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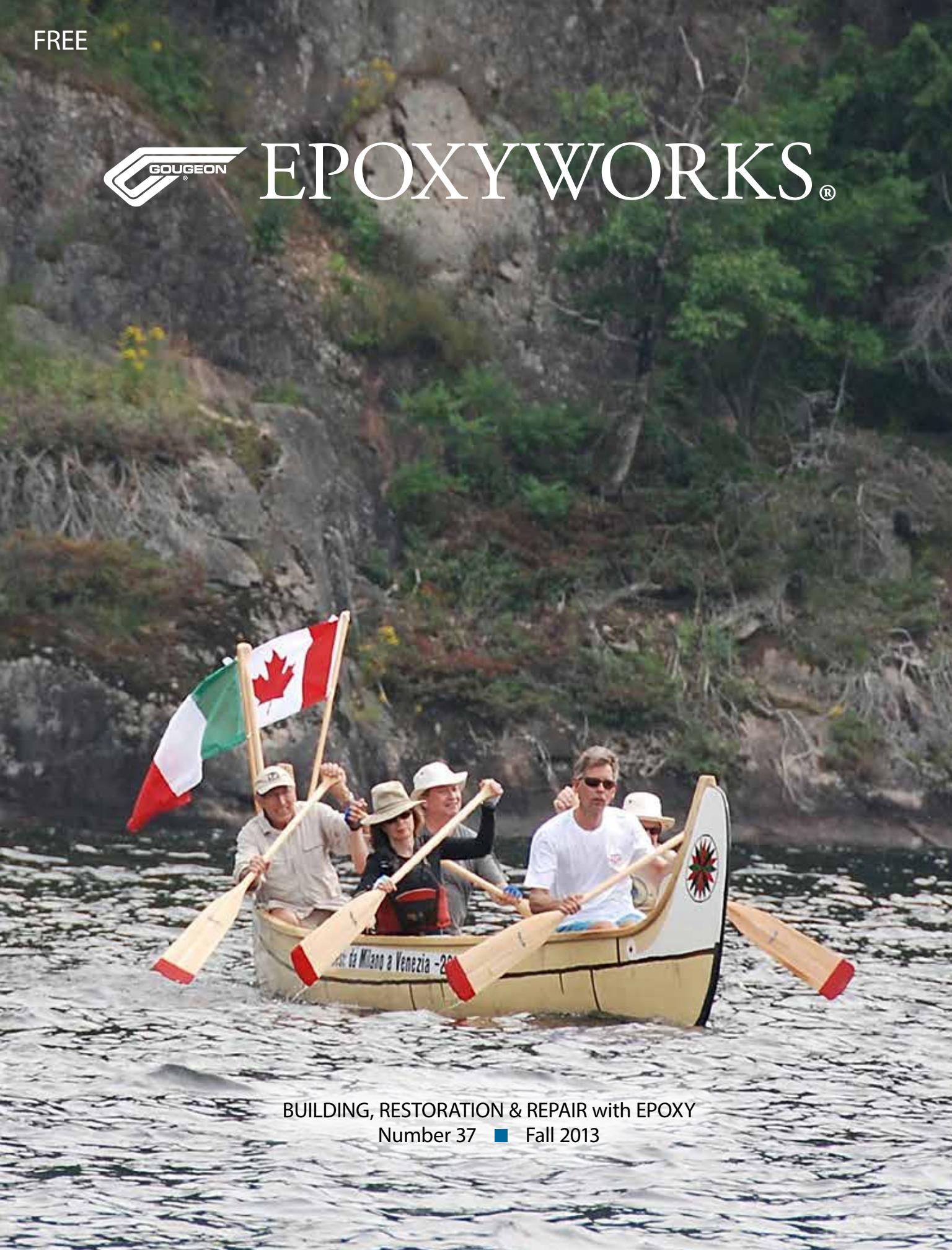

BUILDING, RESTORATION & REPAIR with EPOXY

Number 37 ■ Fall 2013

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Building North Canoes for an Unconventional Adventure

Ron Frenette, of Canadian Canoes, directs modern voyagers from the back of the 26' North Canoe.

By Ron Frenette

Canadian Canoes has been building wood strip epoxy canoes for some 35 years. We've produced many thousands of western red cedar canoe strips from clear planks which originated in British Columbia. Eventually we realized that ripping the strips one at a time then adding on the bead and cove profiles was terribly inefficient. With valuable input from Peter Feindel from Taurus Craco Woodworking Machinery, we used a milling machine to produce consistently accurate canoe strips. What once consumed five hours of monotonous work producing the strips for one canoe now takes about four minutes on the milling machine. This huge increase in production allowed us to offer, along with Ted Moores and Joan Barrett from Bear Mountain Boat Shop, canoe and kayak building kits for home boat builders.

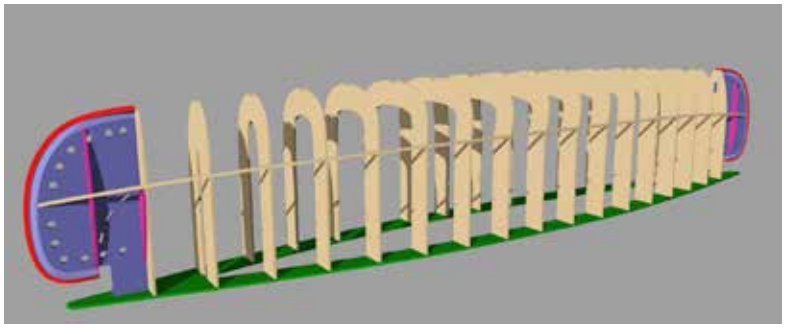
In February of 2011, a gentleman in Milan, Italy ordered our 17' Nomad kit. He launched the boat on a beautiful lake near the Swiss border with towering mountains as a backdrop. Shortly after, he told me about a traditional trade route from Venice to Milan when the Venetians controlled the trade goods, mainly spices, from the east and south. He asked if there was any possibility of some Canadian paddlers joining him in paddling the Ticino and Po Rivers from just below Milan to and through the Grand Canal of Venice itself.

Around that time, our friends and colleagues at Bear Mountain Boats were reporting that they had several inquiries about plans for a reproduction North Canoe, not in birch bark but in wood strip epoxy construction. It was not a great leap to the possibility of combining the suggested canoe route with the much larger North Canoes as the craft to be used on this paddling adventure.

Another friend and colleague, Glenn Fallis who operates Voyageur Canoes in Millbrook, Ontario, has been making similar canoes in a fiberglass and resin matrix for many years. In addition to the 26' North Canoe, Glenn and his workers make a 36' Montreal Canoe. When I outlined the trip and project to him, Glenn generously provided a significant amount of offset data which went into naval designer Steve Killing's design program. Steve then produced image renderings and CNC files which would allow us to make the station molds.

I promoted this adventure to find a group of a dozen or so friends and colleagues to join my wife and me in building these canoes, providing training, shipping the canoes to Italy and

Steve Killing's Canoe station mold rendering



Left— High-density particle board being cut on a CNC machine to produce the station molds. Right—Station assembled and leveled with leveling bolts where indicated

Left— Bending the stem pieces around the mold Right—Strips being applied to the stem of the canoe

paddling the 400 kilometers to Venezia. To our great delight, a group materialized. (Along with some of their hard earned spending money!) Fourteen people have signed on to the voyage.

Construction

Glenn Fallis produces North Canoes as a composite product. Because our background is in woodstrip construction and we wanted to offer these canoes as kits, we invited Bear Mountain Boat Shop to get involved. Bear Mountain helped popularize the construction of strip-built canoes sheathed in fiberglass cloth and epoxy, and are a resource to many home boatbuilders for boat building kits, plans, instructions, how-to videos and classes. Our version of these North Canoes employs woodstrip construction with epoxy.

Left and middle— Profile gages for shaping the stem Right— Adding the rows of bead and cove strips

In October 2102, Voyageur Canoes cut 12 sheets of ⅝"-thick high-density particle board on a CNC machine to produce the station molds for this project. It took a long Saturday work session to assemble all the segments then attach them to a floor-mounted oval. We built three North Canoes in four different places (which is why the background scenery is inconsistent in the photos). The image above shows a black floor platform and a series of leveling bolts. The floor in this shop was not flat so we made and leveled this platform then assembled the floor oval and all the station molds.

One of the first tasks in woodstrip boat building is to use steam and muscle to bend the stem pieces around the stem stations. These canoes follow the same process, but there are many more laminations and heftier pieces.

Preparing the strips of wood turned out to be a lucky opportunity for us. Generally, we produce long, clear strips of red cedar as our customers are looking to have a handsome craft with all the graining and colors red cedar displays. In our case, the hull was going to be covered with 10 ounce cloth, West System 105 Resin/207 Special Clear Hardener with 3% pigment added to simulate the inner bark of the white birch. Over the years, Ted and I had accumulated a good pile of shorter lengths of eastern white cedar which had limited applications in our shop processes. We had a substantial pile of 15' planks. We ripped and planed these to ¼" x ⅞" then we used our routers to add the bead and cove profiles to the edges.

One of the real challenges was to create the somewhat triangular shape of the stems; this process creates a flat place for the canoe strips to connect to when they "land" on the stem. On all of our other watercraft, the stem is very accessible and the fairing process can be done mostly with the builder standing upright. But the North canoes have their stems tucked under

and located about six inches above the floor. Our first canoe stem was shaped/faired using the conventional fairing batten and block plane. (After a mere seven visits to a chiropractor, my spinal column was realigned.) This was a valuable lesson. We asked Steve Killing to create some magic for us and he produced drawings which allowed us to cut a series of profile gauges, which made it possible to shape about 90% of the stem on the work bench. What a difference!

Adding the many rows of bead and cove strips progressed quickly with a team of four. On one occasion, we were able to attach 26 rows on each side of the molds. The hull was filled in and faired with block planes followed by a machine sanding with 80-grit discs and a final hand sanding with 120-grit paper.

Once the hull was well cleaned, we ran full length sheets of 60" wide 10-ounce fiberglass cloth overlapped along the midline. We then began the process of applying three coats of WEST SYSTEM 105/207 to saturate the cloth while bonding it to the hull and filling the weave. We were not going for a clear finish, and added 501 White Pigment at 3% by volume to each batch of epoxy and brushed this coat onto the cloth. With appropriate waiting periods between coats, it took about six hours to apply three coats of mixed epoxy with the pigment.

To simulate birch bark, we added slightly overlapping layers of 50" wide 6-ounce cloth with Glenn Fallis' cleverly painted bark pattern. We then wet out the top layer with two coats of WEST SYSTEM 105/207 Epoxy.

Next, we lifted the hull free of the molds and turned it right side up for the first time. After scraping the interior with curved paint scrapers, we sanded it by machine and hand. All this was in preparation for laying in more 10-ounce cloth and then was wet out with tinted epoxy.

Once the interior epoxy coats cured, the canoes became noticeably stiffer. It was ready for us to add the trim elements. Steve Squelch was a patient worker when it came to installing those sweeping curved end sections, which proved to be very challenging to complete. When those were in place, we attached the remaining sections of the inner and outer gunwales. This is one situation where the builder cannot have too many clamps.

By early spring 2013, the canoes were fully constructed, with only some decorative features to be completed. The canoes were all decorated by mid June and have been paddled regularly.

Painted with a birch bark pattern, the canoe receives another coat of epoxy.

Patiently applying the curved end sections

Testing foam flotation chambers

We added pour-in-place foam chambers at both ends and submerged the canoes to test the efficiency of all the flotation.

A traditional voyager salute

As this article was being prepared in mid July 2013, the canoes were secured inside a steel container somewhere on the Atlantic Ocean, headed for the Port of Genoa and then on to Milan to await the arrival of the paddling teams in early September. The Ticino and Po Rivers and the Lagoon of Venice and finally the Grand Canal in Venice now await us. This is certain to be a most unconventional paddling adventure. ■

SLIVER Project

By Don Gutzmer

After attending the 2012 Port Townsend Wooden Boat Festival, I visited the Northwest School of Wooden Boatbuilding in Port Hadlock, Washington. School instructor Bruce Blatchley was excited to show off their one-of-a-kind boat project, *Sliver*. The 62-foot double-ended daysailer was designed by well-known yacht designer Robert Perry and commissioned by Kim Bottles of Bainbridge Island, Washington. The Northwest School students of the 2011 and 2012 contemporary boatbuilding classes worked on the project. For a school that teaches traditional wooden boat building, learning to build a hybrid of wood/composite construction using epoxy was a unique challenge.

Sliver Specifications

LOA	61' 11"
LWL	55' 4"
Beam	9' 10"
Draft	10 ft.
Disp.	17,718 lbs.
Sail Area	976 sq. ft.

Sliver's hull is strip-planked with 1"-thick western red cedar and sheathed with one layer of 24-oz. tri-axial cloth on both the interior and exterior using WEST SYSTEM® Epoxy. The bulkheads were fabricated by building a sandwich composite using high-density foam core and fiberglass using epoxy.

Proud owner Kim Bottles visits every Monday to check the progress of his new boat. While he was growing up, his family owned wooden boats, so he appreciates the benefits of using wood in the construction. It was nice to hear designer Robert Perry comment after seeing the progress of *Sliver,* "When I stand in that shop and look around at the pieces of the boat, I am really glad we ended up with the build team we have. I can't imagine how it could have been better."

The deck was constructed with fiberglass skins and foam core vacuum bagged with WEST SYSTEM 105 Resin and 206 Slow Hardener.

Due to the size of the project, the boat is being constructed by two different classes. The first class consisted of 12 students and the second had five.

Over the two-year period students have been building *Sliver*, they also built a PT 11 Nesting Dingy designed by Russell Brown, a Joel White "Bangor Packet," a flat bottom skiff, and two Joel White "Nutshell Prams" in order to gain experience and fulfill the course curriculum requirements. Graduates of the 12 month curriculum receive an Associate Degree of Occupational Studies (AOS). Currently there are three graduates working on the 62-foot daysailer *Sliver* in order to help keep things moving along while students are not in class.

Sliver is the largest boat project the NWSWB has taken on. It sure will be an eye catcher when completed. ■

Sliver was designed to be light and look modern.

Hull construction in progress

Advantages of **879 Release Fabric**

By Mike Barnard

When most epoxies are exposed to the atmosphere (especially cold and damp conditions) a secondary chemical reaction can occur at the surface of the epoxy, leaving a waxy looking by-product called amine blush. This water-soluble film appears only at the end of the cure cycle, and not at all when WEST SYSTEM® 207 Special Clear Hardener is used.

Much ado is sometimes made regarding blush because if it is not removed it can inhibit bonding when recoating and clog sandpaper, but the reality is, it's easily avoided and easy to remove.

To dissolve blush, dip a scrub pad, like a 3M Scotch-Brite pad, in clean water and wipe across the surface. Follow this by wiping with white paper towels to remove the dissolved blush before it dries on the surface.

A scrub pad creates fine scratches on the surface, but this is not actually a problem. Since the epoxy has cured to a solid state, a new application of epoxy will not chemically link with it anyway, which is why it is necessary to create a roughened surface to facilitate a mechanical bond by sanding with 80-grit sandpaper before recoating.

Chemical bonding, which is achieved by recoating before the first coat is completely cured, is stronger than mechanical bonding. As long as the first layer of epoxy is wet, sticky, or tacky, it is advisable to add the second coat of mixed epoxy, thereby avoiding blush in the first coat. However, there are times when you will want the epoxy to fully cure before you move on to the next step. These are the times when the 879 Release Fabric comes in handy.

Release Fabric offers several advantages in epoxy laminating applications. Just one layer over a wet fiberglass laminate is easily smoothed with a plastic squeegee and removes irregularities and trapped air from the surface. Excess epoxy will seep through the weave of the Release Fabric, leaving the laminate with a higher fiber-to-epoxy weight ratio. The result is a strong, lightweight laminate. The Release Fabric protects the wet fiberglass cloth as it cures and allows you to level layers of fiberglass without damaging the fabric. It's left in place until the epoxy cures, and can be left on the surface for an extended period, such as when you want the laminate protected from dirt while you complete other work on the project.

Any time after the epoxy is cured, the Release Fabric is easily pulled away. The fabric leaves a weave texture on the fully cured epoxy, which gives good mechanical adhesion, although for best adhesion, it is still recommended to sand. In addition, amine blush cannot form under the Release Fabric. Any blush will actually be on top of the fabric, occurring on the epoxy that seeped through to the top of the fabric and was exposed to moisture in the air during cure. Because of this, any blush is peeled away and discarded with the used release fabric. ■

Replacing a Small Boat Cabin Sole

By Jeff Wright

The amount of wood used in a production fiberglass boat is significant; it is used for many things such as stringers, bulkheads, floors and backers. Higher quality production boats often use marine grade plywood for these applications but it can still be damaged by long term exposure to water.

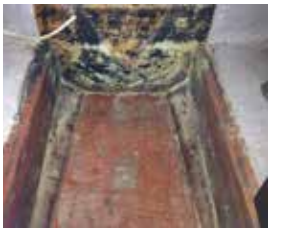
The cabin being disassembled

My personal boat, *Funktional*, is a 1986 Formula 242 LS that had a cabin sole that became water logged and lost its stiffness. A limber hole that became plugged over 25 years ago finally resulted in an uneasy feeling when standing inside the cabin. When I purchased the boat 10 years ago the sponginess was barely noticeable, but after several more seasons the flexing became obvious. When my 24-pound dog jumped from the vee berth and the cabin sole deflected, it was clear the plywood had deteriorated. I decided that it needed to be repaired and took advantage of the Michigan winter to tackle the project.

Two views of the cabin with the carpeting removed

The first step was to disassemble the furniture in the cabin so that the carpet could be easily removed. It is important to realize that the closet and wet bar cabinets were installed in the boat before the deck was set in place and after the carpet was installed. This means these cabinets cannot be removed. I was able to loosen these assemblies enough to pull out the carpet from underneath the cabinetry.

Left—The cabin sole with a layer of chopped strand mat Right—Rotary cutting tool for cutting through the chopped mat tabbing



With the carpet removed the actual cabin sole could be cut out. It was bonded in place with a layer of chopped strand mat that was applied over the top of the floor and up onto the hull bottom and stringers. A rotary cut off tool with an abrasive disc was used to cut off the tabbing, by keeping the guard close to the surface the amount of dust was minimized. I took care to ensure I was cutting into this chopped mat tabbing and not the hull; on some boats it may not be obvious and running the cut off tool into the hull bottom would create a lot of damage to repair.

Left—Water logged, cracked cabin sole Above—Aft floor support softened by water damage

To help locate the position of the new sole, a small lip of the chopped mat tabbing was left on the hull bottom and stringers.

After the fiberglass was cut around the floor and I could remove the plywood from the cabin it became clear why it was spongy. Not only was it waterlogged, it had a crack in it. The manufacturing defect that I mentioned earlier was also visible; a limber hole had been clogged with flotation foam. When the boat is on the trailer water can flow forward and this water did not have a good way to completely escape back to the bilge pump.

A small frame supported the aft section of the floor which was also soft and would be replaced

Left—New cabin sole with aft support frame
Right—New cabin sole set in place

with the new sole, but the cleats that supported the companionway step were in great shape, except the screw holes for the step were stripped. I swabbed these holes with epoxy to give the screws something to bite into.

The original floor was ½" marine grade plywood, and considering the age of the boat and the amount of moisture it was exposed to it performed well for over 25 years. It was about 2' wide and about 4' long.

I did not have any ½" marine plywood and did not want to invest in large sheet to only cut off 2 feet. This application is not critical to the strength of the hull, and now that the limber hole was unplugged it will stay much drier. I had an old sheet of ¾" AC exterior plywood and decided that by filling in the exposed knots, applying a light layer of WEST SYSTEM 740 4-oz. fiberglass on each side and thoroughly sealing the end grain around the perimeter it would be durable enough for this application. In addition, by shortening the length 2 inches I was able to orient the grain across the panel which will have increased strength because originally the grain ran lengthwise.

New cabin sole installed with WEST SYSTEM 737 17 oz. biaxial fiberglass on each side. The fiberglass will hold the plywood in place and seal any gaps between the sole and the hull.

Please keep in mind that marine plywood is superior for boat building and would be considered required for certain structures.

The new sole was set in place using the outline of the old tabbing as a guide. A perfect fit was not needed because the new fiberglass tabbing bridged a small gap and the carpet covers the entire area. The sole rests on the hull bottom and the tabbing holds it down in place so there was no need to bond the plywood to the hull bottom. Weights were placed on the sole to hold firmly against the hull while the tabbing cured.

The installation of the carpet was the most difficult part of the project.

The surfaces that the fiberglass would be bonded to were sanded by hand with 80-grit sandpaper, once again to keep dust to a minimum. I used WEST SYSTEM 737 fabric, the first piece I placed down was 4" wide and then the second piece was 6" wide. The biaxial fabric easily conformed to the needed shape and the differing widths reduced the chance of the edge being felt underneath the carpet.

The finished sole repair with carpet installed

All of this work was done in a garage in Michigan in March. To ensure that the cold weather would not inhibit epoxy cure, I prepared the sole in my heated basement and used a small electric heater to warm the cabin when using the epoxy to tab in the sole. WEST SYSTEM 105 Resin with 205 Fast Hardener was the best choice for use in cool weather. Other advantages of using

WEST SYSTEM Epoxy include low odor, excellent adhesion to the wood and existing hull laminate, and superior water resistance.

After the epoxy had cured I wiped it down with water to remove any amine blush that may prevent the carpet adhesive from adhering and sanded any fiberglass strands that were poking up.

The crew approves of the new repair job.

I found a plush marine carpet from Cabela's and purchased outdoor carpet adhesive from my local big box store. The installation of the carpet was most difficult part of the project. The new carpet could not be installed underneath the cabinet and wet bar so I had to closely trim the carpet with razor blades and a pair of Swiss Army knife scissors. Seam sealer was used to prevent it from fraying.

When I started the project I was most worried about spilling epoxy inside the boat. By using lots of plastic sheeting I am happy to say not a drop got onto any upholstery or gelcoat. Unfortunately, the carpet installation did not go as well. The carpet has to fit around several corners and there was really nowhere to stand as I put it in place onto the sole, so things got a little messy. It all worked out in the end. I am sure many people are more intimidated by the fiberglass portion of this repair but I found the carpet was actually the biggest challenge.

The repair has made the cabin feel much more secure when stepping down from the cockpit, and new carpet really makes a very comfortable berth for the crew. ■

Improve wooden paddles and oars with G/flex

By Tom Pawlak

G/flex epoxies weren't developed with coating in mind, but early on in their applications testing we discovered they are excellent at dealing with impact. This became evident when we used G/flex 650 (the unthickened version) as a coating and when we used G/flex 655 (the thickened version) as a protective buildup.

G/flex 650 is not optimized for use as a coating, but we found it was worth the extra effort it takes to apply to wooden parts that might get dented in service, such as wooden canoe paddles and boat oars. As a coating, G/flex deflects without cracking when the wood beneath it gets dented.

Compared to the cracking that normally occurs with production-made wooden paddles and oars when the blade is dented, a coating of G/flex can offer a huge benefit.

Every pair of wooden oars I've ever purchased has had the clear sealer finish peel off wherever they were slightly damaged. When the coating is damaged due to abrasion or impact, water gets into the surrounding wood and the coating peels off soon after. This is because the wood swells and the coating can't stretch enough to stay attached.

As a base coat, G/flex handles minor impact without cracking. The wood does not swell, which means the protective paint or varnish layer applied over it stays nice looking. It will require less maintenance over time. If the coating is breached due to a more severe impact and water does get in, G/flex can stretch enough to stay attached and is less prone to peeling off. (See "How to use G/flex 650 as a sealer under varnish or paint")

G/flex 655 handles impact remarkably well when it is applied to the tips of wooden paddles and oars. We repeatedly struck a cured bead of it with a ¼" diameter steel rod. The epoxy didn't crack or chip. We applied G/flex 655 to an oar tip which was used as a demonstration piece at several boat shows this past spring and summer. We struck it dozens of times with the steel rod. Visitors to our booth would cringe in expectation of damage to the paddle tip, but no damage occurred. (See "How to improve the toughness of wooden paddle and oar tips with G/flex 655")

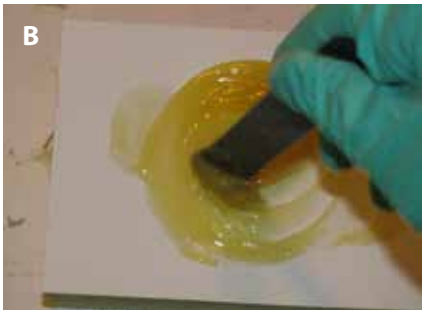
How to use G/flex 650 as a sealer under varnish or paint

1. Remove all old paint, varnish or sealers to expose fresh wood. (top)
2. Brush on a coat of G/flex 650 with a stiff bristled brush. For an ideally stiff brush, trim bristle length by half. (bottom)
3. Apply a seal coat of G/flex epoxy beginning with any end grain, moving on to face grain and edge grain. Finish by applying a second coat to the end grain.
4. Apply a second coat, if desired, while the first coat is tacky like fly paper. If the initial coat is already cured, clean with water and abrade it with an abrasive pad or sandpaper before recoating.
5. If you plan to paint or varnish, first allow the G/flex epoxy to cure overnight or longer, then wash with water and sand dull.
6. Apply the paint or varnish of your choice. An excellent varnish over any epoxy is Captain's Varnish #1015.

How to improve the toughness of wooden paddle and oar tips with G/flex 655

1. Remove all existing finishes on the tip of the paddle or oar.
2. Sand a 45° bevel on the end of the paddle or oar blade, front and back, with a hard sanding block and coarse sandpaper. (Photo A)
3. Mix a batch of G/flex 655 on a flat surface. (Photo B)
4. Apply the epoxy to the tip of the paddle from both sides, one side at a time. (Photo C)
5. Invert the paddle blade and clamp while curing so epoxy does not slump during cure. (Photo D)
6. Wash the tip with water and touch up with a sanding block. Apply another layer of G/flex if necessary to achieve a smooth, uniform buildup.
7. Give it a day to cure at 70°F or above (or a bit longer at cooler temperatures) before using the paddle.

Test the blade tip for toughness in the shop by striking it with the shank of a large screwdriver, but I think you'll agree it is much better to do this sort of testing on the water while paddling over a rocky, clear-water stream. ■



Small Projects and Repairs

By Jeff Wright

Many of our *Epoxyworks* articles feature projects that our customers have spent years building and represent major personal accomplishments. I also believe we have many customers who, like me, use WEST SYSTEM Epoxy simply to keep an older boat in good repair.

The following are examples of repairs and small projects that I have completed on my personal boat over the last ten years. These would apply to many production fiberglass boats. Since WEST SYSTEM Epoxy has a shelf life measured in years, it is easy to keep it on your shelf and tackle these tasks when it's convenient.

Seat Post

The extruded aluminum seat post and cast aluminum seat base often will wear on each other over time, creating a loose fit. This can make the seat feel unstable and uncomfortable in rough water.

Following a procedure similar to the concept of our rudder shaft repair (see Fiberglass Repair Manual page 60) I applied a coating of WEST SYSTEM 105 Resin/205 Hardener/423 Graphite Powder to the seat post and allowed it to cure. I then lightly sanded it until the seat would slide back onto the post, and rotated it several times until it turned with just a slight resistance. It has remained secure for several seasons now.

Trailer Tool Box

I built a relatively simple storage box for my trailer using ¾" plywood coated and bonded with WEST SYSTEM Epoxy. It provides a place to store my spare trailer parts, wheel chocks and tie downs. In addition, it makes a great step when loading the boat on the trailer. This tool box has been attached to my trailer for over ten years and has seen at least 20,000 miles of highway travel.

Trim Pump

When my original trim pump would not hold up the outdrive any longer it was time to replace it. The new updated pump had a different mounting bracket so the mounting holes did not align in with the old holes in the boat. Since this is likely to get wet at some point I wanted to seal up the old holes permanently so I filled them with thickened epoxy.

Fasteners in the Transom

Stern drive boats require the plywood core in the transom laminate to be strong enough to withstand the force of the outdrive when underway. When I purchased my boat it was already 17 years old and appeared to have had some of its hardware removed and reinstalled since it left the factory. I wanted to ensure the transom core would stay dry so I sealed the wood inside the screw holes with epoxy for the trim tabs, swim platform brackets, pitot tube clamps, and on the wood exposed by the exhaust through-hulls.

Trailer Bunk Bolts

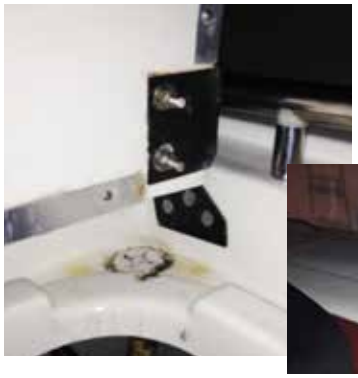
The lag bolts that fasten the carpeted wooden bunks to the trailer can be problematic. The wood often stays very wet because of the carpet and then the bolts become loose. If the bolts fall out the bunk can become unattached when the boat is loaded. Thru bolting may work in some cases but there is the risk of the bolt head contacting the boat hull.

By simply coating the screw hole in the wood with epoxy and then screwing in the lag bolt in, I am assured that they will stay in place.

Engine Hatch Hinge

The plywood that is used for the cushions of my engine hatch upholstery is also used as the backers for the hinges. Over time the plywood in the area became slightly deteriorated and warped from years of moisture.

I removed the cushion from the engine hatch and pulled the upholstery back from the corners. I dried the wood and then saturated it with epoxy, restoring its strength. This was an easy and cost effective way to get these very important hinges bolted to a solid surface.



Snaps

Most snaps for covers are either riveted or screwed right into the fiberglass laminate with no access to the backside. As with many older boats I have had some of these come loose. By coating the screw hole with epoxy the snap can be screwed back into place easily and securely. ■

Cooler

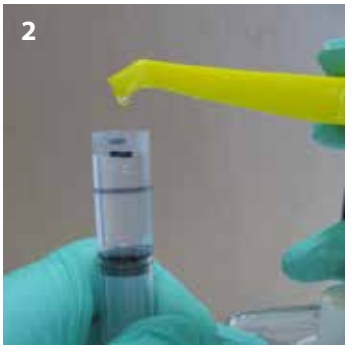
I wrote an article about building this cooler in Epoxyworks 30. It has worked well and optimized the space in the small cuddy cabin.

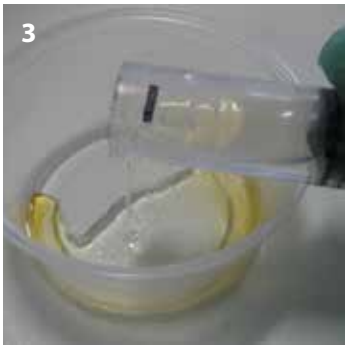
Smaller Can Be Better

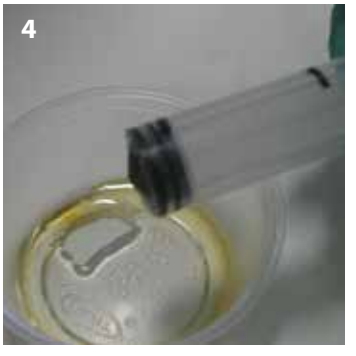
By Tom Pawlak

My favorite way to mix small batches of WEST SYSTEM® Epoxy, when less than full pump strokes on the mini pumps are required, is by metering resin and hardener into a graduated cylinder made with a plastic syringe. The 807 Plastic Syringes, in our product line, can be modified for this by cutting off the end of the syringe body so it looks like the end of a clear piece of plastic tubing. (Photo 1)

For the 5:1 mix ratio needed for 105 Resin and 205 Fast Hardener or 206 Slow Hardener, you'll need to measure ¼" back from the cut off end of the syringe body and make an indelible mark. From this ¼" mark, measure back 1-¼" and put another indelible mark. Now pull the syringe plunger down to the 1-¼" mark and fill the syringe with 105 Resin to the ¼" mark (using the mini pump to fill to the line exactly). Now top off the syringe with 205 or 206 Hardener dispensed from the hardener pump. (Photo 2) Press the syringe plunger forward to dispense all the resin/hardener into a mixing cup and swipe the plunger tip clean along the lip of your mixing cup. (Photo 3 and 4) The syringe can now be stored after wiping with dry paper towel for future use because all of the hardener was washed away with resin. Stir the resin/hardener mix in confidence knowing that you've measured exact quantities of resin and hardener.







If still smaller batches are needed, mark up the opposite side of the modified syringe with a ⅛" mark and a ⅝" mark and use your pumps to conveniently fill the syringe to the marks.

If you are working with 105 Resin and 207 Special Clear or 209 Extra Slow hardener, another syringe can be modified with the 3:1 by volume ratio with an indelible mark that is ¼" back from the cut off end and from this mark measure back ¾" and place another mark. This will yield the 3:1 by volume required for 105/207 or for 105/209.

Another approach to mixing accurate small batches of epoxy is to use an inexpensive gram scale like our 320 Small Batch Epoxy Scale. These small scales allow you to mix up to 600 grams of epoxy at a time. This equates to about a pint of epoxy.

The appropriate mix ratio for our **105 Resin and 205 Fast or 206 Slow Hardener by weight is 5:1. Our 105 Resin and 207 Special Clear mix ratio is 3.7:1 by weight. 105 Resin cured with 209 Extra Slow Hardener is mixed at 3.6:1 by weight.** These small gram scales have a tare feature that makes it easy to zero the scale after the initial cup tare and after weighing the first component.

Once your mixing cup is on the platen and the scale is tared to ZERO we prefer weighing the hardener first. We do this because accuracy on the hardener amount is more critical than the resin. In other words, because the amount of resin isn't as critical as the amount of hardener, you have a bit of room for error. So if you over shoot the amount of resin by a bit it's not a big deal but if you measured resin first and then you overshot your hardener you are more likely to be off-ratio. By starting with the hardener, the calculation for the resin amount is based on an exact weight of hardener.

These electronic scales, especially the battery operated types, have an auto off feature to save batteries. Be sure to touch the platen periodically so the scale does not shut off from inactivity.

Another excellent way to meter small batches of epoxy is to use Six10 Adhesive. This adhesive is packaged (resin and hardener) in a standard size caulk tube and can be dispensed one click at a time from the caulking gun.

G/flex Epoxy 650 and 655 as well as G/5 Adhesive 865 with their 1:1 by volume ratio are also convenient for making very small batches of epoxy. ■

Time is Everything

By Grant Hilger

The evening of March 19, 2013 I inspected my 217cm Atomic™ downhill race skis in preparation for race day. Because of the early ending to winter in 2012, these skis had not seen the light of day in almost two years. The only real chance I get to ski with them is at the annual Boyne Highlands Downhill Race in Harbor Springs, Michigan. This late March tradition is usually the grand finale of Michigan's ski racing season. This year the weather was shaping up perfectly for outstanding conditions, and I was chomping at the bit to ski fast! Much to my surprise, when I picked up one ski I found that a section near the tail was delaminating. On the inside edge of the left ski, a 1.5"×0.5" area of the top skin was bubbled up from the ski's side wall. The bubble was ⅜" of an inch high. I was less than impressed with this find.

Delamination area

Some of the steel inside the ski's core had corroded, causing the top sheet to lose its bond and bubble up. This corrosion was most likely accelerated by salt, which is often used in late-season ski races to keep the snow from softening in the intense sunlight. The salt and water must have made their way into the ski's core during the 2011 race. It then had almost 24 months for the corrosion to occur. With the issue identified, it was time to plan a repair. The clock was ticking.

I had a cartridge of WEST SYSTEM Six10 adhesive in my repair kit, and I thought that this would work for the application. I rounded up acetone, pipe cleaner, mixing stick, mixing cup, small flathead screwdriver, paper towel, gloves, safety glasses, wax paper, wood blocks and a C clamp to complete the repair. My plan was to attempt to salvage the top sheet and re-bond it to the ski's core. This is the procedure I followed:

Step 1: I gouged out the corroded metal from the bubbled up top sheet. I was careful not to damage the top sheet, because then I'd need to repair that as well. I used a shop vac to help suck the metal shavings out of the hole in the ski. Once all the corroded metal was removed, I blew out the void in the ski with compressed air.

Step 2: I used a pipe cleaner and acetone to clean out both the inside of the ski's top sheet and the ski's core to aid bonding.

Step 3: Once the area was dry, I mixed a small amount of Six10 adhesive and brushed it into the void on all surfaces with another pipe cleaner. I then used the plastic mixing stick to fill in the void as much as possible. This probably added more epoxy than was needed, but it was such a small area that I wasn't too concerned with waste when it squeezed out. I was more concerned that the repair was robust.

Step 4: I applied wax paper to the skis so that the epoxy wouldn't get anywhere that I didn't want it to, and then I clamped the ski.

Clamped and curing at 68°F

Step 5: I allowed the epoxy to cure for 24 hours before removing the clamp.

The repair seemed to be sound, and time was of the essence, so I prepped the skis for racing by hot waxing them with race wax. I was concerned that adding heat to the ski this quickly after curing might compromise the repair. To my delight, everything held fine. Hurdle number one, cleared.

Now the ski had to hold up to the stresses, vibration, and temperature of a 38 second, 60+ mph run down an icy ski hill. The ending to this story is a happy one. The repair passed its first trial with flying colors. No ill effects were observed in the ski's performance, and following the race run I inspected the repair. It looked like just as it had when I removed the clamp earlier that week. If you're at all interested in the race, the skis allowed me to complete the race run in 37.99 seconds, hit a top speed of 66.1 MPH as recorded on GPS, and win my age class by 0.5 seconds (a significant margin in ski racing). ■

3/19/13—6 pm
Discovered delamination

3/19/13—8 pm
Repair complete, epoxy clamped and curing

3/20/13—7 pm
Hot wax skis for race day

3/24/13—1 pm
Race Time

Repair complete, ready for wax and then the race

The kitchen after renovations

Kitchen Remodel
with WEST SYSTEM Epoxy

By Don Gutzmer

I told my wife that I planned to remodel the kitchen because we were replacing our appliances. The first thing she said was, "Not another project!" She has learned over the years that I will always be working on something.

Once I started the project, I learned quickly that you should never paint a wood surface that you'll eventually want to strip. Think twice before painting anything wooden. Removing the paint from the cabinet doors was messy and the hardest part of the whole project.

These pictures will help explain the process. First, I applied a paint stripper which lifted about 90% of the paint. A flexible metal scraper helped remove the lifted paint quickly. Next, I hand sanded parallel to the grain with 60-grit to remove all remaining paint. Plan A was to use a water-based stain and then apply the epoxy, but

The kitchen before the renovation. The cabinet doors were painted cream on the top and red on the bottom.

I had a hard time finding water based stain from my local store. So I went to Plan B and coated the surface with a stain and polyurethane combo to help seal the wood prior to applying epoxy to prevent any fish-eyes. It worked great! The adhesion of epoxy to bare wood is better than bonding to a coating like polyurethane, but the epoxy was primarily used for cosmetic reasons and it bonded very effectively for my application. Keep in-mind that the coating the epoxy will bond to will be the weakest link for adhesion purposes.

After the paint stripper was applied and lifted paint was removed, the surface was sanded with 60-grit.

I applied Minwax® American Chestnut PolyShades® stain and polyurethane in one. At first I applied the stain with a China bristle brush on the smaller doors. I found out that on the larger doors it was better to apply the stain with cheese cloth to prevent leaving too much stain and having it darker than desired. I dragged a dry 800 Roller Cover over the stained surface to help even out the coating. The Minwax dried for about a day before I sanded it dull with a Scotch-Brite™ pad.

Minwax Polyshades

Stained surface

The surface was coated with West System 105 Resin and 207 Special Clear Hardener; I poured it on and spread the epoxy over the surface with an 809 Notched Spreader. A quick pass from a propane torch moving at a rate of 12" per second helped remove any trapped bubbles. After the epoxy cured I removed drips along the edges with a sanding block. The polyurethane coat helped seal the wood enough to prevent any out gassing when heat from the torch was applied. The 105/207 was left as the finished coat. The final result was a clear buildup that looks like 12 coats of varnish. ■

Finished door with ⅛" thick coating of 105/207

Finished racecar trailer

What's new at Staudacher's Shop

By Don Gutzmer

Aircraft designer and builder Jon Staudacher's newest project is an enclosed wooden trailer for his new race car. Jon designed a trailer to be suitable for hauling his open wheel race car and living in over a weekend at the race track. The trailer was built by scarfing and gluing together individual pieces of wood to form a beautiful natural wood finished race car trailer. Jon always surprises me with how innovative he is with projects.

After Jon built his race car he had a design in mind for a new plywood trailer. The trailer consists of ¼" Baltic birch plywood sides with reclaimed southern yellow pine boards for support ribs. The southern yellow pine boards that he used came from a local high school's old bleachers.

The plywood was scarfed together on Jon's long strongback (long flat table) to create all the sides of the trailer. Three coats of WEST SYSTEM 105 Resin and 207 Special Clear Hardener were applied to the panels while they were horizontal on sawhorses, making it easy to work on. Vertical grain Douglas fir boards were bonded to the top and bottom of the sides of the trailer. The inside of the trailer was bright finished, and the natural wood imparts a pleasant feeling inside the trailer and just makes you feel good.

Jon's races are over weekends throughout the summer, so making the trailer comfortable to use was pretty much a necessity. Building the trailer low to the ground (compared to an aluminum framed enclosed trailer) helps significantly when singlehandedly loading and unloading a race car that has only 1.5" of ground clearance. Also keeping the floor of the trailer low to the ground is nice when walking in and out over an entire weekend.

The floor is made from ½" Baltic Birch plywood with a laminated 8' southern yellow pine tongue lag bolted through the floor. The roof consists of 4 mm okoume plywood with Douglas fir strips to increase stiffness and support. The advantage of using the epoxy is its ability to seal the wood and waterproof everything to prevent water from leaking in, while traveling down the road or parked at the track.

Storage compartments were built on one wall side to make it convenient for hauling any tools or hardware needed at the race track and also served to strengthen and stiffen the sides of the trailer significantly. Jon built an area in front of the trailer that was boxed in to haul two sets of spare tires; it also had a plywood top that was hinged to convert into a bed.

Three 12" diameter holes were cut into the top as skylights made out of polycarbonate.

Storage compartments were built into the door for tools needed at the race track.

Top and Bottom—Trailer assembly in progress

The hinged door was designed to have storage compartments to haul any hand tools needed at the race track. The finished trailer weighs around 1,200 lbs.

The trailer was finished by spraying Jon's favorite automotive clear coat after all the pieces of the trailer were glued together. It's not a lie when I say that Jon's wood race car trailer sure turned out really nice. It's safe to say Jon's trailer will turn heads on the road and at the track. ■

½" Baltic Birch Plywood was used for the trailer floor.

Mother of Invention

By Tom Pawlak

In 2011, our Technical Advisors Bruce Niederer and Don Gutzmer were packing tools for a trip to Mystic Seaport where they would once again provide guidance and instruction to families participating in the WoodenBoat Show's Family Boatbuilding event. They recalled from the previous summer that spring loaded wire cutters were very helpful for removing the twisted copper wire used to temporarily hold stitch and glue boats together after the joints cured. Unfortunately, none of the spring loaded wire cutters could be found.

We took a pair of conventional wire cutters (no spring attached) that we had on hand to the maintenance area to find an appropriate sized spring. Back in our shop, we sanded the cutters to expose bright metal and glued the spring ends in with G/flex 655 Thickened Epoxy Adhesive.

That was two years ago and the spring-action wire cutter is still one of our favorite tools and works fine. ■

The new technical building

New Gougeon Brothers Inc. Technical Building

By Jeff Wright and Bruce Niederer

January 2013 was a big month for the Gougeon Brothers, Inc. Technical Department. This department is responsible for our technical customer service, product development and quality control. In January the Technical Department moved into a completely new building that adjoins our current facility.

The new technical building site before construction

Conversations regarding a new technical department building started several years ago. As our business grew over the last 30 years we built additional lab and shop space inside our existing building. This served us well, but having separate labs meant we had to control the environmental conditions in multiple rooms, a difficult task at best. We also found ourselves walking unnecessary miles between the instrument lab, the formulation lab, and the multiple places we stored raw materials. We had also outgrown all available office space. We knew that a new building was the best option, and it was time to pull the trigger! We began work with a local design/building contractor to plan our new building.

The highest priority for the layout of the new building was the laboratory. Climate control (temperature and relative humidity), conditioned electrical power, counter space, storage and ventilation were all aspects that could not be compromised. We now have a fabulous single workspace with all of our precision instruments which includes equipment for measuring thermal properties, viscosity, chemical composition and more. Another key feature of the lab is an independent "floating" concrete slab which isolates our MTS hydraulic mechanical testing machines from outside vibration interference.

For the workshop we had a very different focus—flexibility. Forty years ago when the company got started, wood was the primary material that WEST SYSTEM Epoxy was used for. Then along came fiberglass, carbon fiber, and synthetic fibers

Left — Our new technical department workshop

Below—Our new chemistry lab

such as Dynel®. Not to mention polyethylene "plastic" boats. In order to properly support our customers who are using these materials now, and to be ready for some unknown materials in the future, we wanted to make sure our workshop could quickly adapt to accommodate projects of different size and scope.

To accomplish this we moved from a central dust collection system to individual units for each large power tool so they could easily be moved. A very large garage door was installed for that inevitable boat project that one of our Tech Advisors may want to tackle. The workshop also has a heated floor that evenly distributes unobstructed heat, and air conditioning for those few days when the weather in Michigan exceeds 90°F. Each Technical Advisor has a dedicated portable work bench with easy access to the same chemicals and analytical equipment that our Lab Techs and Chemists utilize. This design will allow us to adapt and work with the same materials and process as our customers.

The work shop will also house our environmental testing chambers, which are still under construction. We will have a 100°F / 20% humidity, 100°F / 100% humidity and 60°F / 80% humidity chambers so we can simulate working conditions from the rain forest to the desert.

Each employee has an enclosed office—no cubicles or open office space—and they all got to keep their staplers! Seriously, we want to be sure that our Technical Staff has a distraction free workspace to talk with our customers who take the time to call us. Our conference room has the opposite approach. It is a wide open space that encourages collaboration and impromptu meetings for brainstorming sessions.

Moving was not an easy task. Besides sorting through and letting go of decades of "stuff" — which for some guys was emotionally draining, akin to losing an old friend— we had to maintain our customer service and quality control support. Our advanced IP based phone system helped us easily manage the transfer of incoming calls from old offices to new, so customers could always reach a specific Tech Advisor. We also took the time to recalibrate each instrument after they were moved to ensure we still generated precise, accurate data.

Our move to the new building took place shortly after we lost our founder, friend and mentor Jan Gougeon. Out of respect for the innovative work he did with advanced materials that laid the foundation for much of the work that the Technical Department performs and the love and esteem the entire Gougeon employee family holds for Jan, the facility is dedicated to his memory. ■

This plaque hangs on the wall in the entrance to our new Technical Building.

Will it stick?

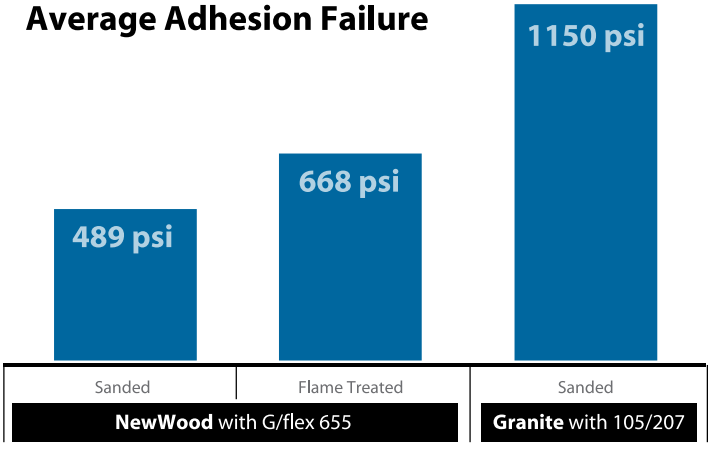
By Mike Barnard

Do you have a material you would like to glue with WEST SYSTEM Epoxy, but are unsure how well it would work?
Email us at Technical@westsystem.com or call 866-937-8797.

Many times each day we get questions about sticking to various substrates. Most questions are on something that we have already tested, so we check our large database and advise on how best to adhere to the surface. Other times the request is unique and we are unsure if WEST SYSTEM Epoxy will stick to it or not. In the event we do not have any experience bonding to a material, we recommend testing the adhesion. An at home test method could involve gluing a wood block to the test surface, then pulling the block off once the epoxy is cured. The test method we use is much more quantitative because it measures how much force it takes to remove the epoxy.

PATTI (Pneumatic Adhesion Tensile Test Instrument)

We use a piece of equipment that is specified in ASTM D4541 called the PATTI (Pneumatic Adhesion Tensile Test Instrument) meter. It uses compressed air to exert a force perpendicular to the surface so we are testing true axial tensile adhesion. The values obtained are in units of PSI (Pounds per Square Inch). In order to use this method, we glue an aluminum stud down to a properly prepared surface. Next, a plastic ring is placed around the stud so the epoxy does not cling to the side and increase the bonding area. Then we let it cure at room temperature for anywhere from 1-14 days. Once it is fully cured, we attach the PATTI meter to compressed air and the bonded stud and pull the stud off the surface. If the substrate fails, then we know that the epoxy is stronger and it will make for a great repair. If the bond between the aluminum stud and the epoxy fails, then the epoxy sticks better to the substrate than to the stud. The value can be considered a minimum for how well the epoxy sticks to that substrate since the bond to the aluminum failed before the bond to the surface. If the epoxy pops off the surface without much force, either the epoxy will not stick, or surface preparation needs to be re-examined.



Two materials that customers have inquired about recently are granite rock and NewWood®.

The granite chunk that I obtained was small, so I was only able to test adhesion with three studs. But the results from the three pulls were very similar, so I am comfortable reporting these results. To prepare the rock, I sanded it lightly with 60-grit sandpaper to remove some slight high spots and cleaned it with a plain white paper towel and isopropyl alcohol. The epoxy used for this test was 105 Epoxy Resin with 207 Special Clear Hardener because the customer wanted to use this as a table top. The lowest value achieved was just over 1,000 PSI. The granite broke before the epoxy pulled off the stud.

NewWood is a relatively new product on the market and is made up of 50% recycled wood and 50% recycled plastic. This company sent us several 1'×1' samples for adhesion testing, so I was able to experiment with plenty in order to determine the best method of treatment. Since the product contains 50% recycled plastic, it was logical to use our plastic-friendly G/flex 655 so my testing revolved around that product. Most of the failures occurred in the substrate of the NewWood, meaning G/flex stuck as well as it could have. For more information on NewWood, visit NewWoodManufacturing.com. ■

Larsen Thunderhawk

By Mick Ignatiuk

Before restoration

Built in 1957, my 15' Larson Thunderhawk Jr. is a fiberglass runabout reborn. I launched her into the waters of Grass Lake, in Fox Lake, Illinois in late August, 2010. But before this happened, the boat underwent a major restoration.

I purchased this boat in August of 2009, after it sat idle for several years, collecting dirt, rainwater, leaves and snow. All that remained was its shell, motor and a rusted trailer. I found a group of Larsen enthusiasts who helped me locate my boat's original specs, drawings and color charts.

I began the project in September, 2009 by separating the deck from the hull. I had easy access to remove the old interior finish, remove and replace the deck supports, and complete the fiberglass repairs. The hull has three water tight chambers. Two of them serve as seats. They were full of water due to broken fiberglass tabbing. The transom was entirely rotted, as were two back stringers. I repaired all of this with WEST SYSTEM 105 Resin® and 206 Slow Hardener®, thickened with 404 High Density and 407 Low Density fillers, and biaxial glass.

The interior finish coat is silver gray Zolatone®, which is a durable, easily worked product.

Next, I needed to put the deck and hull together. I glued the joints with epoxy thickened with a blend of 404 and 407 fillers for strong but flexible bonds. Screws were placed every six inches. The joint at the transom and those two feet either side of it are glassed with WEST SYSTEM 105/206 Epoxy and 4" biaxial tape.

I set the boat bottom-up on a custom made stand, removed the old finish, and repaired the cracks. Then I applied Awlgrip® #545 primer. Several weeks later I did the final sanding and sprayed on Awlgrip Eggshell White. During this same time, the rusty trailer was powder coated, received a wooden platform up front, new wheels and new lights.

After removing the old deck finish, I applied a coat of epoxy, then another coat thickened with 407 filler over the entire surface. This covered the small cracks and pinholes. I followed this with Awlgrip #545 primer. After the primer was cured and sanded, I sprayed on a topcoat of Awlgrip. As the finishing touch to the painting process, I added vivid red stripes.

All of the boat's original hardware was re-chromed and a new acrylic windshield was fabricated. I spent a lot of time refinishing the steering wheel to make it look like new because it was impossible to find a replacement in better shape.

To complete the interior, I varnished the floor boards and the boards that cover the battery and fuel tank. The instruments, hardware and electrical system were installed next, followed by the steering system and wheel.

An important and long-awaited aspect of this restoration was the complete rebuild of the outboard motor, an Evinrude 35hp Lark, also known as the Big Twin. John Monahan from Little Falls, Minnesota did the work. His shop is full of old engines in various stages of restoration to original condition. Monahan is a great man doing excellent work.

The last major refurbishing project was the seats, and they posed a tough challenge. The seat backs are curved, and the original backrests were missing. I ended up fabricating new parts, which took a long time. I also had new cushions made and installed. All that was left to do was apply decals and clean the boat, and finally it was finished.

On August 29, 2010 I launched the boat. The engine started and I finally got to see what this little boat could do. Everything went great and we topped out at almost 30 mph.

After restoration

My Larsen Thunderhawk is 53 years old, but after the restoration, I think it looks better than it did when it was new. I feel like I just got this boat from the manufacturer. ■

What you can do if you want epoxy to stick.

don't

By Bruce Niederer

We spend a good amount of time doing everything we can to inform our customers how best to make WEST SYSTEM Epoxy stick to wood, metal, and even plastic, or underwater with the introduction of G/flex 650 and 655. Still, there are many instances when you don't want the epoxy to stick to one surface or another.

Table tops and work surfaces

The most simple fix is to cover your work bench with 3 mil or heavier plastic sheeting. It's inexpensive and tear resistant, can be taped to the work surface and cured epoxy will peel off it. Other even cheaper options include cutting open a garbage bag or plastic storage bag. However, plastic sheeting can melt if a cup of mixed epoxy sits on it and overheats.

A good option is to use a waxed Melamine board available from lumber stores. Applying 2–3 coats of a good automotive paste wax with carnauba in it creates a pretty good non-stick surface that has the advantage of being hard for more exacting work or clamping operations where the plastic might get in the way. Guide lines can also be marked on it accurately without having to deal with any movement. Our Senior Tech Advisor Tom Pawlak uses and recommends Meguiar's® Mirror Glaze Auto paste wax.

We use plastic packaging tape as a mold release for repairing damaged wood trim.

Another easy option for preventing adhesion to a working surface is plastic packaging tape. It works quite well when you want the epoxy to stick in one place and not another, like on temporary frames used for stripper canoe construction.

Fasteners and Hardware

When you want to install a threaded bolt or screw and be able to later remove the fastener, there are a couple easy options. In our boat building class with the Saginaw Bay Community Sailing Association, we keep a wax toilet ring on the work bench and stick a bunch of screws in it. We just pull these out as we need them. The wax gets in the threads and we can back the screw out easily after the epoxy has cured. You can also put auto paste wax on a piece of cheesecloth, grab the threads firmly below the head and back it out with a cordless drill in reverse. This applies a nice thin coat of wax evenly over the entire thread pattern.

Pam® Cooking Spray is a quick and convenient adhesion preventer. Simply place the fastener on a paper towel and spray the threads, butter the threads with a bit of thickened epoxy so air isn't trapped, push the fastener into the oversized, partially filled hole and let the epoxy cure. Back it out after the epoxy hardens and now you've cast threads in the epoxy.

Polyvinyl alcohol or PVA is a green liquid available at hobby shops and craft shops. Dip the fastener in or brush it on the threads, let it air dry and install the fastener like I just described for Pam.

There are a number of aerosol mold release sprays on the market. A couple we've used around the tech shop are Stoner® E-497 and E-499 Thermoset Mold Release. They work well for all Thermoset resin systems used in most boats—epoxy, polyester and vinylester. They do not contain any silicone, which you want to avoid in any mold release, especially a spray. Silicone

aerosol sprays can contaminate the entire shop if you're not careful.

Another common household product that makes a decent mold release is Aqua Net® Regular Hold hair spray. It is nearly all PVA and works well.

Mold and plug surfaces

Molds and plugs get used in both production and one-off projects. In a mold the part gets built inside the form. With plugs the part gets built on the outside. To make flat panels, we often use tempered glass card table toppers—the most simple and basic shape for a mold surface. Mold shapes and surfaces can get very complicated especially in a production setting. It takes a lot of engineering to design and build a mold to make, say, the inside liner of a boat hull.

Many one-off composite projects utilize a plug because they are easier to build and generally require less material and associated cost. A one-off project might simply use stripper construction over frames to make a plug quickly and easily. Sometimes this can be made simpler by building a frame and stringer "skeleton" plug, glassing over the stringers and filling then fairing to build the designed shape. Plastic packing tape works great as a mold release over the frames and stringers.

The one thing all molds have in common is that the contact surface needs to be prepared so that the part can be easily removed once cured. Another requirement is that the part not pre-release or pull away from the mold/plug surface while still curing or while being post cured. Pre-release is generally more problematic with poly- and vinyl- ester resins systems because they shrink about 3–5% while curing, but it can and does occur with epoxy. Pre-release can cause print through, requiring more post-finish work, so the right choice of mold release can be critical to the success of a project.

For simple home-built projects, many of the materials I've mentioned above will work on molds surfaces. Meguiar's or other carnauba-based car waxes will work and they are easy to find. The aerosol sprays—Stoner Thermoset Mold Release agents and Aqua Net hair spray can work well by themselves or in conjunction with a wax. The trick is to mist the sprays over the mold surface. Multiple thin coats work much better than a couple heavy coats and result in a better surface profile as well. Many times the first part pulled from a mold is the most problematic and the wax/spray used in combination addresses the issue very well. You can read what a friend did to build a mold and make fan shrouds for our local Metro Buses using the wax and hairspray method in *Epoxyworks 14*.

Senior Tech Advisor, Tom Pawalk, prepares an aluminum surface for epoxy by applying a coat of PARTALL Paste Wax #2.

There are also a wide variety of application-specific commercial mold release products. Application variables are resin type (epoxy, PE or VE), cure schedule (room temperature cure or post cured) and the size and complexity of the mold. For room temperature projects, I have become enamored with PARTALL Paste Wax #2. It's a little different to apply than a car wax—you don't let it dry to a haze or it is really hard to buff out. I let it sit for about 60 seconds and then start buffing with cheese cloth. The result is a highly polished surface that resists separation and fish-eyes.

For post cured parts, it's necessary to have a high temp wax that will not break down at elevated temperatures and cause the parts to stick. PARTALL Hi-Temp® wax utilizes a Teflon® additive to achieve this property. Neither of these products contain silicones.

Another wax I have more experience with is made by TR Industries—TR 104 Hi-Temp wax. This product achieves its high temp properties by formulating with very high carnauba content. We have used this wax at temps of 180°F for 8 hours without pre-release or break down occurring.

Any of these waxes can be used with PVA spray films to increase the release-ability on difficult or intricate molds. Remember, with epoxies, poly- and vinyl-esters you should **avoid mold releases that contain silicones** which can contaminate the part or worse. ■

How Six10 was Formulated

By Mike Barnard

For additional information on Six10, visit: westsystem.com/ss/new-six10-epoxy-adhesive/

Putting epoxy resin and hardener into a single cartridge was an idea we had years ago, but the technology was never around to do it. Once the technology became available (in the form of a u-TAH chambered cartridge with a mixing wand), we needed to develop a two-part epoxy to go in it.

We chose the characteristics we wanted for this new epoxy: long open time, fast through-cure, full cure overnight, and ability to cure at low temperatures. With these guidelines, our chemists developed a formulation that has the pot life of 206 Slow Hardener and time to a full-cure similar to 205 Fast Hardener.

We didn't determine the ratio needed for Six10 (2:1 by volume). It was set by the cartridge manufacturer. Our role was to formulate an epoxy system to fit that ratio. We also had to choose a static mixer that would completely mix the two parts while keeping the volume in the mixer to a minimum.

In order for the static mixers to work properly, there could not be any air voids in the cartridges. Air voids exert different pressure on the resin and the hardener during the mixing process and can throw the mix ratio off kilter. To solve this, while developing the product, we used a small mixer that allowed us to mix components in a vacuum. Once the tubes were filled, we could continue our testing. The small mixer was eventually replaced with a scaled up larger mixer for final production.

We tested an assortment of mixing wands before selecting one. A longer static mixer would have wasted more epoxy (whatever was left inside the wand), while a shorter one would not have mixed the components thoroughly. The dual goal was to achieve a complete mixture while minimizing waste. To determine the performance of each mixer, we dispensed lines of epoxy and tested them in our lab to see if they were fully mixed.

The cost of these static mixers also helped to determine the end choice. Some of the mixers tested were much more expensive (and didn't perform as well) as the one we selected.

We measure the pot life and viscosity of every batch to ensure product quality, and we also measure shear thinning, the property that makes Six10 lose viscosity when it's worked, and allows it to gel when it's left alone. We developed Six10 to have good shear thinning so the resin and hardener components would be thoroughly mixed by the time they reached the tip of the mixing wand. Shear thinning also allows Six10 to saturate fabric with some effort while retaining a non-sag consistency. To test for shear thinning we work the product to induce a lot of shear, let it sit for exactly one hour, then measure its viscosity. This allows us to compare batch-to-batch viscosities with great accuracy.

The shelf life of Six10 is a minimum of two years (just like the hardeners throughout our WEST SYSTEM line), but it should last longer, assuming room temperature storage. We keep samples of every batch of epoxy resin and hardener we manufacture for a minimum of 2 years. ■

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.**

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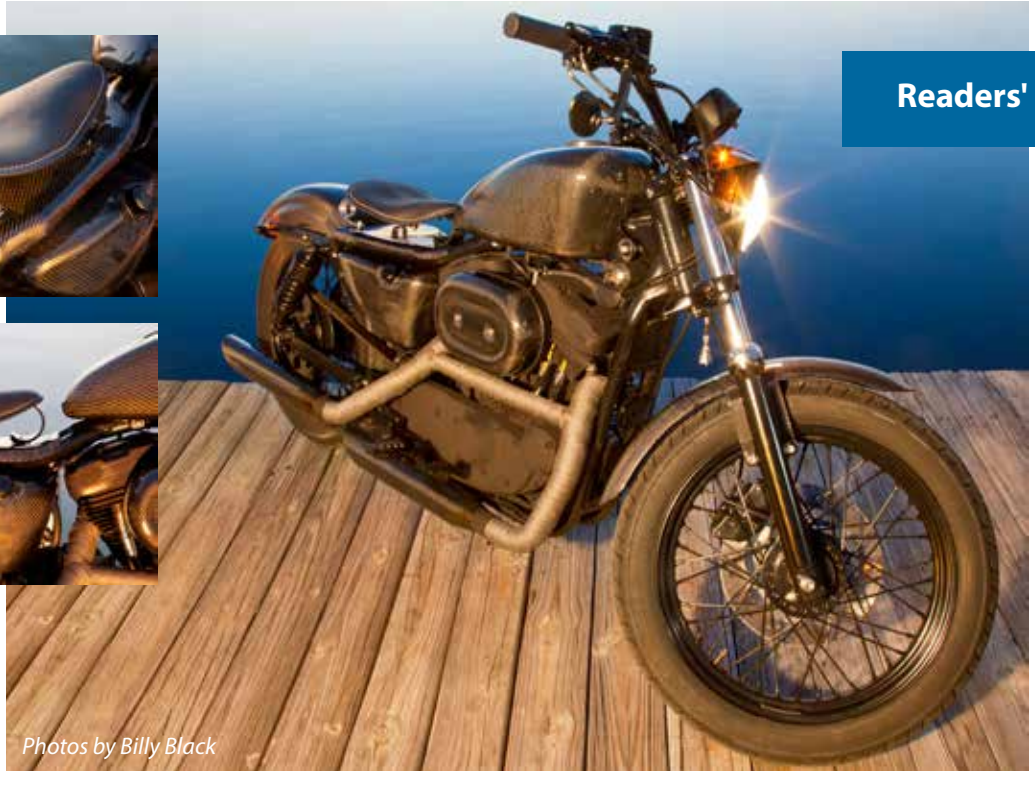
Readers' projects



Harley Davidson Sportster 883 refurbished by Rafa Abella using WEST SYSTEM Epoxy

Photos by Billy Black

Garden fountain made from a hollow piece of driftwood coated with WEST SYSTEM Epoxy. Submitted by Paul Foley.

Rob Caveney built a 18' 9" Whitehall pulling boat named Indian using WEST SYSTEM Epoxy.

Jerold Knox repaired his wooden golf club with G/flex and wood shavings stained to match the his club.

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