UPDATE TO THE
SEARUNNER CONSTRUCTION MANUAL

PHASE I-UP

BUILDING FOR LONGEVITY

By Jim Brown

Some old boat yards, those with lots of real estate, seem to specialize in collecting derelict vessels. Among these, one often sees wooden craft in various stages of decomposition, and sometimes they include the 1960s-inspired, owner-built, plywood multihulls, like Searunner trimarans. Perhaps their owners are still paying rent to store their crumbling dreams. Others are obviously abandoned to the weeds, their state of disrepair beyond anyone but the likes of Joshua Slocum who, with great skill and bravery, rescued the abandoned *SPRAY* and sailed her alone around the world.

So, how long do you want your boat to last? Since 1972 I have been the sole keeper of my old Searunner 31' trimaran SCRIMSHAW, or was it she who has kept me? When building her I had no thought of her life span; ten years seems an eternity when you're in your thirties. All I wanted was to take my family on a long boat ride, and I had no idea the boat would become such a fixture in my life. She was built in a rain forest, of economy materials, before the common availability of epoxy, and she still sails today (2014). There's not a spot of rot in her, but she's "full of holes," and I'll try to tell you why

Lightweight wooden boatbuilding has changed a lot in her time. *Praise Be*, it's still done mainly with wood, because in my opinion the best way to get a good boat that you can really love is to build it yourself of wood. But like all materials it has its problems, so what follows is an account of what one man has learned about how to make an old Searunner last, **Section One**, and about building new wooden boats for longevity today, **Section Two.** My opinions have been hard won and so are expressed firmly as if resulting from worst case scenarios. I only wish someone had done the same for me.

SECTION ONE

RESCUING THE OLDIE-BUT-GOODIE WOODIE

On examining derelict vessels, one wonders about the wisdom of attempting to repair pervasive maintenance neglect, especially big rot problems. Almost any degree of damage can be overcome now with epoxy; just cut out the soft spots and re-build. But the matter rests on one's resources and resolve. If the craft in question happens to have been originally built by its presently aspiring savior, then there is a good chance of success. After all, if you built it, you can probably rebuild it. But despite your crumbling boat's emotional value, perhaps it would be better to start anew or try farming.

Let's focus, then, on vintage plywood boats that have a real chance to see extended service in the future. These will likely be the ones whose exterior fiberglass sheathing was carefully done at the start, and survives pretty much intact. The hulls, decks, hatches and windows show little sign of leaking. There will be little evidence of standing water in their bilges or anywhere down below. Their *copious ventilation* will have prevented terrarium-like conditions from developing inside; this last point is critical.

Wood Itself…

Wood is truly wonderful stuff. The strength and stiffness of the western softwoods like Douglas fir, often used for making plywood in the past and for boat framing still today, and the tropical species like okoume, often used today in plywood, make them the ideal choices for modern (read lightweight) wooden boatbuilding. And make no mistake, wood *is* modern?

Both owner-built and professionally-built vessels of great variety can have laminated wooden structures that exhibit surprising stiffness, strength, lightness, and fatigue resistance. Such physical properties can rival those of the most exotic, synthetic, aerospace composite materials, yet are routinely achieved by even amateur craftspeople in home workshops with ordinary tools and at relatively low cost. Until the advent of epoxy, all they lacked was permanence. Yes indeed, epoxy has caused an absolute sea change in small craft design, construction and repair. In this Section, we will speak mainly of repairs to oldie-but-goodie woodies, those built without epoxy. Together with the new techniques discussed in Section Two, let's hope this may lead to your boat – old or new – lasting for generations. To achieve this, your first step is:

Put Holes In Your Boat…

For multihulls especially, to accomplish *enough* ventilation, I believe that many small openings in the hull sides are better than one or two traditional cowl vents installed on deck. My trimaran *SCRIMSHAW*, now over forty years old, has spent most of her life afloat and often in the tropics. She lives today because I poked her full of holes.

These include eight, 4” screw-out “inspection ports,” two in the main hull forward and two more aft, and one in each end of each outer hull. All were located in the *hull sides!* On no account can I recommend any type of ventilator located on deck; they always leak in driving rain or spray (except perhaps traditional Dorade vents) for the same reason, neither can I abide any deck hatches located over bunks.

This perforation discipline is hard to practice in monohulls, but in multihulls, the main hull vents (again, located in the hull sides are protected from rain by the wing overhangs, and the outer hull four (located on their inboard sides near each end) are protected by the hull’s overhanging flare. These latter sometimes take a few drops of rain, but the air exchange is sufficient to dry them up quickly.

SCRIMSHAW also features three “scuttle plugs.” These are small, thru-hull openings in the deepest bilges of all three hulls. Used nominally to scuttle the craft, but practically to admit a few thousand pounds of water as ballast (for holding her down in the event of riding out a hurricane in harbor), they also serve as drains when the craft is hauled out of the water. They permit cleaning inside with a hose, and serve to evacuate any standing water while on the hard. All those poor derelict vessels wasting away in boat yards are probably leaking rain water through their decks and hatches, and therefore they are harboring puddles and ponds inside. They might well have been saved by drilling simple holes at all their interior water traps. Holes are easy to fix later, but no, most owners will say, “Don’t ask me to drill holes in my boat,” and so they face problems sometimes impossible to fix.

Whenever a craft is disused and left in some form of storage (which is most of the time for most boats) all these multiple vents are left open whenever the craft is idle, whether it lies afloat or ashore. It is during disuse that “steam box” conditions inside can cause insidious, pervasive degradation.

To exclude nesting birds and sheltering beasts, all open vents need screens made of ¼” mesh hardware cloth, cut oversize and stuffed into the openings, and these coarse screens can be doubled with mosquito netting when necessary. Vents located in the accommodation are installed to open from inside, and their covers can be attached by a cord to hang nearby. Those that open from outside must have their covers un-attached, so at least two extra covers are needed as spares.
Of course, all these small openings must be closed before sailing anywhere, and they should also be closed on the approach of major storms. Dealing with all these

openings is downright inconvenient but – in my opinion – absolutely necessary for the longevity of a non-epoxified, lightweight wooden boat that lives south of the Mason-Dixon Line.

Searunners were originally designed with “wet hatches” leading into storage bins in the wings, and these have caused a fountain of problems. It has long been recommended that all wet hatches either be fitted with coamings and gasketed covers - or better yet - be omitted. In boats built without epoxy, they should be permanently closed and ‘glassed over, and the voids created in the wings should be copiously ventilated from inside.

Ventilation is vastly improved in boats that live at anchor or on moorings. Out in the breeze, their ability to weathercock pumps the air exchange. In fact, I believe that berthing a boat, or storing it on land, is really hard on it. Unless it is under cover or turned around frequently, the sun cooks it on one side. Also, in some marinas there are errant electrical fields created by shore power and these can be devastating to boats. There are preventive measures for this complex electrical problem, but they, too, are problematic and expensive. The best way to avoid them is to refrain from leaving shore power on your boat plugged in all the time or, better yet, moor out.

Dealing With Dings…

The life of a modern wooden boat depends on its epidermis, its skin, its membrane of fiberglass sheathing) to *keep its wood dry*. Just as with many living organisms including humans, the skin is the largest organ in the body, and with wooden boats, there is “skin,” or surface, both inside and out. In multihulls especially, there is a whole lot of surface, and every square inch of span, every hollow, corner and knob, deserves regular attention because during the service life of the craft, its “hide” is bound to get dinged up.

Unlike with living organisms, boat dings don’t bleed and they don’t send a pain message to the brain. Instead, they soak up water and become quietly “infected.” That is, when water enters through a violation in the epidermis, and is literally drawn into wood by the natural capillary action of the wood cells, it causes the wood to swell, and this swelling is powerful, irresistible, and inexorable. For example, all the huge stone blocks used in the construction of the Egyptian pyramids were cut, or rather split, to size by swelling wood. The stonecutters bored holes into the rock in lines to describe the block shape they wanted, then drove wooden pegs into the holes, (driven below flush to form cups, and then they poured water into the cups. Overnight the pegs would swell and split the stone along the line of pegs.

This skill supports the notion that if water enters the wood of your boat through a ding in the coating or sheathing, the wood is going to swell, probably enough to cause the ding to grow, and thereby admit more water, even with the next night’s dew. These growing cracks can easily split a film of paint and even a light fiberglass sheathing. Called “zippers,” these cracks in sheathing are identified by the in-line, slightly-but-regularly jagged cracks that appear in ruptured woven fiberglass. They may also appear as multiple, tiny, parallel “checking cracks” in wood not sheathed but only coated.

All these lesions can – if left unattended – really eat up a modern wooden boat. Even when the sheathing is sufficiently strong to resist zippering, such as multiple layers of fiberglass at chines and sheers, you can bet the wood is trying to swell *on the inside*. If accompanied by terrarium conditions inside, this can lead to real complications.

When water enters through a ding, and migrates via capillary action away from the ding, and if the epidermis is otherwise complete, then that water *can’t get out.* To repair such a problem, it may be necessary to remove the coating and/or sheathing from the saturated area, and impose extreme drying conditions such as absolute shelter from a continued source of water, and perhaps the use of heat lamps to drive water out of the wood.

Therefore, it is very useful to deal with dings as soon as they occur, or as soon as they are discovered. This implies an awareness of dings by the crew and the owner, but it does not mean that you have to stop sailing and at once perform a proper repair by sanding the area and applying a careful fiberglass patch and re-painting. No, the immediate need is just to stop the regular supply of moisture by applying a “band aid.” In this case, just a thickish smear or bead of some *flexible* sealant, applied with the gloved finger, can completely seal the problem. If the surface is wet, try to dry it and blot the wood, clean and dry the surrounding surface (rub or sand off dirt, salt and paint chalk) and then apply the band aid. Even if the wood inside the ding is wet, seal it up anyway for now. At least that will keep the air out, and to flourish, rot needs air.

Such band aids are what sailor’s call “homeward bounders, meaning temporary repairs made to keep the vessel going on the homeward leg of a long voyage. They are intended for more careful attention later in the boatyard. Nevertheless, a good band aid can last for years, even for an extended cruise.

A flexible calk is prescribed for band aids because the wood is wet and so will swell, however tiny the ding may be. A simple swipe of hard-curing epoxy resin is ineffective for band aids because, without fiberglass to reinforce it, swelling can crack the resin open, or the epoxy may not cure properly if the wood is wet. Band aids, therefore, are best made with a flexible calking sealant that is tolerant of a wet substrate. By applying sealant slightly beyond the extent of the ding, it will allow the ding to zipper a little underneath the band aid. One of the new flexible epoxies may be appropriate for band aids, but they require mixing (probably more than is needed), and the mixing itself is inconvenient if the craft is in use.

Silicone sealant would be ideal for band aids except that nothing will stick to silicone later; it has to be completely removed and the area thoroughly sanded before making a permanent repair. The Polyurethane calks, like *Sikaflex®* and *3M 5200®* are the most tenacious, flexible and sun resistant for band aids but, if the ding is located where a machine sander cannot reach, the polyurethanes are so tough that they can be hard to sand off later when making a permanent repair. The polysulfides, like Life Calk, are much easier to remove in tight places where the machine sander cannot reach, but they don't last as long in the sun as the polyurethane sealants. No matter what may be available, anything from duct tape to dum-dum, you can save yourself a lot of trouble if you seal dings with *something flexible* as soon as practicable.

Metallurgy Madness…

One of the great mistakes made in designing Searunner trimarans was to specify alloy 304 stainless steel for all the chain plates and rudder hardware. It was the most available of the stainless alloys at the time, and, as in many other boats, the older Searunners have really "aged" because of it. Nowadays only alloy 316 should be considered.

Another of my great mistakes was to draw all the Searunner metal work as welded components, especially the doublers welded to the tops of the chain plates. This was standard practice in the days when bronze plate was used for such marine fabrications, but with escalating copper prices, bronze became unapproachable, and the welding of 304 stainless steel caused real metallurgy madness. Among the problems are such phenomena as crevice corrosion and stress corrosion cracking. The upshot is that my partner John Marples, who is a highly qualified marine surveyor and mechanical engineer, has long since re-drawn all the Searunner metal parts and written comprehensively on marine metallurgy. He makes this text available to anyone, free and on request to www.searunner.com .

Please note: Anyone owning, selling or buying an old Searunner, one which has been used extensively in seawater, and whose metal parts are as originally designed, is hereby advised to inspect all metal parts carefully as described in the Marples text.

Time marches on! Thirty or forty years on the original rigging and hardware is asking a lot. Because of their double-spreader rigs and other redundancy, dismastings in Searunners are rare but they are dangerous as well as inconvenient. Rudder failure at sea can be even more debilitating. When replacing this hardware, *include new fasteners of 316-alloy stainless steel.* Carefully re-bed the replacements with polyurethane sealant.

Similarly, Searunners were designed to include chain plate-like tangs for lifting the boats by crane with a cable bridle. This system worked fine when the boats were new, but the lifting tangs suffer the same corrosion problems as with the rigging chain plates, and heavy stress on the lifting bridle tangs increases the prospect of slight shifts in their position, which can cause the sealant to be violated with leaks resulting. Leaks around such deck-piercing components may well soften the wood to which they are attached. At least one dropped boat has resulted. We urge owners to remove these tangs and patch the deck in their vicinity. At the very least, ***do not use*** the Searunner crane-lifting system or anything like it in an old wooden boat.

For boats built to last, all its chain plates and similar hardware should be designed for installation *outside* of the hull planking or superstructure. This avoids the problem of piercing the deck, and eliminates the age-old problem of sealing the deck around such highly stressed hardware.

One possible exception to betting hardware with flexible sealant may be in the case of "bonded hardware." This is the technique described in the great reference book entitled, "The Gougeon Brothers On Boat Construction," which prescribes literally gluing heavy hardware to the boat with epoxy. This system implies that the hardware cannot shift even minutely, and it has proven effective even for large boats with extreme rigging loads. However, bonded hardware does not address the issues of long term bonding of epoxy to metal parts that are subjected to protracted exposure in seawater and severe thermal cycling as in the tropics. Furthermore, stainless steel depends on contact with air to achieve its corrosion resistance, and certain applications can allow seawater to puddle in crevices, thereby causing oxygen starvation and accelerated corrosion where it is hard to observe. For real longevity, my personal preference is to bed heavy hardware with flexible, polyurethane sealants using plenty of 316 stainless steel fasteners and always without piercing the deck.

Rigging wire also deserves yearly review, and careful inspection before every offshore voyage. All the wire terminals should be scrubbed with an abrasive pad and examined for hairline cracks and evidence of corrosion inside. Terminals at the deck are exposed to more salt, and so are usually the first to show signs of corrosion such as swelling and cracks bleeding rust stains. However, all the upper terminals also should be inspected. This requires ascending the mast in a bosun's chair with a small mirror, for viewing around and behind the terminals located against the mast. Then, by descending the mast slowly, the inspector is permitted to slide his fingers over all the wire, feeling for broken strands. In 1X19 wire, if one strand is broken, this does not suggest that 18/19ths of the strength remains…. No, a single broken strand indicates the remaining 18 strands are probably ready to break, and replacement is in order. Making eye splices in 1X19 wire is not recommended.

Some Searunners, such as the 25 and 31 have extensive aluminum parts. If anodized as per the original specifications, these components have been seen to serve well for at least forty years, but like the stainless parts, aluminum deserves careful periodic inspection. When Stainless steel fasteners are used to mount aluminum components, and the craft sees extensive service in seawater (especially warm, high-salinity seawater as in the tropics), the aluminum can often be seen to corrode in the immediate vicinity of the fasteners. One method of preventing such corrosion is to carefully clean the corroded area with an abrasive pad and fresh water, and then bury the area – the fastener's head and its immediate surrounding aluminum – with silicone sealant. A small "acid brush," such as is used to apply soldering flux, can be used to apply the silicone sealant, and two coats are required. Of course polyurethane sealant can also be used, but the clear silicone is very sun resistant, just as water-exclusive, and much less visible than the opaque polyurethanes.

Of course the vessel's sails, hardware, plumbing and wiring must also be inspected and/or upgraded, and all repairs to the sheathing and structure should be done with epoxy. Now with all of the above pontification in the record, and for what it's worth as one man's opinion on how to save the old lightweights, let's keep it as reference as we consider building anew for longevity.

SECTION TWO

BUILDING NEW TO LAST

For millennia, wooden boats have been built with redundant massiveness to allow for cycling saturation and fungal degradation. Traditional wooden boats are built like baskets, and modern wooden boats are built like bowls. In either case, water can get into their wood and have trouble getting out. In addition, decked-over vessels keep wet water out and keep wet air in. With either the basket or the bowl, extremely humid conditions are often created below decks. Given leaks in the basket or cracks in the bowl, the wood in either one can turn to oatmeal from outside in and, especially, from inside out. But it doesn't have to be that way. You can build your boat of unobtanium or – better yet – of wood/epoxy.

About Epoxy…

Please see INSTALLMENT 1 of these updates to Phase I of the SEARUNNER CONSTRUCTION Manual.

More About Wood…

The problem with wood is not when it is in the tree; it is when it gets messed with by man. In the tree, the fledgling, water-transporting cells of the outer sapwood layers surround the mature, strong cells in the heartwood, thereby maintaining the trunk's true strength at a relatively *constant moisture content*, sealed off from the air and the agents of decay. But when the tree is turned to lumber (or to veneer for making plywood) it exposes the wood – for the first time in its life – to the air and the world.

Meade Gougeon, who pioneered today's wood/epoxy boatbuilding method, says, "When we rip wood into boards, it gets its first chance to dry out. It shrinks and checks, and becomes just like a sponge, ready and waiting to soak up water again, swell up again, dry and check again, swell again faster, and so on, literally trying to tear itself apart,."

Furthermore, Dry wood is far stronger than wet wood. “Just try using a toothpick,” says Meade’s brother Jan. “It may be stiff and sharp at first, but it soon becomes wet and wimpy. Give it time, oxygen, warmth and moisture, and it will rot away.”

There is little doubt these days that any modern (read light weight) wooden boat should be totally epoxified inside and out. At least the potential for great longevity exists with this technology. It has to be used right, and kept right, but thousands of years of evidence supports this potential.

For example, consider the furniture retrieved from the Egyptian Toombs. Beautifully spare, the highly crafted pieces are still usable after a thousand years and more of storage in sealed stone chambers in a desert; a stable moisture content. And then there’s Ice Man, the early-modern human found frozen in a receding glacier in the Italian Alps. He and his bow and arrows were still intact after *five thousand years* in the cold with a stable moisture content!

But a boat, now, lives both in the water and out, hardly a moisture-stable environment. Furthermore, the very nature of a decked;-over vessel implies both keeping wet water out and – what’s worse – keeping wet air in. If you really want wood to last, and the boat is to be light weight, there is little doubt these days that it should be absolutely mummified on all surfaces with epoxy.

Today’s wood resources have changed too. Instead of Douglas fir plywood, which is hard to find in decent quality, nowadays the usual choice is for the imported okoume, sapele and others. This is good stuff if labeled “1088” and if it is not counterfeit. When buying plywood, try to make a deal with the supplier that you intend to cut a little corner off of one sheet and boil it for five minutes. If it delaminates, you should be able to send the whole lot back at the supplier’s expense. Imported plywood usually comes in millimeter sizes, but the conversion to specified inch sizes is simple, and the good news is that most imported, exterior grade panels have at least five plies, and the species take well to epoxy.

Framing lumber, for stringers and frames, is still usually Douglas fir, but sometimes one of the various mahoganies (or other suitable species that are light, stiff and rot resistant) is available at competitive prices. Choices can be complex, but most of these lumbers, when combined with good plywood and good epoxy, will build a great boat.

The Pin Hole Factor…

Of course the craft’s entire structure must be protected from moisture vapor everywhere and –for real longevity -- this protection *must be maintained!* Let’s face it, we are dealing with a mere coating here, a film, a membrane, a sheath. Said *in extremis*, it’s almost like a condom wherein a tiny pinhole renders the whole concept useless. One cannot be a little pregnant but with wood it’s not that bad because a boat can be a little wet, at least for a while, but to make it last, it wants to become dried out and sealed up again. So, besides coating and/or sheathing every wooden surface you can see, even the glue joints where you can't see, must be sealed. Right, both surfaces of all bonded joints, and especially all end grains, should be doused with epoxy glue during construction, right from the beginning.

Coating and Pre-coating…

To build for real longevity, then, apply epoxy coatings to as many components as possible before they are assembled in the boat. Ideally, all convex edges and corners will be eased with sandpaper or rounded by router before coating. Sharp protrusions cause epoxy to pull away from them, leaving them thinly coated and vulnerable, as well as unpleasant to handle or live with.

Arrange your shop to allow bench space, saw horses and hanging hooks to facilitate this pre-coating. When components lay flat, they are so much easier to coat than vertical or inclined surfaces, or when trying to coat them after they are installed in the boat. For instance, to pre-coat both sides of, say, a frame, in a single operation, elevate the frame at least 1" above the bench. Use triangular-section sticks, or partially driven nails, or other props to achieve minimum contact with the bottom, wet surface. To get fancy, you can hang small components on strings from the ceiling for coating.

Always brush, squeegee or roller the coating material in two directions – up and down and crosswise – for an even coating, and when applying to vertical or angled surfaces, make the final strokes vertically to avoid sags.

However, flooding the wood with epoxy on the first coat accomplishes little and costs a lot. Using the squeegee, brush or roller, apply the initial coat of epoxy as light as you can make it. End grain areas and plywood edges can benefit from a second swipe after the first has had a moment to soak in, but otherwise make the first coat as "dry" as you can get it, like it was scraped with a squeegee. Then, after the first coat has cured, a light sanding will remove whiskers so that a second coating, also applied sparingly, *cannot soak in* because the first coat has sealed it out. Therefore, the second and all subsequent coats will cure with a smooth, glossy finish, almost like glaze on ceramics.

In areas where water can puddle, such as in bilges, behind refrigeration, and below heads and showers, beneath galleys and machinery, a third coating of epoxy can be worthwhile.

Blush…

Please note that most epoxy formulations cure leaving a slight, greasy film of "blush," which can prevent subsequent coats from bonding. This film is water soluble and can be removed by washing or wiping down with plain water. On large areas, rinse and wring out the wiper regularly.

Re-coating can be performed without wiping down if the existing coat has cured to just beyond its gel state, still a little sticky. However, wiping down blushed surfaces, and light sanding, is required if the existing coat has cured hard.

This blush problem is aggravated by working in low temperatures and high humidity. Avoid working with epoxy when the air and the materials are colder than 60º F, and 70º is recommended for bonding structural joints. Your project will benefit overall by having a warm, dry, covered place to work, at least on sub-assemblies. In some climates, building outside can be accomplished, if with difficulty, by selecting the weather for final assembly and finishing, but your success in meeting this challenge can certainly influence the longevity of your boat.

Outgassing…

A stable temperature also can be very helpful. When coating wood, a lot of air is trapped inside. If the temperature is rising while the epoxy is still fluid, escaping air can blow little bubbles, *or cause tiny pores,* in the coating. To avoid this outgassing, apply coatings when the temperature is stable or declining. Subsequent coats will usually seal pores if properly applied.

In practice, the fabrication of wooden parts with epoxy glue joints is performed during the workday until late afternoon, and then their pre-coating is performed just in time to vacate the area until the following morning when all coatings will have cured undisturbed overnight. This provides a descending temperature to avoid out gassing, and avoids contaminating wet coatings with sawdust and other activity in the shop.

Decks…

Coating the undersides of decks is a special challenge. Ideally, each panel of decking is cut and fitted into place with minimal fasteners, then removed and pre-coated on its underside. And – while this initial coat is still just beyond the gel state – another coat is applied and used as the glue for promptly fastening the decking down to the boat. To assure a complete bond of the decks glue joints, glue is also applied to the hull's deck beams , stringers and sheers in the same operation as when second-coating the undersides of the deck panels.

Plywood decking applied over sealed voids, or in areas destined to receive insulation or headliners, should be triple coated. Insulated or headlined decks can be problematic for boats headed to the tropics, Not only can condensation and leaks be retained out of sight and deprived of ventilation, but the decking cannot dispel heat into the boat and so may suffer from extreme heat buildup. This is especially true of decks that are not painted white.

Of course, some of this coating must be done after components are assembled, but the longevity of your boat, and the task of building it, will both benefit from doing as much pre-coating as possible.

Sheathing…

While some small wooden boats can do without fiberglass sheathing on their exteriors, no seagoing craft or cruiser's dinghy can be subjected to the rigors of that heavy service without being sheathed with fiberglass and epoxy. In fact, many kayaks, canoes, and dinghies, and certain larger vessels, are designed for sheathing inside and out; they depend on it for their stiffness; they use their plywood skin as a core for a "glass/wood/glass" sandwich construction, a very effective approach.

However, this method is not used for most larger wooden vessels, where sheathing on both sides would add unacceptable cost and complication. In these larger craft, their plywood skins are made sufficiently thick, and their interior skeletons add sufficient stiffness, to allow sheathing on their exterior surfaces only. This is the case with all Searunner trimarans and most (but not all) larger plywood vessels. When epoxy coated on their insides and sheathed only outside, they become very strong and stable over time. But to achieve real longevity and to *minimize long term maintenance and repair,* a robust exterior sheathing is critical for "workboat" service, and a cruising boat is really a highly specialized workboat.

In preparation for sheathing, all depressions and fastener holes (where fasteners have been removed), and all outside corners must be thoroughly rounded and all concavities filleted. Then, all heavy wear areas (such as cockpit soles, thresholds, anchor-handling areas, and propane bottle and dive-tank storage spaces) deserve special attention and at least two layers of sheathing. All deck-to-hull joints, superstructure transitions, scarfs and butt seams, and all multihull wing edges) should be reinforced with extra layers of sheathing. Even in the shade such as under the wings, all transitions between wing and hulls and at scarfs or butt seams in the plywood, extra reinforcement is indicated to resist the slamming loads imposed by underwing pounding on wave tops. Similarly, all seams in the hull topsides, and bottoms, such as at scarfs, butts, chines, stems, transoms and especially centerboard trunk apertures, require very careful fiberglassing with multiple layers.

How many layers? Well, that depends on the size of the boat, the weight of the fiberglass cloth being used, and the particular area being sheathed. Most Searunners were built with 4 ounce fiberglass cloth – a single layer – on most flat areas. Two layers are specified at flat butt seams in the plywood, with three layers at concave corners and four layers at outside corners and underwing transitions. Two layers are prescribed for all below-waterline flats just to give added abrasion resistance for scraping off barnacles and sanding off bottom paint. When done will, this schedule has been seen to last for decades even when done with the old polyester resin and the old, relatively crude “e-glass” fabrics then available.

However, In hindsight it would have been better to specify two layers of 4 oz. on all open flat areas (plus the above mentioned added reinforcements) if only to provide a margin for sanding. One may ask why not just use one layer of 8 oz. cloth instead of two layers of 4 oz.? Well, with two layers, any damage done to the top layer, such as with the machine sander, preserves the integrity of the underlying layer.

Fiberglass cloth is wonderful stuff. It has great tensile strength, and when bonded with epoxy it has far better film, shear and peel strength than with polyester, but if you so much as nick it with a sander it greatly diminishes its integrity. In aircraft construction, for instance, the FAA prohibits any sanding at all on fiberglass joinery because sanding can so easily reduce the strength of fiberglass sheathing. This explains the development of Peel Ply, a sacrificial fabric overlay. When applied directly over wet sheathing, this fabric is used to smooth down edges and whiskers in the sheathing beneath. When worked down with the fingers and squeegee, it easily distributes the resin properly in multiple layers of fiberglass beneath, and removes excess resin. After the job has cured, the peel ply is easily removed, like peeling off tape, and the result *vastly reduces sanding*. This alone is reason enough to use Peel Ply extensively when sheathing corners and edges.

While speaking of sanding, it is critical to keep machine sanders completely away from the sheathing that has been applied to convex, protruding areas like *outside corners*. *Sand them by hand!* The machine, even the new DA sanders, will easily grind into sheathing on “proud” areas, only to create insidious maintenance problems months or years – even decades – later.

Hatches…

Leaking hatches have caused the death of many boats because they lead to standing water in the bilges. Any openings in the deck are prime suspects in allowing rain water to puddle inside, and again it is the vapor from evaporated interior standing water that so insidiously attacks the boat from inside out. Searunner plans contain detailed drawings for building your own deck hatches, but the project often is daunting for owner-builders. Store-bought deck hatches can solve this problem, but the good ones are very expensive, and they, too, can leak if improperly installed.

To build your own deck hatches, begin by sheathing the decks first and then cutting the hatch openings, and then installing the hatch coamings. This insures that the sheathing comes all the way to the coamings, which are then installed around the openings. The coamings, which frame the opening and protrude above the deck, are often inadequately sealed to the edges of the openings. The coamings are best made with a noble, very rot-resistant wood like teak (it doesn’t take a lot). And most important, the adhesive used to install the coamings should be a flexible polyurethane sealant. When used copiously, it squeezes out onto the deck and can then be formed into a generous finger fillet all the way around the coaming. This fillet can be painted over when painting the deck. Lap joints at the coaming's corners are similarly sealed, and the same procedure can be used around the companion hatches.

As mentioned in Section One, Searunners were originally designed with "wet hatches" leading into storage bins in the wings, and these have been a fountain of problems. It has long been recommended that all wet hatches either be fitted with coamings and gasketed covers - or better yet - be omitted. In boats built without epoxy, they should be permanently closed and 'glassed over, and the voids created in the wings should be copiously ventilated from inside.

Windows…

Many modern boats, especially multihulls, are so plastered with windows that they turn into green houses and rot boxes. The temperature-caused expansion/contraction rates of the window materials can vary greatly from those of the hull or superstructure materials, and the resulting minute movements make windows hard to seal.

The modern means of installing windows now employs flexible adhesive (no sash or fasteners) that, theoretically, can tolerate considerable changes in the size of the opening relative to the size of the pane. If the installation is truly done with clinical perfection, the results can be surprisingly good. Nevertheless, if your boat is made of wood – and no matter the type of window installation – it is recommended that the edges of the openings and the surrounding areas be very carefully sanded to remove sharp edges and then receive at least two coats of epoxy. The plywood end grains deserve repeated swipes with the first coating, with a light sanding between coats.

Then, if two-part paints are used, the final coat of epoxy is lightly sanded and primer painted, with even the final finish applied, both inside and out, before installing the panes. This assures that the edges of the openings will resist damage from ultraviolet light passing through the panes. When this sun damage is combined with either leaking or interior condensation, water is admitted into the wood around the opening, which can lead to difficult repairs. Indeed, leaking windows can be structurally damaging in any boat made of any material.

Laying Up…

When your boat is being lived aboard, ample ventilation is of course desired. This is hard to employ in cold weather, when condensation can make life miserable and soak the boat inside. Ample heat combined with minimal ventilation helps keep condensation at a livable level, but the condensation problem gives all the more reason for total interior coating with epoxy.

If uninhabited, with no breathing or cooking going on inside, a well-ventilated boat will normally stay dry inside, unless you leave her in a jungle setting, where dampness can really take over. Someone needs to open up and air out in fair weather daytime, or else the whole interior can develop mildew or worse.

However, if your boat is truly water tight, with dust in the bilges and absolutely zero leaking through the deck, the vents , windows or hatches (no possibility of standing water), then and only then it is just possible to close her up tight for storage, especially in northern climes. This helps to keep her clean and dry when not in use, but this tactic must be augmented by placing chemical de-humidifiers inside.

Ventilating, however, is safer all around because it tends to equalize both the humidity *and the temperature* inside and outside the boat – and in her materials. Cycling discrepancies in temperature between wood and the denser materials, like metal fasteners, and even the coating and sheathing, cause any moisture in the wood to migrate toward and condense on the cooler, denser components. Whether you ventilate or close your boat when laying her up, it is knowledge of such insidious phenomena as blush, out gassing, capillary action, hairline cracks, zippers, dings and internal condensation, that emphasize the need to begin with a thorough coating of epoxy inside and a solid sheathing outside, -- and keep it that way…. *for the life of your boat!*

Paintwork...

This subject has caused builders more grief than perhaps any other. For amateurs, the trap is in trying to achieve an automotive finish on a covered wagon. With time it becomes clear that a fine finish adds little to the cruising experience or to racing success. With your new boat, you may want to completely develop it in primer paint only, and even sail it and trail it for a season, before committing to a final paint job. Otherwise it is bound to get dinged-up with additional installations, changes and learning curve repairs.

There are a host of options when it comes to the final finish, and you can get as carried away as you wish with fairing, sanding, colors, striping, miles of masking tape, spraying and spending. You can also slap on house paint with a roller and go sailing.

Finishing “clear,” with varnish, is enticing for a wooden boat, but appropriate mainly for those that can be stored under cover. Clear, varnished surfaces are best when first fiberglassed with maximum four ounce cloth using one of the “clear coat” resin-hardener combinations such as West System® 105/207. Such combinations, if used over attractive plywood, can yield beautiful results in the hands of experienced builders. As always the epoxy must be top-coated, in this case with highly UV-resistant varnish to protect it from sunlight. If clear finishes are used only on vertical surfaces, maintenance is not unreasonable.

Most vessels will benefit from being painted with very light colors, as close to white as the owner's Polaroid-protected eyes will tolerate, especially on the decks. This cuts down considerably on heat, and epoxy does not like getting Hot. Decks are done with non-skid compound, either mixed in or sifted on to the next-to-last coat of paint.

Boats kept afloat in seawater will require anti-fouling paint below the waterline. This anti-fouling paint is best applied over sanded, bare epoxy/fiberglass sheathing, or sanded two-part epoxy primer covering the sheathing. If you have left your boat in epoxy primer for more than overnight, the primer will cure so hard that nothing else will stick to it, so it must be sanded (or etched with "no-sanding" primer)before re-coating with anything,

Sticking with "normal" marine paints for hulls and decks, there are just two choices: One-part polyurethane paint, and two-part polyurethane paint.

- **One-part poly** (comes in one can) is easy to apply, re-apply and patch, is not too smelly or toxic, comes in a wide selection of colors, is not too expensive, dries serviceably hard, and holds its gloss for about four years in constant outdoor exposure.

- **Two-part poly** (comes in two cans to be mixed), takes skill to apply, is more difficult to re-apply and patch, is extremely smelly and toxic (requiring a carbon-cartridge respirator even when applied outdoors), has a more limited color selection, is relatively quite expensive, dries extremely hard for heavy use and abuse, and holds its gloss for about seven years of continuous outdoor exposure.

The choice is yours, and should be obvious depending on your circumstances.

Please note that *on no account* is spray painting recommended for either of these paints unless truly professional skills and facilities are involved. Today's polyurethane paints have excellent handling properties for application by brush and roller – *if* they are correctly thinned with *the correct thinner for hand application*, and used only in the correct range of temperature and humidity prevailing during application and drying. When applied by foam roller and "tipped off" with a foam or soft bristle brush (making the final brush strokes *vertically* to avoid sagging), they can yield essentially "spray painted" results.

As with any paint applied over any non-porous surface, thorough sanding is essential. By "thorough," it is meant that there is nothing left of epoxy's gloss or any un-abraded portions of the previous paint. The surface must be free of any extraneous contamination like motor exhaust, un-vented kerosene heat, tree drips, human perspiration, etc. The best way to achieve this level of preparation is to paint promptly after sanding.

When re-painting older boats, certain areas like non-skid decks cannot be adequately sanded, without re-non-skidding, so after a rigorous scrub down with fresh water (allowed to dry completely), the surface is wiped down with the same thinner prescribed for that paint. The wiping rag must be really clean, non-synthetic cloth.

As can be seen, these modern paints are tricky, so tricky we wouldn't use them if their results were not so good. The directions on the can – and the consulting services available by phone and on-line from the paint manufacturer – should be followed to the letter. These instructions may include applying a primer first. On decks especially, a white, two-part epoxy primer is recommended to offer additional protection of epoxy from sunlight. Even two coats of primer can be used, the first a dark color, the second one white, applied in tack-free succession. (Again, if epoxy primer is left to harden for more than about 24 hours, the primer will cure so hard that nothing else will stick to it unless it is sanded (or etched with "no-sanding" primer).

No-Primer Finishing…

There is yet another option worthy of mention, but it requires at least some level of professional painting experience. "No-primer" finishing consists of applying a final finish of two-part poly directly over a well-prepared – but not primered -- epoxy coated or fiberglassed foundation. That is, two-part poly finishes will stick like crazy to bare epoxy and, if correctly thinned, they can be applied with a foam roller even without the customary "tip-off" with a brush. Cleanliness and dust control are essential, and a minimum of two coats in "tack free" succession are necessary. Excellent information on this method, and on epoxy work in general, is available at www.ptwatercraft.com.

No matter what paint or painting method you use, some experimenting, on inconspicuous areas of the job can be helpful. For example, vary the amount of brushing thinner, mixed in small batches, and applied to, say, the inboard sides of the floats, will determine how your mix is responding to the conditions. If your surface is really clean and well prepared, your results can be aesthetically excellent and very durable for many years. If the above makes painting sound inapproachable, just remember that the real purpose of the paint is mainly to keep the sunlight off of the epoxy.

May your boat serve your grandchildren!

Jim Brown, 3/18/2014