture before installing it.

This technique spreads the fastener's load out to the larger diameter of the epoxy annulus. The larger hole creates more bonding surface area.

Again, vertical or inverted surfaces can be tricky, so the process is a little different. You'll want to thicken your epoxy with 404 until you reach a non-sag consistency so it will hang in the hole well. (You could also use Six10®, which has a great gel consistency and can be dispensed from the cartridge fully mixed). Use tape to hold the epoxy in the hole until it has cured.

Removable Hardware

For some applications, your fastener or bracket needs to be removable. A motor mount would be a great example. There are two ways to achieve this. One is embedding a stud in epoxy and using a nut to tighten down your bracket onto the stud. The other is bonding a nut into the epoxy with cast threads (basically creating a threaded insert out of epoxy).

Embedding a stud uses the same basic steps that we used for bonding in a fastener in an oversized hole. The primary difference is that you have to make sure the oversized hole is large enough to accommodate a nut on the threaded rod. We recommend threading a nut onto your stud in a position where it will remain slightly proud of the final epoxy surface. By leaving the nut slightly proud, it will be easier to clamp down your hardware or motor mount. Once you've determined the correct position of your nut, fill the hole with epoxy, insert your stud, and allow it to cure.

In some applications, a stud may not work or may be undesirable. This is when we recommend our second technique. Using a nut and bolt, we set up the hole and nut as we did for the stud, leaving the nut slightly proud. Before casting the nut and bolt in the epoxy, use a release agent on the threads that will be encased in epoxy. I like to use cooking spray because it's cheap and we always have some in the house, but wax or silicon spray can also be used. After the epoxy has cured, you can back the bolt out and mount your hardware. The nut bonded into the surface of the epoxy works as a clamping point as well as preventing thread wear. You will lose 5 to 10% holding power compared to having a fixed stud.

Putting it to the Test

To demonstrate the effectiveness of these techniques, I set up an experiment using Douglas fir wood blocks. The species and grain of the wood plays a large part in the holding power of the fastener. For this reason, I used blocks cut from the same Douglas fir 2x4. All the eyebolts were solvent washed, and I scuffed the threads using a 3M® Maroon Scotchbrite™ pad. For my baseline block, I pre-drilled one block to 7⁄32", just over an inch deep, to accommodate the threads on the ¼"x1" eyebolt. The remaining blocks were each prepared using one of the previously mentioned methods.

After allowing the samples to cure for 7 days, it was time to pull the eyebolts. We have a simple device with a steel frame where we can mount the block. Using the lever arm with a load cell, we can measure the pounds of force applied to the eyebolt before it fails. In this demonstration, the load was pulling the eyebolt straight out of the block. Keep in mind, a sheer load, like that on a deck cleat, pulls across the grain line, so the holding strengths in those situations would be even higher.

Using the testing device to measure the max loading.

Bonding Technique Max. Loading (Pounds)

No Epoxy Used as a Baseline	965
Hole Saturated with Epoxy	1148
Oversized Hole	1667
Removable with Nuts	1477

As you can see in the results from this demonstration, saturating the wood with WEST SYSTEM Epoxy increased the eyebolt's holding power by 18% over the one installed without epoxy.

When I used an oversized hole, with WEST SYSTEM Epoxy thickened with 404 High-Density Filler, we increased the holding power by more than 70% compared to a standard installation. That's 45% more than soaking with epoxy alone. By oversizing the hole, we exposed more wood fiber, increasing the bond area for the epoxy.

When making the fastener removable, you do give up 5 to 10% of the holding power compared to bonding the fastener using the oversized hole method. Depending on your use, making the hardware removable may be well worth the sacrifice.

We have focused on how fastener-bonding increases the holding power, but it also helps keep moisture out of the substrate regardless of whether it's solid wood, a composite core, or a solid fiberglass laminate. Bonding fasteners with WEST SYSTEM Epoxy helps prevent moisture from wicking down the fastener, creating unseen corrosion of the fastener. This is particularly important in salt-water areas.

Epoxy is a great way you maximize your fastener's holding power while minimizing or preventing water intrusion. When bonding fasteners, as with anything, overkill is not always the right answer. It is much better to assess the situation and determine which technique will work best for your application. Using the information we've covered, you are now armed with the tools you need to make an educated decision on which technique to choose and how to execute it successfully.

You can find more on fastener and hardware bonding in Chapter 7 of our ***Fiberglass Boat Repair and Maintenance manual*** or Chapter 6 in our ***Wooden Boat Restoration and Repair manual***. Scan the QR Code to download the manuals.

Repairing My Boat's

PLASTIC CONSOLE

By Craig McCune

Close-up of a stress crack in the plastic console.

After 20-plus years of vibration and pounding on the water, the molded plastic console on my 2001 Lund® boat was riddled with stress cracks and broken pieces. All of the fastener-mounting points were stripped out or broken. As often happens with older boat components, replacement parts were no longer available. I'd have to repair the console myself.

I am familiar with WEST SYSTEM® products but called their technical support line to verify my choice to use G/flex® Epoxy. It's commonly used to repair plastics such as molded kayaks. The Technical Advisor I spoke with agreed that G/flex was the best option. He assured me it would bond well as long as I used the correct plastic surface preparation methods: stripping the paint and flame treating. The console is made of ABS plastic, which G/flex adheres to nicely.

As recommended, I began by stripping off all of the paint with denatured alcohol and Scotch Brite® abrasive pads. Then I sanded the entire surface with 80-grit sandpaper. After widening the cracks with my rotary tool, I drilled a small hole at the end of each to prevent the cracks from expanding. I beveled and rounded the edges of the plastic to remove all sharp edges.

Applying a layer of 6oz. fiberglass with G/flex 650.

The console after being repaired.

Immediately after flame treating the plastic with a propane torch, I filled the voids and cracks with G/flex 655 Thickened Epoxy Adhesive. Flame treating promotes the epoxy's adhesion to plastic.

I reinforced the console's underside and topside by applying multiple layers of 6-ounce fiberglass, wet out with G/flex 650 Toughened Epoxy. Using G/flex 655, I textured the repair areas to blend them with the original console surface. I then encapsulated the repaired console with two coats of G/flex 650.

To prepare for painting, I cleaned the cured G/flex coating with water and a Scotch Brite pad to remove any amine blush before dulling the epoxy with 180-grit sandpaper. Next, I applied SEM® Plastic Adhesion Promoter followed by three coats of SEM Vinyl Coat™, a flexible aerosol coating for marine vinyl and plastic. Finally, I sprayed on two coats of SEM Tac Free Protective Topcoat for a clear, flexible satin finish.

Overall, I am very happy with the plastic console repairs on my Lund. I believe the console will easily last another 20 years or longer.

Veneering a Transom

By Bill Bauer

I've been restoring an MFG 15®. The transom was made up of one very thin fiberglass hull transom sandwiched between two ¾" mahogany layers and bolted together. I chose to reinforce the fiberglass transom with 12 oz. fiberglass. I also laminated the backside of each mahogany layer piece with 6 oz. fiberglass, and the front (exposed) side with 4 oz. fiberglass.

After doing all this work, I decided the original transom wood was too marred so I added a layer of mahogany veneer. Since I don't have a veneer-clamping table, I simply used another transom as the clamping table.

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Watch our boat repair videos. Scan this tag or go to **youtube.com/WestSystemEpoxy**

The original transom, glassed with 4 oz. and three coats of WEST SYSTEM 105 Resin®/207 Special Clear Hardener®.

The 105/207 coating was sanded with 40-grit in preparation of applying the veneer.

The sanded transom was then brushed clean and wiped down with alcohol and a paper towel.

The transom is roughly 9 sq.ft. To adhere the veneer, I chose 105/207 in case there was bleed-through onto the veneer. I mixed two batches of five pump strokes each, and five teaspoons of 403 Microfibers Adhesive Filler. This made a honey-like consistency. I spread this mixture on with a notched trowel.

The veneering stack: the transom to be veneered, epoxy thickened with 403 Microfibers, veneer, plastic sheet, cardboard, plastic sheet, and the other transom. The cardboard helped to distribute the pressure.

The veneer I used was 2-ply flat cut mahogany that's a wood-on-wood construction. It's backed with a non-mahogany wood rather than paper and is available from Veneer Supplies (*veneersupplies.com*).

A heavy center weight and clamps around the edges completed the setup.

I let the transom stay clamped for several days and then lightly sanded the veneer with 120-grit.

The 4 oz. fiberglass was wet out with 105/207 using a squeegee to apply only enough epoxy to hold the cloth in place. Too much epoxy will cause the fiberglass to float on the epoxy, resulting in a wavy surface.

The 9 sq.ft. of 4 oz. fiberglass cloth took about eight pumps of 105/207 to apply. I used two batches of 4 pump strokes each.

After about four hours at room temperature, the epoxy had cured enough to support the second coat, and four hours after that, the third coat. Five pump strokes of epoxy were enough for each of the additional coats. I applied these with a foam roller. These coats were enough to fill the weave in the fiberglass.

After allowing the epoxy to cure for three days, I applied seven coats of 1015 Captains Varnish with a foam brush to both halves of the transom.

The purists will promote bristle brushes to apply varnish; I like Jen Poly-Brush® foam paint brushes because they do an adequate job and I don't like to clean brushes. Three or four coats should be enough, but I apply seven coats to new wood to provide a good base and a deep finish.

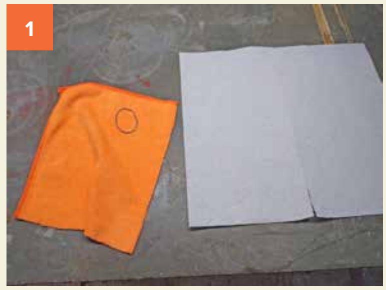
The first two coats were lightly sanded with 120-grit. The next three coats were sanded with 220-grit, and the last two coats were rubbed with Scotch-Brite™ General Purpose Hand Pads. The transom was dusted off and wiped with a tack rag before each coat of varnish.

I applied the seventh coat using the "wiped on" method by soaking a lint-free, clean rag with a mixture of 50/50 varnish/mineral spirits and wiped it on the surface. This applied a thin coat that was free of runs and brush strokes.

It is important to lightly sand and apply a new coat of varnish every year to seal the varnish. Any small crack in year-old varnish will let moisture in, causing the underlying wood to darken and the varnish to lift and flake off.

Bill Bauer is a boat builder who helps maintain the local schooners Appledore IV and Appledore V. Visit his website at wrbauer.net.

Varnishing Tip



I use this to apply the final coat of varnish. It reduces runs and brush strokes.

I use a mixture of 50/50 varnish/mineral spirits.

A lint-free rag is padded with a clean, folded paper towel.

This is then dipped in the 50/50 mix and wiped on the piece to be varnished.

Tennessee Bridge built with G/Flex

A sustainable solution for aging infrastructure

By Mark Morrison – Institute for Advanced Composites Manufacturing Innovation

IACMI FRP Composite Bridge

On the surface, the span looks like any of the thousands of small, narrow two-lane bridges across America. This new, high-tech bridge in Morgan County, Tennessee uses G/flex® Epoxy in a fiber-reinforced polymer (FRP) composite material deck embedded with fiber optic sensors. It replaced a damaged, decades-old concrete crossing which, like thousands of low-volume bridges across the nation, was structurally deficient and outdated.

According to the American Society of Civil Engineers, about 8 percent of the more than 617,000 crossings in the U.S. are structurally deficient and need repair. FRP composites offer a low-cost, low-maintenance option. The new structure in Tennessee demonstrates the benefits of composite materials for bridgework.

Due to the use of technologically advanced materials, including G/flex, the bridge deck system requires less installation time, conserves energy and construction costs, and has a 100-year lifespan.

"This composite bridge has already made a positive impact on Morgan County," said Highway Superintendent Joe Miller, who added that local officials were looking for a low-maintenance crossing that could be installed fast and at a lower cost than a traditionally built span. "We have numerous bridges within the county and hundreds across the state that are in need of repair and could benefit from this technology."

For Morgan County, the lightweight, easy-to-install crossing comes at no cost, courtesy of the composites industry. Tennessee-based Composite Applications Group (CAG) led the effort. Working together under the umbrella of the Institute for Advanced Composites Manufacturing Innovation, or IACMI—The Composites Institute®, almost a dozen private companies collaborated with industry organizations and university researchers to make the new span a reality.

Developed by Structural Composites Inc., the 16' long and 25' wide bridge deck is engineered for high strength and is 90% lighter than concrete. It uses G/flex Epoxy in its two 8' x 25' corrosion-resistant FRP deck panels that were fabricated off-site in a controlled environment.

Because the completed sections were so lightweight, they could be transported to the building site and installed in one day using a forklift. This required less onsite preparation, reduced the need for construction equipment, shortened the installation time, and lowered energy costs.

IACMI Technology Manager John Unser, who is also vice president of the program and project management for CAG, said composites have been used for bridge deck applications for more than twenty years. They have exceeded all performance and safety standards set by the American Association of State Highway and Transportation Officials. However, he said, many transportation departments across the country, especially those from smaller jurisdictions, are not familiar with the composite technology.

To learn more about how FRP can offer a sustainable solution to the nation's crumbling infrastructure, visit compositebridge.org.

IACMI and its industry partners are developing a comprehensive case study based on the Morgan County project, including comparing the total costs of a typical concrete span and one using an FRP deck. Unser said they will share the results with federal, state, and local officials, transportation departments, and the civil engineering community to help them get familiar with FRP construction.

Researchers and engineering students from The University of Tennessee, Knoxville's (UTK) Fibers and Composites Manufacturing Facility are part of the partnership. During production, they embedded smart fiber optic sensors developed by Luna Innovations into the surface. These high-density sensors are being used to monitor the composite deck system over time to give critical performance and safety data. This will provide a sustainable solution for aging infrastructures. In addition, wireless technology developed at UTK is remotely monitoring the response of the bridge system and traffic counts via cloud computing.

"Lack of durability data is one of the major barriers to the adoption of novel and advance materials including carbon, basalt, or glass fiber reinforced polymeric composites in civil infrastructure," said Dayakar Penumadu, the Fred N. Peebles Professor in the Tickle College of Engineering at UT and Characterization Fellow for Materials and Processing for IACMI. "This is a major obstacle for integrating new materials and structures quickly and requires successful demonstration as is being done through this IACMI project. Bridge decks are the most damage-prone elements, and we are integrating smart sensors distributed throughout the composite deck that will provide us with valuable performance data for years to come."

Close-up of the SC FRP bridge deck fabrication.

Installation of the road bed.

Building a Strip Kayak

By Alan Bergen

Before jumping into building a strip kayak, I wanted to find out all I could about the process. I read the book *Kayakcraft: Fine Woodstrip Kayak Construction* by Ted Moores cover-to-cover and referred to it frequently during construction.

I selected Bear Mountain Boats' 16' 5" Resolute touring kayak from their online catalog. I chose this boat based on my size and weight, and its excellent stability. The next step was deciding whether to build it from scratch or from a kit.

Building from a kit means everything is provided except for the strongback, which is a long, low table used as the foundation for the molds that define the shape of the kayak. People who don't have my kind of woodworking and fiberglassing experience can also build a kayak (or canoe), but I'd recommend they begin with a kit boat.

I have a lot of experience as an amateur woodworker, and I have worked on my sailboat with fiberglass and WEST SYSTEM® Epoxy. I was confident I could build a strip kayak without a kit, So, I chose to build from full-size plans. Soon the fun began.

I started by building the strongback (Fig. 1 & 2). I took my time because inaccuracies here would be transferred to the finished boat. The next step was building the molds. I transferred the full-size plans to plywood, cut them out with a saber saw, and attached them to the strongback (Fig. 3-7). Using a string, I checked to make sure all the molds


1

Strongback.


2

Strongback with mold stations attached.


3

Molds and extensions.


4

Bow stem mold.


5

Stern stem mold.


6

Bending stems on stem molds.


7

Stern mold mounted on strongback.


8

Batten mounted on station molds.


9

Laminated stems.


10

Internal stem mounted on bow stem mold.


11

Internal stem mounted on stern stem mold.


12

Planking hull.

were in line. I used a batten to adjust the height of the molds so that they were in vertical alignment (Fig. 8).

The hull was built first, upside-down. Since I was building my kayak without a kit, I had to purchase 1" x 6" x 18' cedar boards, cut them into ¼" strips and used a router on the edges—bead on one edge, cove on the other. The internal stems were made out of cedar, bent around the stem molds, and then laminated with epoxy (Fig. 9-11). I chose cedar because it's lightweight. The external stems were bent around the internal stems. I used Jatoba (Brazilian cherry) for these, which is very hard and inflexible. This, I cut into ⅓₂" strips, and laminated the pieces together. For speed, I could have nailed each strip to the molds, but I only did that with the first strip.

I squeezed wood glue onto the cove edge of the first plank and used scrap pieces of cedar to hold the next plank in place (Fig. 12). The planking would have gone faster if I'd used nails in each plank, but the nail holes would have shown through the fiberglass and epoxy. Instead, I held each plank in place using a c-clamp at each mold. I could only attached one strip at a time to each side of the hull, and then wait for the wood glue to set before removing the clamps and gluing on the next strip.

It's important to note that after gluing a strip, any wood glue that squeezes out must be washed away with a wet rag or the epoxy won't penetrate the wood at those locations when you add the fiberglass. With all the strips glued into place, I attached the external stems and trimmed them to shape.

Using WEST SYSTEM 105 Resin® and 207 Special Clear Hardener® (Fig. 13 & 14), I applied 742 6 oz. fiberglass cloth. Once cured, I turned over the hull. The deck was built in the same manner as the hull (Fig. 15 & 16). In retrospect, I could have gotten by with 740 4 oz. fiberglass on the hull, making it lighter.

After applying 4 oz. fiberglass to the deck, I lifted the hull off and removed the molds (Fig. 17). My next steps were fiberglassing the hull interior and deck, and epoxying the deck onto the hull. Using a saber saw, I cut out the cockpit and hatch, and completed their construction using laminated pieces of ⅛" mahogany plywood (door skins), finishing them with walnut veneer (Fig. 18).

The final construction step was attaching a walnut shear. I selected walnut for protection in case I rubbed up against something, and also because it's the same wood species used for trim on other parts of the kayak.

To finish the strip kayak I applied nine coats of Cabot® Gloss Coat Spar Varnish with UV inhibitors, sanding lightly between each coat.

The strip kayak's final weight was just under fifty pounds. When it came to purchasing a seat, I discovered that kayak companies wouldn't sell me one. I bought one from a local company that rents kayaks, which had been removed from one of their old rentals.

The worst aspects of building a strip kayak were not being able to fit my car in the garage until the boat was finished, and needing to varnish out the scratches every year. The best parts were the feeling of accomplishment and the admiring comments I received.


13

Fiberglassed hull.


14

Hull upright - ready to plank deck.


15

Deck sanded.


16

Deck fiberglassed.


17

Molds removed.


18

Veneered cockpit and hatch.


19

The finished kayak.

Maximize Your Safety when using Disposable Gloves

By Glenn House – GBI Director of Product Safety and Regulatory Compliance

Most epoxy systems can cause skin irritation or allergic skin reactions. Hardeners can be particularly severe skin irritants and sometimes can even be moderately corrosive to skin tissue. Consequently, you should always protect your skin from epoxy with protective clothing and gloves.

Disposable gloves are the most convenient and economical hand protection for use with epoxy, but they do have limitations. One challenge is finding the right disposable glove that will stand up to the chemicals in both the resin (Part-A) and the hardener (Part-B). Both resins and hardeners have components that attack glove materials differently and at different rates.

Your typical 4-6 mil thick disposable nitrile, neoprene, butyl rubber, natural rubber, or latex glove can withstand up to 30 minutes of working with epoxy before it degrades. When the gloves begin to degrade, epoxy chemicals can permeate the membrane and reach your skin. For longer jobs, replace used gloves with a new set before the 30-minute mark. These types of gloves offer the suggested protection for general epoxy use, based on tests and data provided by chemical and glove manufacturers. WEST SYSTEM® offers a neoprene 4-mil disposable glove, part numbers 832-4 and 832-50, that works well for these quick jobs. Other disposable glove materials, such as vinyl and polyvinyl chloride (PVC), degrade faster when exposed to epoxy and allow chemical breakthrough to occur quickly.

In addition to material, breakthrough rates are determined by the thickness of the glove. The thicker the glove, the longer it will take for breakthrough to occur. Keep in mind that breakthrough and degradation can occur with the recommended glove materials, but it will take longer to occur. To date, there is no "all-purpose" disposable glove that will withstand exposure to a wide range of chemicals, be durable enough to last a long time, and still be thin enough to provide the desired dexterity.

By knowing what to look for in proper hand protection, and using these guidelines to wearing gloves effectively, you will be able to work safely with epoxy.

Disposable Gloves Guidelines

The following guidelines can be used to provide the best hand protection while using disposable gloves:

1 Protective Barrier

Use a protective barrier cream underneath the disposable glove to provide secondary protection in case a glove should tear or puncture. You should not depend on the barrier cream to provide primary hand protection by itself.

2 Double Layer

Double layer your disposable gloves. This will ensure you always have an uncontaminated pair underneath. Periodically (every 20-30 mins.) replace the top glove before it degrades or gets damaged. You can use cotton liners under liquid-proof gloves to absorb sweat and add comfort.

3 Replace Gloves

Replace gloves carefully. Carelessly removing and re-donning gloves can cause additional, unnecessary epoxy exposure. The most common technique is to peel the gloves off inside out, one at a time, being careful not to contact the wrist area with a contaminated glove.

4 Dexterity & Sensitivity

Disposable gloves are favorable for projects where dexterity and fingertip sensitivity are necessary. Conversely, for longer projects, where gloves may be immersed for an extended period of time, and where dexterity is not as crucial, a thicker glove may be the right choice. This is especially true if you can't change your gloves frequently.

5 Try Different Materials

It is well known that materials used in manufacturing latex gloves can cause allergic reactions in certain individuals. If this affects you, try using a nitrile, neoprene, butyl rubber, or natural rubber disposable glove instead.

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. They are also available as **free downloadable PDFs at westsystem.com.**

How-to Publications

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. Also, procedures for gelcoat blister diagnosis, prevention and repair, and final fairing and finishing.

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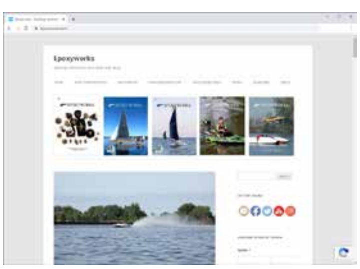

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EPOXYWORKS® | Readers' Projects

Jeff Hobgood used WEST SYSTEM 105 Epoxy Resin and 207 Special Clear Hardener to epoxy the mahogany veneer to the steel panels on his customer's '48 Packard. "I used the epoxy to vacuum bag the veneer to the steel panels before placing them back inside of each door and the tailgate. I also used G/Flex in some of the joints to make them strong. The technical advice on what products to use for my project helped make my project a success, as you can see in the photo."

Phillip Delaney worked from 1982 to 1987 restoring his Thistle sailboat, Osprey, with WEST SYSTEM Epoxy and assistance from our technical service. "Don't know how I would have ever restored #376 without you. Epoxy changed my life."

Brian Burns makes traditional Spanish guitars, using WEST SYSTEM Epoxy at several points in their construction. "I vacuum-bag laminate my three-ply sides, filled the pores of open-pored woods (like rosewood, Spanish cedar, and mahogany), and epoxied on fingerboards with it. WEST SYSTEM is also used for other little jobs like adhering back joints and inlays."

Larry Anderson carved this full size 1932 ford 31 years ago and his product has NEVER failed. NOT ONE piece of wood has ever come apart.

After building a canoe and paddle board, Rich Amy of Eden Prairie, Minnesota needed a new challenge. He built this 14' teardrop camper in his garage. The outer skin is redwood and Baltic birch with fiberglass and WEST SYSTEM Epoxy.

Michael Stendzis built a 14' Seneca Pacific Power Dory from plans between May 2019 and July 2021. In her construction, he used copious amounts of WEST SYSTEM Epoxy. "The process was incredibly fun, with lots of challenges to figure out as I went. I had never completed a woodworking project of this scale before. The boat is a plywood on frame design, wrapped in fiberglass/epoxy and paint. She is named Camilla C as a tribute to my beloved grandmother."

Share your work and fuel your creativity

Submit your projects at info@epoxyworks.com