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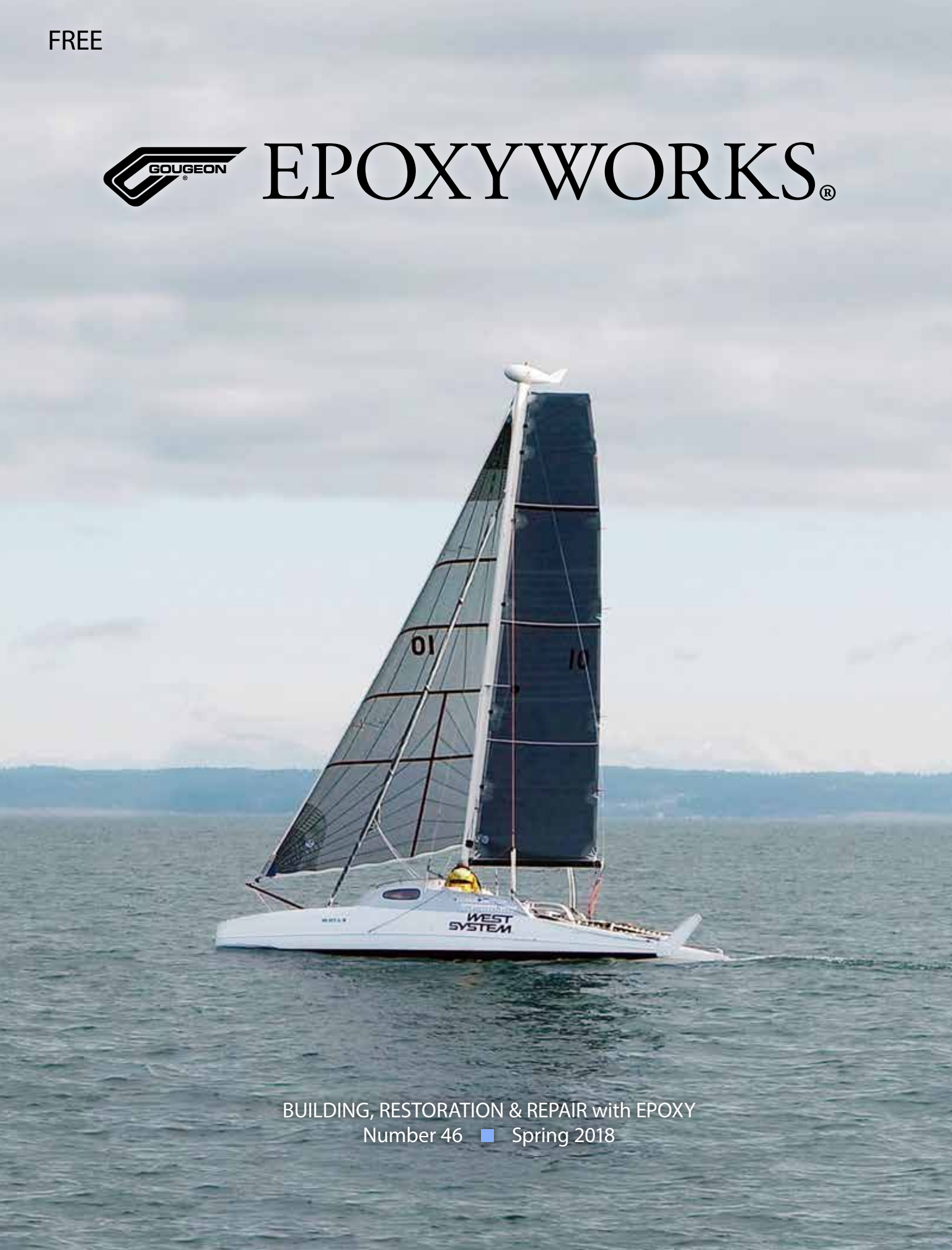

BUILDING, RESTORATION & REPAIR with EPOXY

Number 46 ■ Spring 2018

EPOXYWORKS®

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Browse back issues or look for specific topics.

The cover photo and photo to the left are Russell Brown's refit G-32 catamaran.

G-wiz!

Russel Brown's New Toy

By Russell Brown

The work of the Gougeon brothers has been like a guiding light to me starting when I was a young teenager. It wasn't just the methods and skills they developed that inspired me (and led to my career in boatbuilding), it was the "outside the box" thinking about boat design they employed. While Meade Gougeon led the effort to develop and teach epoxy skills and building methods, it was his brother Jan who had the courage to design, build, develop, and race boats that were very unusual and often counter-intuitive, yet very successful. Jan's G-32 catamaran is an example of his genius.

How do I know about this boat? I own one. After being intrigued with the G-32 for 20 some years, I bought one. I overhauled and built a new rig for the boat and then raced it in the 2017 Race to Alaska. The R2AK is a 750-mile race from Port Townsend, WA to Ketchikan, Alaska. The race was somewhat trying for me because I had spent so little time sailing the boat before the start and had some issues with the new rig, but I still managed to keep the boat on its feet and knock almost 4 days off of the single-handed record.

I have had a lot more experience on the boat since the race (including sailing the boat back from Alaska with my wife, Ashlyn). I have grown to have much respect and affection for it.

What is so different about the G-32? It is a road legal (8 ½' wide), 32' long trailerable catamaran. It's the same width as a Hobie 16, yet twice as long. It trades initial stability for efficiency. The boat is very aerodynamic and has incredibly slender hulls, so the tiny rig pushes the boat at competitive speeds.

The boat is tippy, yes, but it has a very effective water ballast system which is filled and emptied with control lines on each side of the cockpit.

Looking down one of the hulls of the G32.

The masthead float was redesigned to be a bit smaller and more aerodynamic than the stock G-32 float. The float was built with S-glass and epoxy because a large radar reflector would be mounted inside. The fiberglass is transparent to radar as opposed to carbon fiber.

In total, the new masthead float weighed 4.5 lbs. which is approximately 2.5 lbs. less than the original.

Around-the-boom reefing for the mainsail and a furling jib make controlling power very easy and the boat is quite capable in wild weather.

The G-32 is self-righting. If capsized, a masthead float that doubles as a wind vane keeps the boat from going upside-down, and the boat is righted by canting the rig with the running backstays. There is some rigging and work involved, but it takes less than five minutes to right and only one's ankles get wet.

The launching, retrieval, set-up, and break-down of this boat are in a class to themselves. The mast raises and lowers in literally just a few minutes using the boom as a jin pole. The entire set-up and launching can take as little as 15 minutes and a 12-year-old could do the work involved.

The feature of this boat that I marvel at the most: It is dry. There are conditions when a lick of spray may come aboard, but usually, only a few droplets ever make it into the cockpit. The dryness is obviously not due to freeboard or flare, so I attribute it to extremely fine entries and a designer who had the courage to try something really different.

Gougeon Brothers, Inc. produced 14 of these innovative boats in the 1990's. They were molded in foam, fiberglass, and a predecessor of Gougeon's PRO-SET Epoxy, a very popular laminating epoxy currently used in building all types of composite structures.

The G-32 was meant to be an affordable cruising and racing boat, but it didn't achieve large market success in the short time that it was produced. The boat had strong fans, myself included, and the sailing performance of the boat is remarkable. I think the main reason the boat wasn't more successful was that the boat wasn't well understood.

Re-building my G-32 showed me time and time again that every feature of this boat was done with purpose. Many of the features were integrated with one another so there weren't many things that

The boom is used as a jin pole to raise and lower the mast.

New rudders were built in two halves in CNC machined female molds. They were constructed using many layers of carbon fiber for the skins and a foam core with a large wooden shear web in the fattest part of the foil. They are a bit more modern (higher aspect) than the stock rudders and just over half the weight of the originals.

could be changed without affecting something else.

I did a fairly major overhaul of my boat. Some of what I did was related to it being an older production boat and some was related to wanting to strengthen and outfit the boat for the type of sailing I like to do. Much of the work is documented at Gougeon32@blogspot.com.

I built a new rig for the boat, which added a bit more power (the new rig is taller, but still shorter than the boat is long), and the new mast is a bit lighter and more aerodynamic. It's also stiffer which allows flying light air sails from the masthead without excessive mast bend.

Some complexity was added with the addition of the new rig, some was taken away as well (such as the masthead running backstays and forward diamond stay). Is the boat faster with the new rig? I don't know. I do know that the boat can take a terrible thrashing and come out smiling.

Crossing the straights of Juan de Fuca recently while returning from a race, I had to sail upwind in gale conditions. With the jib rolled in and the mainsail heavily reefed (which can be done in less than a minute) the boat becomes quite controllable and stable. It will tack easily, point very high, make respectable speed, and stay very dry. The boat will heave-to by merely easing the main sheet. The jib can be rolled out in seconds to increase power in the lulls. To say that this was an easy crossing would be stretching the truth, but I made it across with daylight to spare and no damage.

Re-building my boat (sail number 10) was fun and I have learned a huge amount from the process. Building parts has been the most fun and I'm hoping to document some of these parts in future articles of *Epoxyworks*.

Above: The G-32 gelcoat has been chipped off, the low areas filled and then faired with long boards. The whole boat was coated with 105/207.

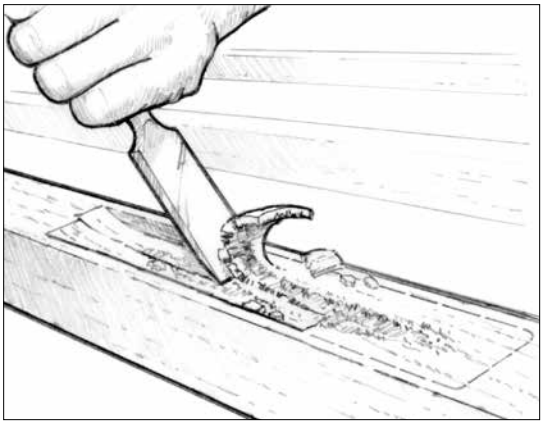
Left: The boat was lightly sanded before being painted.

Wooden Window Repair

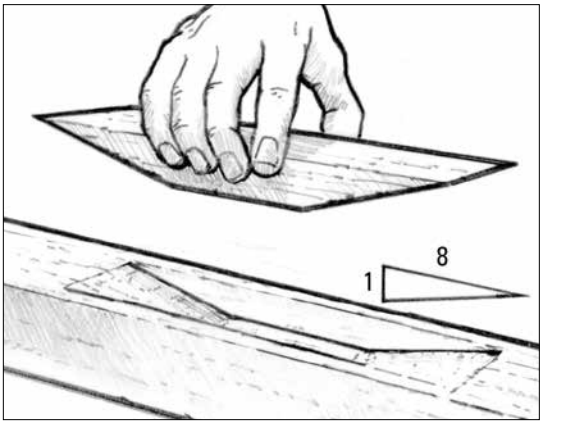
By Tom Pawlak

Wooden windows frequently become weathered and develop rot due to their constant exposure to the elements. Often times repairing a wood window is much faster, cheaper and more aesthetically pleasing than replacing it. Over the years we've been contacted by architects in search of instructions on how to repair this kind of damage using WEST SYSTEM Epoxy. The following method is what we share with them to restore weathered wooden sills, sashes and trim:

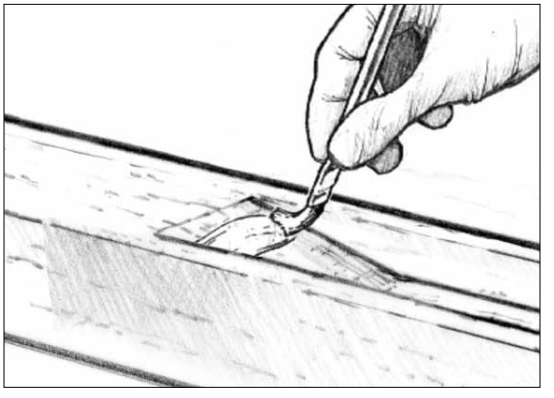
- Remove all the paint in the affected areas.
- Expose clean wood by opening up cracks and splits with a saber saw blade, broken hack saw blade, scratch awl or the tip of a pocket knife.
- Excavate rotted material and remove all loose, compromised or weathered wood fibers with a stiff hand-held wire brush worked parallel to the grain in the wood.
- Dry the surrounding area.
- If the cavity is more than ½" deep and a ¼" wide cut and fit a wood plug to fill the bulk of the cavity. Alternatively, gaps can be filled with thickened WEST SYSTEM® 105 Resin mixed with 206 Slow Hardener or 209 Extra Slow Hardener. Use 105 Resin with 205 Fast Hardener if working in temperatures at or below temperatures of 60°F (16°C).
- Care must be exercised because epoxy generates heat (exotherms) if applied in mass. Applying too much at one time will cause the epoxy to exotherm and smolder or in an extreme case, it can generate enough heat to catch fire.
- Follow the working temperature guidelines in the WEST SYSTEM Epoxy *User Manual & Product Guide* (available online at westsystem.com) when selecting hardeners for the job.
- Coat the immediate area, the excavated cavity and wood plug with unthickened WEST SYSTEM Epoxy. Keep brushing the epoxy on until the wood will not absorb anymore. It will take multiple applications on the end grain to completely fill the pores.
- Thicken the epoxy with one of the high-density fillers (406 Colloidal Silica, 403 Microfibers or 404 High-Density Fillers) to a mayonnaise consistency and apply it to the cavity.



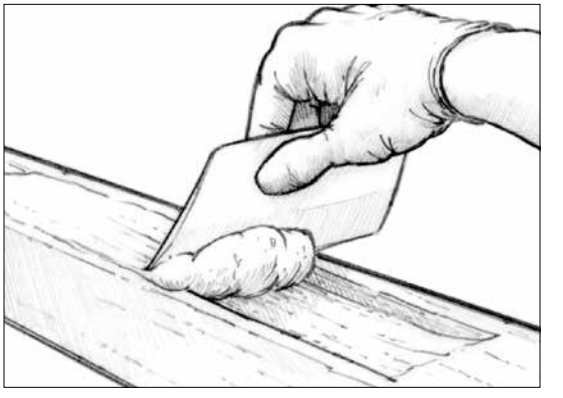
Excavate all rotted, loose or compromised material from the repair site.



Ideally, the excavated area should be filled with a wood plug shaped to a similar size as the cavity. Adhere the plug with thickened epoxy.



Coat the cavity with unthickened epoxy until the pores are completely filled.



If it is not practical to fill the cavity with a wooden plug, it can be filled with thickened epoxy. Choose a slow hardener that will generate less heat.

- Press the wood filler piece (if any) into the thickened epoxy displacing much of it in the process.
- Clean up any excess epoxy.
- Allow the epoxy to cure until it becomes tacky.
- Apply epoxy thickened with 407 Low Density or 410 Microlight (mayonnaise consistency) to fill in any remaining low spots.
- Allow the epoxy to cure.
- Sand the low-density epoxy smooth and flush before applying a good, fast drying wood primer. The following primers have worked reliably over WEST SYSTEM Epoxy:
    - Cover Stain Primer/Sealer made by Zinsser
    - Bulls Eye 1,2,3 made by Zinsser
    - Flash Bond 400 made by XIM
    - Fresh Start, an acrylic-modified latex primer made by Benjamin Moore
    - Alkyd based oil paint primers can be used over WEST SYSTEM Epoxy but they will dry slowly unless they are applied sparingly.

  If you want to avoid sanding the epoxy, you can apply certain fast-dry house paint primers while the epoxy is still partially cured (rubbery). All of the previously listed primers can be used that way except the Alkyd based oil paint.

If you are restoring window frames, remove all the window glass and paint in the glass glazing areas. Abrade the surface with sandpaper or with a sharp wire brush and apply a coat of unthickened 105 Resin/Hardener to seal these surfaces and protect the wood from moisture absorption. Allow the epoxy to cure before sanding lightly and resetting windows in glazing putty.

Refinishing a wood strip canoe

By Tom Pawlak

About 30 years ago, I built an 18' wood strip canoe. At the time, my family was young and I could only work on it intermittently. Over the course of six months, I had faired my mold frames, applied the redwood strips, faired the outside of the hull with a keen eye and applied the fiberglass cloth. Two months later I decided to take it off the mold to fair and fiberglass the inside. To my horror, the exterior hull bottom had a big dimple in the middle when removed from the forms. I immediately knew the cause. The humidity in my garage had skyrocketed since the outside of the hull was finished with fiberglass and epoxy. The unsealed inside of the hull had probably gained 4-5% in moisture content since the outside was fiberglassed.

I quickly re-attached it to the mold frames and forced it back to shape. Using small brad nails I attached the edges of the hull sides at the shear to each frame. I secured an industrial heat gun to the cement floor under the mold, pointed it straight up toward the inside of the hull, turned on its lowest setting and came back several hours later to check things out. A significant portion of the oil canning was gone, so I moved the heat gun fore and aft to get the shape back in those sections as well.

Over the next couple days, I faired the inside of the hull then placed it back on the mold frames to make sure everything looked good. Thankfully it

Tom's canoe hanging in its place of honor in the tech shop.

Localized coats were applied only to the low spots on the bottom of the canoe to build up the thickness.

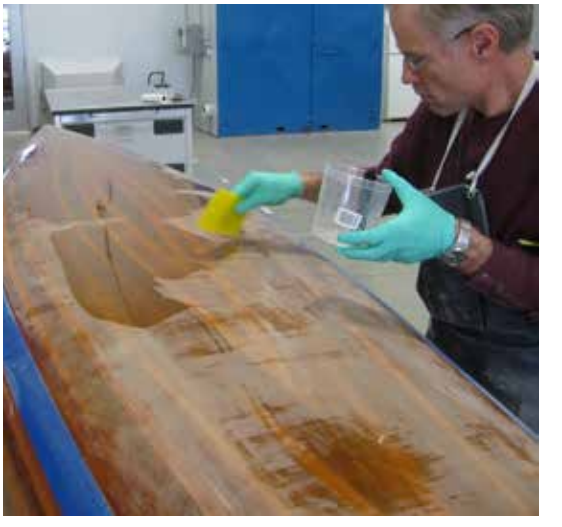
did so I took it back off and fiberglassed then faired the inside again.

On the outside I rolled a couple more coats of clear epoxy on a few subtle low spots, let it cure, long boarded it and applied a coat of two-part polyurethane clear. For 28 years the boat looked great.

A few years ago I decided to refinish the hull bottom with a couple coats of Z-Spar Captain's® Varnish 1015. In preparation for that, I once again long boarded the hull to identify any subtle low spots. What I discovered was I had low spots but they were more than I would call subtle. The low spots had a pattern to them. There was a low spot centered every 16 inches along the mid-section of the hull. I laid a fairing batten on the hull centerline and the batten touched the hull at each of the locations where the strips were originally held to the temporary mold frames.

Now refairing the bottom with epoxy fairing compound would be easy to do but I wanted the hull to remain clear. This meant I could not use epoxy fairing compounds because it would hide the wood grain. So I taped off the perimeter beyond the low spots and sanded the surfaces dull. Because it would require several coats of WEST SYSTEM 105 Resin and 207 Hardener to fill the low spots I added a bit of G-5 Five Minute Epoxy to the mix. This helped the clear 105/207 epoxy to gel sooner which allowed another coat to be applied an hour later.

After applying multiple localized coats and letting it cure, I got a long metal straight edge out to make sure the low spots were indeed filled. The results looked promising. The real proof though



Top: Multiple fill layers were applied to the low spots on the bottom of the canoe.

Bottom: After sanding with a long board there were still some shiny patches like is shown in the lower right indicating a low spot that still needs filling.

would be after fairing with a long board. Any low spots would be indicated by shiny epoxy where the sandpaper did not abrade the surface. In fact, there were a few more subtle lows that required another coat of epoxy or two to bring them into the fold. I applied two coats of Captain's Varnish and I must say the hull outsides look as good as new.

The canoe has been hanging on the wall in our new tech shop for a couple years since the hull exterior was refinished. The inside of the hull looks a bit drab in comparison since its clear top coat was applied 30+ years ago when the hull was new. I'll be retiring in the spring so I think it's time to get the inside prettied up and ready for an adventure.

Meade A. Gougeon

September 25, 1938–August 27, 2017

"The wind is coming up. Tell the boys they can commence with the race."

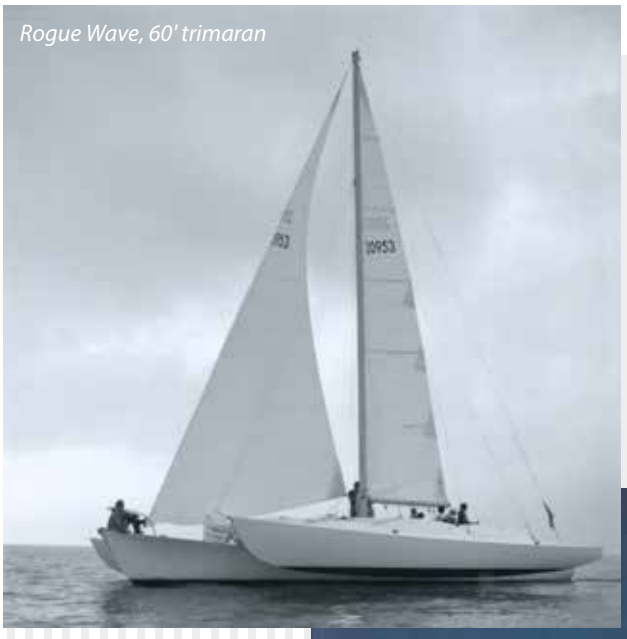
Fittingly, these would be the last words of Meade A. Gougeon as he watched a fleet of sailboats, including his trimaran *Adagio*, assembling for the Great Lakes Multihull Regatta in front of his home on the Saginaw Bay.

Meade, along with his brothers Jan and Joel, founded Gougeon Brothers, Inc. in 1969. The brothers pioneered the use of epoxy in boat construction and repair. They got their start building DN class iceboats with wood and epoxy.

By 1973, the brothers' small boat shop in Bay City, Michigan was the largest builder of iceboats in the United States. Even so, in 1974 they sold the DN portion of their business to focus on soft water boats and WEST SYSTEM®.

In 1971, Meade launched *Adagio*—the first large, all epoxy bonded and sealed wooden boat built without the use of fasteners. He'd built her with his brother Jan in just six months. She's been sailing on the Great Lakes ever since, winning the Bayview Mackinac Race in 2000, 2002, 2006, 2016 and 2017. *Adagio* is proof that fully bonded monocoque structures can be built not just to last, but to be serious competitors for generations.

In 1979, Meade wrote *The Gougeon Brothers on Boat Construction*. This boatbuilding guide details composite construction techniques using wood and epoxy. It remains a favorite resource for professionals and first-time boat


Rogue Wave, 60' trimaran

Adrenalin, 40' trimaran

Slingshot, 60' proa

builders, and is often used as a textbook in boat building programs.

A few of the notable wood-epoxy boats built by GBI include the Ron Holland-designed two-ton monohull *Golden Dazy* which won the 1975 Canada's Cup; the 60' Dick Newick designed trimaran *Rogue Wave*; the Georg Thomas-designed proa *Slingshot* which was clocked at speeds of over 40 MPH; *Adrenalin*, a Formula 40 trimaran of wood, epoxy, and carbon fiber; the Gougeon 32 production catamarans including *Incognito*, which, skippered by Russell Brown, finished first in the solo class in this year's Race to Alaska.

Aboard the outrigger canoes *Voyager* and *Elderly Care* respectively, he placed first in his class in the grueling, 300-mile Everglades Challenge in 2014 and 2017. He raced iceboats with the International DN Ice Yacht Racing Association for several decades, winning the US Championship in 1981 and 1997. He was inducted, along with his brother Jan, into the National Sailing Hall of Fame in 2015.

Always a positive force in his community, Meade served on many local non-profit boards and was a local philanthropist.

Adamant that GBI should remain a robust company in his absence, Meade went to great lengths to assure that the next generation of management and employees were prepared to succeed him and his peers. Because he laid the groundwork for his succession, the company remains focused on servicing our customers, community and industry.

It was Meade who came up with the idea for *The Boatbuilder*–the predecessor of *Epoxyworks*–in 1977. Meade believed in sharing everything we learned along the way about epoxy, chemistry, materials testing, best practices in the shop, design, construction, and repair techniques and approaches.

We thought it would be appropriate, and really cool, to republish *The Boatbuilder 1* July/August 1977. One of Meade's proudest achievements is this publication and he marveled at how *Epoxyworks* evolved over its 41 years in continuous print.

If Meade could say it himself he would thank all of you, our *Epoxyworks* readers, from the bottom of his heart. In his absence, we, the Employee Owners of Gougeon Brothers, Inc., offer you our sincerest thanks.

Alan R. Gurski
President

Railroad Repair

By Bruce Niederer

"It takes a lot to laugh, it takes a train to cry. . ."

-Bob Dylan

I received a call out of the blue from an old sailboat racing friend, Gary Plezia, who is now the owner and founder of Southern National Track (SNT) which he began after leaving Conrail in 1996. SNT is a regional company based in Florida certified and licensed in the southeastern United States from Texas east to South Carolina. SNT specializes in building and maintaining railroad tracks and complex switches, track beds, gradings and drainage, crossings, signals and platforms as well as crane rails for ports and industrial clients.

We got talking about his business and Gary mentioned he uses WEST SYSTEM® 105/209 thickened with standard big box store high strength grout blended in a concrete paddle mixer until the epoxy/grout mixture reaches a flowable viscosity much like jar honey. Gary told me "Other industrial epoxies I can use for this process cost about the same, but the primary reason I use WEST SYSTEM Epoxy is due to the range of hardeners and cure speeds for these deeper pours. I could not get away with making a series of 3" depth pours with anything else out there. To my knowledge, and 46 years of RR track construction experience, I am the only one in the industry making concrete RR Crossing repairs in this manner! I have some repairs where we used this technique and they are 15 years old now and still going strong". He proceeded to share some of his typical projects.

Left: Reinforcing was added to brace the rails. The grout pour is at 5" deep.

Above: The pour at 75% total depth.

Broken Ties on a Sharp Turn

The steel ties originally suspending the rail in a solid concrete pour, now about 15 years old, were found to all be broken once the concrete was jackhammered away. The broken ties in this sharp 17-degree turn allowed the rails to spread apart. As a result, before repairs could be scheduled, the rail broke apart expanding the repair area to an 80-foot section. The trench was widened using a 90# air chisel plus deepened about 4" under the steel ties. The removed concrete was replaced with the epoxy grout to a total depth of 11"–12".

The large photo on the opposite page shows the pour at about the halfway point—about 5" deep. We can see the extra rebar being added at this point parallel to the track. The square bars running perpendicular to the track are 2" solid bar steel fabricated by SNT that function as additional bracing between the rail and the concrete side wall. This is all then buried under the epoxy/grout mixture.

In the inset picture on the opposite page, we see the rail replacement with pour progress at about 75% of the final depth. Notice the 2" perpendicular braces are now buried under the epoxy grout and another run of rebar has been added. The silver bolts sticking up through the epoxy grout were improvised on site to suspend standard rail tie bearing plates added every 24" to give the rail additional load-bearing capability within the grout.

This gravel mine RR crossing operates 24/7 with trains and thousands of dump trucks crossing it daily. The locomotives alone that operate on this 17° curve weigh 300 tons. This repair has been in operation for about 10 months and the epoxy grout is performing perfectly.

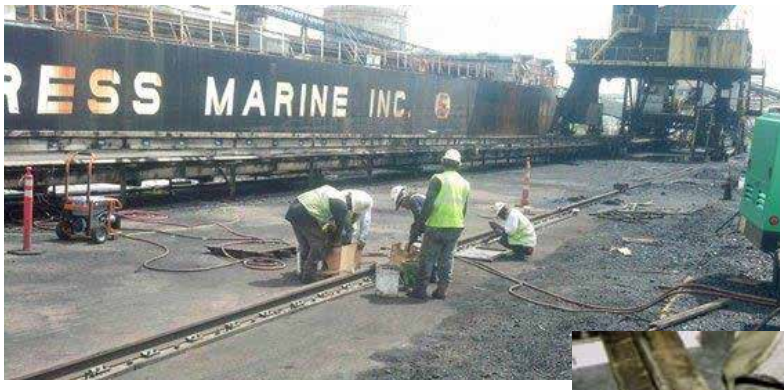
This project was originally supposed to be only a 40-foot section but once the damage already described was discovered the project doubled in scope to 80 feet of the rail section. The SNT crew had planned to use 2 drum kits of 105/209—which would now not be even close to enough epoxy. They ended up emptying every West Marine store from Homestead to Ft. Pierce, FL of their 5 gal. C-group kits—30 in all! Their efforts paid off—the job started on a Friday and was completed Sunday evening and trains were running on it Monday morning.

Coal Pier Crane Rail

In the top right photo, a SNT crew installs a new crane rail at a power company coal pier. A very large excavator type of coal "scooping" machine (seen in the background) that unloads 160' coal barges and runs on 2 crane rails spaced 40' apart.

SNT employs a 12" wide continuous steel bearing plate that is first epoxy pinned to the concrete pier. They set forms 1" beyond each side of the rail bearing plate and pour in epoxy grout 2" thick until it flows up evenly onto the opposite side. The epoxy grout is known to expand about 4% with curing which nicely snugs up the bearing surface under the steel plate as compared with cementitious grout that shrinks 4% with curing often leaving voids.

The inset in the upper right, from a different job, shows what was happening in the preceding photo—but it happened in the cement pier, not on top of it like this particular job. Here the rail and individual steel bearing plates are suspended above the floor and the epoxy grout is poured into the wood frame to the bottom of the bearing plate. This is for an indoor crane runway at a steel company.



A new crane rail being installed at a power company coal pier.

Epoxy grout is being poured into the wooden frame.

Port Crane Rail

This project involved a Port crane rail replacement. The base plate supporting the rail was cast with epoxy grout 2" thick. The owner specified a 12 kpsi load bearing for the grout and this was easily met using the SNT system.

It's always interesting to me learning about the various ways people think outside the box using WEST SYSTEM Epoxy for unique applications.

Now back to that Dylan song—

"Well I ride on a mail train baby, can't buy a thrill…"

SNT replaced this port crane rail.

Reader Projects

Illinois Institute of Technology

Students at IIT designed and built this Baroque inspired sculpture named The Iron Chapel. The intent of the project was for students to explore the principles of the baroque era through the use of modern materials.

The primary inspiration for the chapel was the dramatic lighting created by the architecture of the period. To achieve this drama in their structure the students built panels that they assembled into columns which connect at the top to create a triangular profile. The positioning of the overlapping panels create apertures that allow light to pass through the walls of the structure supplementing the light from the oculus in the above. The shifting perspective of the viewer gives the structure a life of its own.

The use of carbon fiber allowed them to explore form, work with a singular material, and have a lighter weight and therefore more manageable fabrication process.

The Iron Chapel on display.

A detail view of the overlapping carbon panels.

Above: Students build the individual carbon panels .

The panels are being assembled into columns.

A 1/4 scale model was built before the full scale structure. This view is from the inside looking up into the oculus.

The Wright Edge

Doc Wright is the owner/craftsman of The Wright Edge, an artisan woodworking business in Dallas, Texas. From start to finish, each piece is handled by only Doc or his business partner including sourcing/cutting down, milling and drying. He uses locally sourced, 100% regionally native wood.

Doc Wright
512-203-2482
RevealYourGrain@gmail.com

Lagoon

Species: *Walnut*

Age: *~175-200 years old*

Harvest Location: *Livingston, Texas*

Description: *Black Walnut slab that was freehand routered out to give 4 layers of depth. Then these contours were then filled with different shades of WEST SYSTEM Epoxy colored turquoise to give it 3D depth. This piece was designed and made for Dallasites101.*

Drifting

Species: *Spalted Pecan*

Age: *~150 years old*

Harvest Location: *Red Oak, Texas*

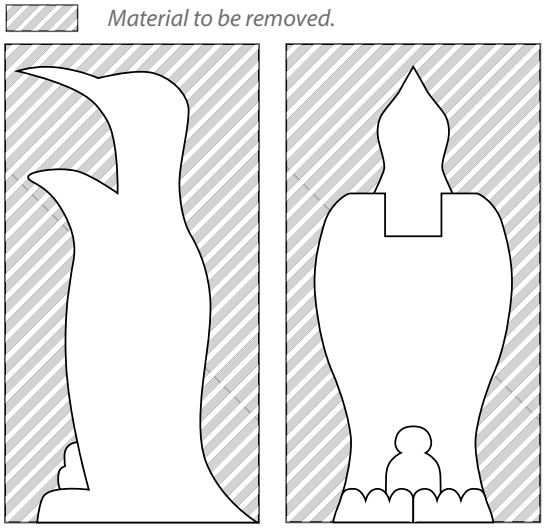
Description: *Two Spalted Pecan slabs cut diagonally, then very carefully encased in clear WEST SYSTEM Epoxy to flow with the grain in a diagonal direction to appear as if it's drifting. 3 out of the 4 corners are clear WEST SYSTEM Epoxy and the 4th corner is a corner piece of Pecan. It truly has a one of a kind feel.*

A Penguin in Iowa?

By Ryan Krafka

I first got the idea for this project driving through a neighborhood in Iowa City where my wife and I live and work. "You have to see this awesome mailbox," I said to my wife as we drove through a neighborhood one day this past fall. There it was, a dolphin mailbox. Not just a mailbox with dolphins painted on it, but an honest to nature fiberglass dolphin with fins holding a mailbox beneath its head. I said to her "You know darling, our mailbox is looking a little lack luster these days, wouldn't it be cool if we replaced it with something like that!?" A few days later we surfed the web for dolphin mailboxes, and nothing came up remotely close to what we had seen. We got to thinking, why not build it? And why not build a penguin instead of a dolphin? We live in Iowa after all, it's equally, if not a little less outrageous to see a penguin than a dolphin, is it not?

As it happens we had just replaced the Styrofoam lid on our hot tub the week before, so we were flush with expendable material begging to be recycled. Also, I have an engineering degree dealing with composite materials (carbon fiber/fiberglass), a shop full of woodworking tools, and the bohemian artistry and audacity to pull off an eccentric project like this. Not to mention my dad and my extensive collection of WEST SYSTEM Epoxy that we both have used on many projects throughout the years at our home shops. To say the least, I was ready to dust off my knowledge of hands-on composites and put it to good use for our US postal system.



Ryan's initial outline applied to the Styrofoam block before roughing in the penguin's shape.

I began by cutting the Styrofoam hot tub lid into roughly 2 ft. by 2 ft. square pieces and gluing them with PL200 caulk into a big block formation about 5 ft. high. I grabbed my stick welder, which must weigh in excess of 100 lbs., and placed it on top for "clamping" pressure overnight. The next day I had a big block of Styrofoam ready to carve. I outlined the 4 sides of this block with what I envisioned a mailbox holding penguin would look like. Donning my personal protective equipment, I set about the foam first with a saber saw, then a diamond bladed angle-grinder, and lastly sandpaper. After a few days of finicky sculpting and excessive sanding, I was happy.

Dry fitting the mailbox form into the shaped Styrofoam mold.

The Styrofoam mold wrapped in fiberglass and epoxy.

The emperor penguin mailbox with chick in it's natural habitat.

Next was to wrap this curvy, edgy penguin with fiberglass and WEST SYSTEM Epoxy. Of all the techniques I've employed over the years, I decided it would be easiest and best to do a wet layup. The process involved painting sections of the penguin with epoxy from top to bottom and apply strips of bi-directional woven fiberglass into the wet epoxy.

I had purchased four 8 square foot sheets of fiberglass, leaving ample material to spare. I cut these sheets into various lengths of 2 in. strips, which I found easiest for wrapping. Over the course of 3 days, after work, I would mix up small batches of epoxy and apply it by brushing small sections of the penguin working from head to toe. I would then lay my strips of fiberglass in the epoxy, ensuring every square inch of fiberglass was properly wet out and adhered to the Styrofoam mold. I maintained a minimal overlap of the strips.

I considered using 205 Fast Hardener but opted for the slower 207 Special Clear Hardener to allow me plenty of open time each batch. It was tricky working the fiberglass over the feet and especially around the fins where the mailbox would be fastened. Having the extra working time proved beneficial.

After the fiberglass had been applied to all of the surfaces, I painted a layer of epoxy over the entire penguin to ensure cohesiveness before sanding. The next evening, using coarse 80 grit paper on a palm sander and a hand pad for finishing touches, I sanded over all surfaces removing small bumps, ridges, and excess epoxy. Noticing the penguin was far from streamlined, I decided to Bondo the slight dimples and shallow ruts that emerge from carving and sanding a stratified medium (i.e. glued Styrofoam stacks). Two nights of Bondo treatment and a significant amount of sanding later, the penguin was ready for painting. (Editor's note: WEST SYSTEM Epoxy blended with 407 Low-Density Filler or 410 Microlight Filler could have been used instead of Bondo for the final fairing coat.)

If you think about it, mailboxes must stand up to a punishing array of barrages. Extreme conditions are normal, especially in Iowa, where

Bondo was applied to fill slight dimples after fiberglassing.

The first "primer" coat applied to the faired surface.

The penguin chick nestled between the adult penguin's feet.

The embedded bolt for attaching the mailbox.

The final painted color scheme.

weather shifts can be mind-boggling from day to day. Rain, snow, ice, high winds, heat, humidity, scorching radiation from the sun, snow plows piling snow against the curbs each winter, two or more people opening and slamming the mailbox shut day in and day out… It's no wonder when you drive around towns it's hard to see a perfectly plumb and intact mailbox these days. I kept these factors in mind throughout designing and building, and those factors lead to the conclusion that WEST SYSTEM was best suited for the job.

Along this same line, I also decided to use three coats of thick oil-based paints. The first "primer" coat was white. I then sketched the dichotomous emperor penguin color scheme on and applied two coats of black and white paint, accordingly white around the belly and neck then black around the head, back, and fins. The next day my wife gave me some of her good paint brushes and I set about painting the more colorful accents of the emperor penguin and its chick. Emperor penguins are a household favorite of ours and I must confess their feet are not orange… I wanted more contrast down low and remembered the penguin's feet from Mary Poppins were both appealing and orange in color.

After painting, the last steps were to epoxy a bolt into the neck for attaching the mailbox, epoxy two marbles into its eye sockets, and lastly epoxy a treated wooden post 20 inches into the base of the penguin. My choice of epoxy for this was WEST SYSTEM Resin and Hardener mixed with their 403 Microfibers Adhesive filler to ensure full, secure bonds between the bolt, marbles, wood, and Styrofoam.

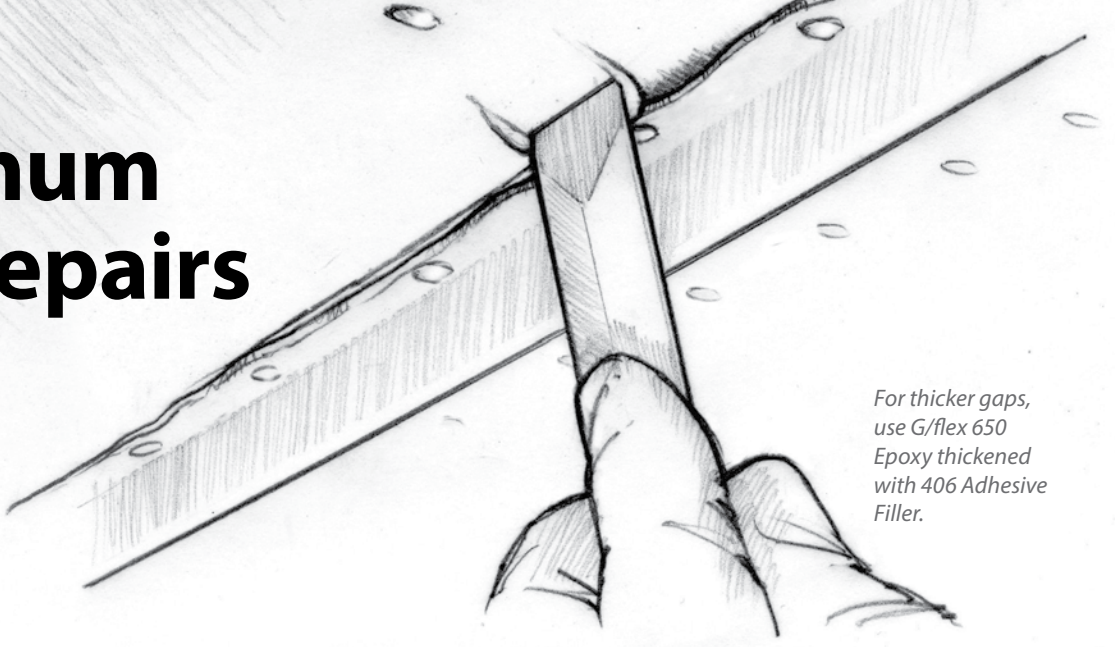
The penguin was finished just before Christmas and my wife, who had not seen it completed yet, was elated to receive it. After the holiday we tore down the old mailbox, dug/chipped a 30-inch deep hole in the not yet frozen ground, and cemented it in. A family member asked what we will do with it when spring and summer arrive… A pair of old sunglasses should do the trick!

This project was submitted by Ryan Roush-Krafka, founder of Krafka Kraft Inc. where he and his wife Jeanette design and build fine wood furniture. To see more of their beautiful woodwork, visit their website at krafkakraft.com.

Ryan's wife was elated to receive the penguin mailbox for Christmas.

Aluminum Boat Repairs

By Greg Bull



For thicker gaps, use G/flex 650 Epoxy thickened with 406 Adhesive Filler.

After developing the Aluminum Boat Repair Kit we have had calls from customers saying they have a larger boat and cannot easily turn it over as recommended to work on the seams and rivets. They ask "will this kit still work on my boat?" The answer is, yes, it will. It will be a little messier but will work the same way upside down or right side up.

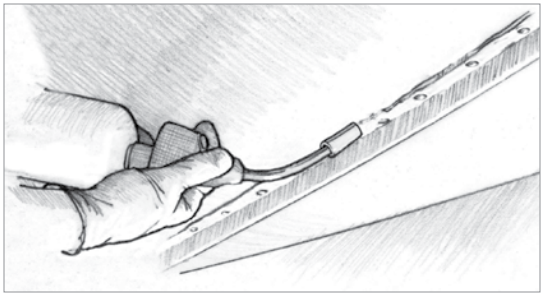
Start by identifying and marking where the leaks are. If possible, do the repair from the inside of the boat so gravity helps draw the epoxy through the leaking area. Working upside-down from the outside is possible, but be careful to prevent drips onto yourself or surfaces you don't want exposed to epoxy. Abrade the marked leaks until you get down to shiny, clean aluminum before starting.

Using G/flex 650, mix equal parts of resin and hardener then load it into an 807 Syringe. Warm the rivets and the seam using a heat gun or a propane torch for a 12" to 18" long section. Apply a continuous bead of G/flex along the seam and around the rivet heads. A second heat from the heat gun or propane torch might be needed to thin the epoxy allowing it to move along the seam and penetrate deeper into the seam and under the rivets. You should see the epoxy wick between the pieces of metal. Remember, the heat will shorten the working time and cause the epoxy to cure quicker. Be careful to not heat the epoxy to the point where it discolors or begins to smoke.

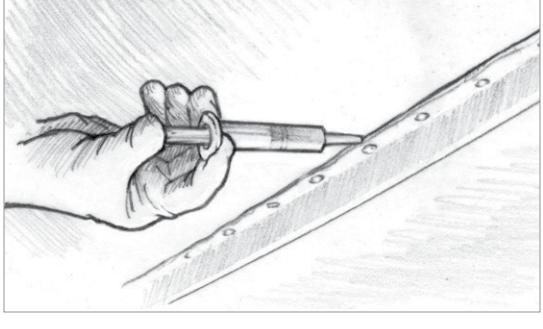
For larger gaps and loose rivets G/flex 650 can be thickened with 406 Adhesive Filler to a mayonnaise consistency, and then forced into gaps with a mixing stick or putty knife. A syringe filled with this thicker mixture can also be used to help force the mixture all the way to the back of gaps. When using a syringe for thickened epoxy it will be necessary to trim the tip back creating a larger opening.

Keep forcing the mixture into the gaps or seams until the epoxy is forced out the other side of the seam or gap. Thickened epoxy bridges gaps and won't drain out of seams while it cures. Wipe the uncured excess epoxy from both sides with paper towels. If needed use a solvent (lacquer thinner or acetone) sparingly to remove stubborn epoxy. Be careful to not wipe the epoxy out of the gaps.

Allow the epoxy to cure overnight at 65°F or warmer before using the boat. You can speed curing by applying moderate heat. Apply a spray paint like Rustoleum® All Finishes to match the aluminum or the existing paint color if desired.



Heat the rivets with a propane torch to allow the epoxy to penetrate the seam more easily.



Use a syringe to apply epoxy to leaking seams and rivets.

When you sight down the glue line between the laminations the lines should be straight. Humps or unevenness in the bevel usually shows up as a crooked line.

Joining Plywood

By Don Gutzmer

Many boat parts require plywood lengths greater than the standard 8 feet, so joining together two panels of plywood is an important step. The most common methods of joining plywood are the butt joint with backer block, the scarf joint and a hybrid between the two. Each method offers it's own distinct advantages and disadvantages in certain applications so it's important to be aware of each joining method.

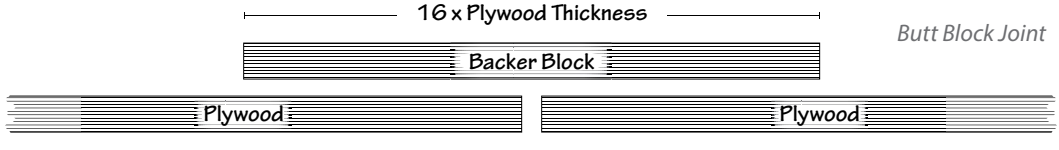
Butt Block Joint

A wooden butt block joint provides a simple way to attach two adjoining pieces of plywood together. A butt block joint is made by edge gluing two pieces of plywood together and adding a backer block to one side of the seam. The width of the butt block should be a minimum of 16 times the thickness of the plywood you are using.

Although a butt block joint is a fast way to join plywood together, it does have many disadvantages:

- Backer blocks create stress concentrations because "the block" is only reinforcing one side of the joint creating an imbalance.
- Exposed end-grain on the butt block is susceptible to moisture absorption unless it is coated with epoxy.
- The addition of more wood adds weight.
- Increasing the wood thickness on the glue joint adds more stiffness which creates a hard spot when the panel is bent around a curved form.

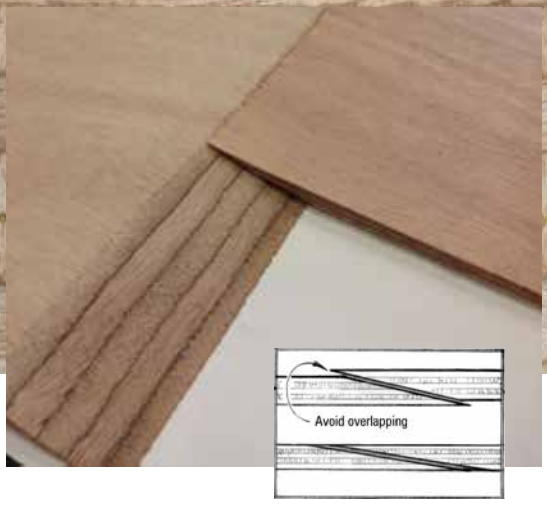
Depending on the application, a butt block joint may be adequate.



Butt Block Joint

Scarf Joint

Although there are several different kinds of scarf joints, we advocate using the simplest and most reliable approach, fabricating identical bevels at the ends of the pieces of plywood to be joined. Dry fit these matching bevels, and then



Scarf joints are tapered to reduce concentrated stresses. Avoid overlapping the pieces of plywood.

permanently bond them with WEST SYSTEM® Epoxy. In many boatbuilding situations, we recommend a ratio of 8-to-1 to determine the size of the bevel. For example, when using ½" (12.5 mm) plywood you need a 4" long bevel.

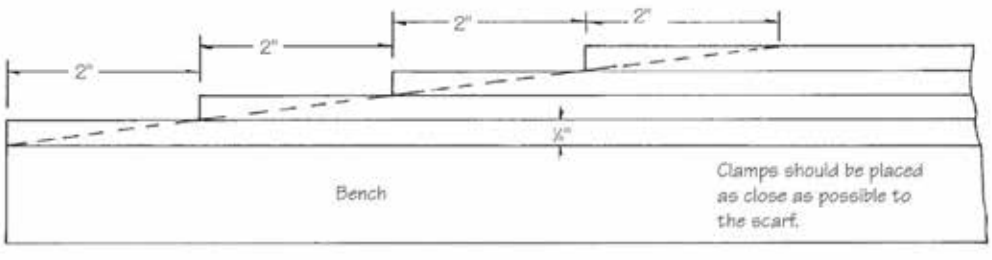
The advantage of scarf joints is that they are strong, lightweight, and reduce stress concentrations. In demanding situations, extra strength can be gained by increasing the length of the scarf and they are even less likely to produce a hard spot that could result in an uneven surface when bent. The disadvantage is that fabricating a scarf joint will take more time and skill compared to the butt block and also reduce the length of the plywood.

Making a scarf joint by hand, the basic tools require a block plane and a smoothing plane. Using a power plane or belt sander can save a lot of time in roughing the scarf bevel down close to its intended dimension, but without this luxury use a smoothing plane with a sharp, deep-set blade to remove a majority of the stock as quickly as possible. Then use a more finely set block plane to finish off the scarf bevel, being careful to keep the bevel straight and flat as you proceed. For best results keep the plane blades sharp at all times.

Multiple layers of plywood can be stacked and planed together.

If you have any unevenness on the scarf joint be sure to sand the surface with a hard and flat sanding block. The plane will lose its fine cutting edge quickly when you plane plywood due to the adhesive between plies. The lines created by the various plies in the plywood give a good indication of progress you are making when creating the bevel. Any humps or unevenness in the bevel usually show up as a crooked line when you sight down the glue line between the laminations.

You can save a good deal of time when hand beveling by setting up several panels in a stack for simultaneous block planing. For instance, assume that you want to plane bevels on four ¼" panels all at once. Draw 2" bevel lines, which represent 8-to-1 bevels, across all the panels. Stack all four of the panels on top of one another on a flat table. Place the edge of the bottom panel flush with the edge of the table. Then place the second panel with its edge



To create an 8-to-1 bevel on pieces of 1/4" plywood, they should be staggered by 2".

matching the bevel line of the first panel, and the third panel with its edge matching the bevel line of the second panel, and so on. Clamp the whole stack to the table and plane one continuous bevel over all of the panel ends.

The 875 Scarffer circular saw attachment is ideal for working with plywood up to 1/4" (6 mm) thick, and with minor hand finishing may be used on panels up to 1/2" (12 mm) thick. Bevels cut with the 875 Scarffer attachment can be more accurate than hand-cut joints, especially if you have little experience making scarfs by hand.

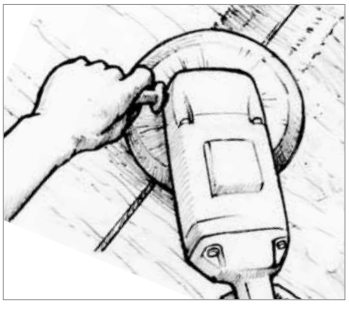
WEST SYSTEM 875 Scarffer

Hybrid Joint

A hybrid joint would be another possible method of joining the panels together. For this method, edge glue the plywood together, create a shallow bevel along the joint on both sides of the plywood and then reinforce the joint with a layer or two of fiberglass on each side of the joint. Bi-axial fabric is a good choice for this application.

The hybrid joint provides some distinct advantages. For one, the plywood panels maintain their full length. Also the joint is less likely to produce a hard spot when bent into shape because the original thickness of plywood is maintained. The disadvantages are that it can take more time to reinforce both sides of the joint with fiberglass and requires some skill/effort to sand the shallow bevel on the joint.

After the application of the fiberglass, the bevel should be filled flush with the surface of the plywood.



Grind the joint to a shallow bevel.

Apply 1-2 layers of fiberglass to the bevel.

For more detailed information about Scarfing visit our website for a free downloadable issue of Gougeon Brothers on Boat Construction Chapter 12 on Scarfing.

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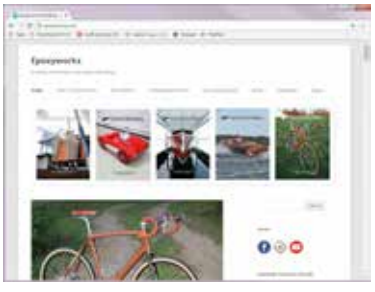

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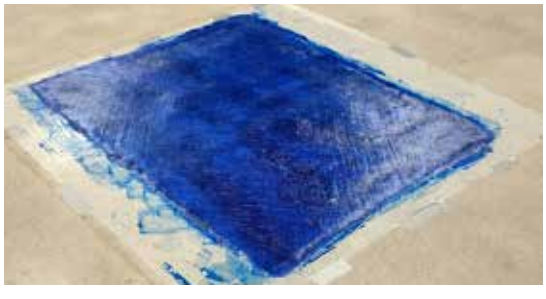
Readers' projects

The Gougeon Brothers shipping department was undergoing a relocation a few weeks ago. In the process of their move, Daryl decided the previous shipping transfer pallet was looking rather tired and needed to be replaced. The shipping department's only request was to incorporate the U of M logo.

Daryl wet out 3 layers of 737 Biaxial Fiberglass with 105/207 he tinted blue. He let that cure until tacky then added the legs constructed from scrap cardboard honeycomb core. The next day the legs were covered with fiberglass wet out with blue tinted epoxy. The third day he flipped the pallet over and created a wall around the perimeter of the top using our 883 Vacuum Bag Sealant. He rolled a thin layer of 105/207 onto the top and waited for it to become tacky before applying a U of M yard flag to the center of the pallet. With the flag adhered to the surface so it couldn't float, he covered the pallet top with about a ¼" of epoxy completely encapsulating the flag. After curing over the weekend, he removed the sealant, sanded the sharp edges and installed it in our shipping department.

Installed and ready for action.



The shop floor, covered with plastic, was a great location for laying up a large flat panel.

Vacuum Bag Sealant was a simple way to create a perimeter wall for a shallow pour.

Bill Goddard and Keti Gibbons live in Naples, Fl. They built this 9' 10" cedar-strip skiff from scratch using clear red cedar and epoxy.