WEST SYSTEMS Epoxies for Model Yacht Builders

I. Background

The Gougeon Brothers of Bay City, MI have been a marine industry leader in producing epoxy-related systems and materials for more than 35 years. They have also developed other high tech epoxies for use in wind-generator blades, spacecraft and other high-performance aircraft (Spaceship One and the Global Atlantic round-the-world jet were WEST SYSTEM epoxy composites). From the outset the WEST epoxies have proven themselves to possess greater ***physical properties***, a far ***superior moisture barrier, less shrink*** *and better* ***elongation, flexural and impact resistance*** properties than polyester and vinyl ester systems. West System Inc. has been an industry leader in research and development and has developed a number of tests and procedures which have become industry standards.

Most of these properties has a place in our hobby/sport, unfortunately the market for model aircraft and boat builders, has not been practical for WEST SYSTEM to package their products in the smaller quantities needed by hobbyists and so, modelers usually buy the adhesives available in hobby shops and hardware stores. Although WEST SYSTEM products in general are not as fast curing as some of the other hobby-related adhesives, they are far superior in use.

A few years ago I started working with WEST SYSTEM and their products to attempt to adapt them to the hobby industry to hopefully bridge the quantity gap differential. I began packaging the various fillers in small quantities as to make them more affordable (my $9.00 Filler Sampler kit provides the hobbyist with six fillers, that if purchased in the smallest WEST package would retail for $75.49). I also packaged these with the smaller G-5 and G-Flex epoxies as to provide adhesives with other products, such as the field repair kit.

We have also successfully experimented mixing the G-5 (5 minute cure) with both the G-Flex and the 105/200 series epoxies (6-10 hour cure) to obtain high strength marine-suitable repairs in 30 minutes or less. This fact allows the user to make a custom blend to mix and match the optimum physical combinations from these hybrids. These hybrid epoxies can also be enhanced by applying the appropriate filler for the application.

The biggest hurdle of all was to find a way to avail the mainstay of the WEST SYSYEM products, their105/200 series to the modeler who doesn't require large quantities. At present their smallest reasonable quantity of resin and hardener in the 105 Series of resins is a 105A and either 205A or 206A group, which totals 39 fluid ounces of mixed epoxy. This was further complicated by the necessity of a #300 mini pump to dispense them. Although these resins have a whole host of other uses, the hobbyist was faced with the problem of currently spending $66.48 for a quantity of resin and the dispensing pump he or she might not use up in several years. Another

equally important drawback for the hobbyist is the Mini Pump's minimum dispensable amount of 0.8 fluid ounces of 5:1 resin, or 0.9 fluid ounces of 3:1 resins. In most cases the hobbyist only needs 5-25% of that amount for the typical job. This was the stimulus to develop the small batch weigh product that WEST now calls the #320 Small Batch Scale. With two small 4 oz bottles of resin and hardener, a little mixing cup and the #320 scale, one can accurately weight out a mixture as little as .04 to .06 ounces – enough for a small job, or up to about 5 ounces – enough for a sizeable project. Thus the #320 scale solved the problem of having to buy a $12.93 set of pumps, together with their waste on small jobs.

The problem of availing smaller quantities of the 105/200 series of resins still exists, but if 2-4 sailing club members shared the cost of the above amount of resin and hardener, its cost would drop to about $10 each, or less if 4 or more people purchased our packages as well. This would make our product more competitive to the lower strength hobby shop epoxies. CAs are very useful where their application is appropriate such as tacking subassemblies together prior to applying higher strength epoxy fillets and joints. Many of the competitive epoxies use more solvents and other chemistry to make their adhesives cure faster and their finishing resins easier to sand. Faster cure usually means a more brittle joint and easier to sand means a soft and weak surface. The WEST fillers can be used with other epoxies, however many of them simply do not have the physical properties, ultra low shrink, elastic modulus, elongation and flexural strength as WEST products which are needed in our sport to make boats light yet super strong.

My plan is to offer EC12 folks (and later other classes as well) competitively priced packages, which will in most cases include little or no cost for handling and postage, plus a support network, similar to what you now have in other areas. Visit their website at www.westsystem.com for a very informative introduction to their product line. You will also notice that they publish all the physical properties of their products, so when you choose a specific WEST resin, you'll know exactly what they can do. WEST SYSTEMS also has a large Technical Service Department, who will happily assist all customers. Furthermore they have a ***free*** User Manual (002-950), which is an indispensable super primer on their product line, ***Epoxyworks*** (000-605), a ***free*** quarterly publication which explains a plethora of ideas and epoxy-related examples and the Technical Data Package (002-960). All three are yours for the asking.

I believe this class is a good place to start because in general it appears to be the most user friendly, organized and documented, with people looking for the very best ways to optimize their boats and share ideas.

II. Products Offered

1. Resins and Hardeners – starting with page 16 of the *User Manual,* you'll see the 105 family of resins, the 4 hardeners, six fillers and 4 special coatings that make up the core of the WEST SYSTEM. Usually, when

applying fiberglass, gluing and laminating joints and sealing one would start with *neat* or unfilled epoxy to wet out the joint materials, especially for wood. On page 19 you'll see the 205 hardener is the fastest and would be used in cooler climates and applications. 206 is used in warmer climates and where more working time is needed and 209 where even higher temperatures or more time is needed. 209 is better for wetting out fiberglass and other fibers and to provide more time to roll out or squeegee down to the optimum resin to glass ratio. The 207 hardener is used as a strong clear coating start to a very bright finish. It has special UV resistance to work with subsequent 3-5 coats of varnish. The 205/206/209 hardeners do not exhibit UV resistance and require paint protection; otherwise they would yellow out in time and become more opaque. Since a #320 scale buyer will have purchased two 4 oz bottles in the kit, We will offer a one-time initial fill of 105/205 or 206 resin as an incentive to try the product. After that two or more people can go in together to purchase an "A" Group size (about 39 ounces of mixed epoxy) and save a few dollars. We are confident that many people will find other uses for WEST epoxies all around their homes and in other hobby-type applications.

2. The only practical dispensing products for our use would be the mini-pumps in the case of the professional EC12 builders and a few of us that would use the epoxies for other uses, and of course the #320 scale that could be used by most of us for weighing out any materials liquid or dry. I even find better results with 1:1 epoxies by weighing them than by squeezing out a few drops of each or trying to squeeze out two equal amounts for the larger jobs.

3. The G-5 adhesives are great for those quick repairs, although they are not as strong and moisture-resistant as the 105 system, they can be mixed with 105 series or G-Flex to yield hybrid cure times and physical properties. The higher viscosity and low pot life and work time in G-5 makes it more difficult to incorporate with fillers than the 105 series, but the hybrid mixtures solve that problem.

4. G-Flex is a relatively new product that is excellent for bonding and has great flexural strength and moisture tolerance. It makes a great hull-to-deck joint when used with 404/406 filler, or purchased as #655 with premixed fillers. The Six10 epoxy is even better for hull to deck joints as it combines G-Flex and the high end WEST PRO-SET chemistry for unusually high impact and torsional strength. The draw-back for the latter two may be the cost and quantity. A thickened 105/205/404/406 mixture does a great job in this application as well, and probably is what many of our commercial builders would use. I doubt very much that any EC12 hull-to-deck joint, T-boned amidships by another in a 20 knot breeze would delaminate with a properly applied 105/205/406 system, or any of the G-Flex alternatives.

5. Pages 22 and 23 in the *User Manual* talks about the six fillers used with WEST epoxies and provides a good guide as to which filler is best for each application. The success of any joint, wood, plastic, metal, etc. depends largely on surface preparation. For wood a good wetting out with neat epoxy followed by epoxy thickened with 403 filler. Bonding directly or with fillets and lamination with less porous surfaces such as metals, plastics and fiberglass requires a coarser surface and the appropriate filler to affect the best bond. The 407 and 410 fillers are more sandable with the latter being the easiest to sand as a cosmetic (non-structural surface). There are many mix and match combinations of fillers that permit optimum characteristics for specific bonding or adhesive applications.

6. The 420 Aluminum Powder and 423 Graphite Powder shown on page 24 of the WEST *User Manual* have many uses where hardness or abrasion resistance is required or in the case of the 423, where low friction and scuff resistance is needed. These two are added to mixed epoxy at the rate of 10% by volume, or 1 part in 30 by weight

7. The remaining products in the *User Manual* have a variety of uses in mixing and applying WEST products.

III. Current Pricelist (through December 31, 2010)

I stock most of the standard WEST SYSTEM products, whose prices can be found on their website, Price Effective through December 31, 2010, such as:

Resin and Hardener only:

#101 Handy Repair Pack w/2-0.56 oz. #105/205 resin	$12.60
#105A Resin, 32 fl. oz.	35.65
#205A or #206A Hardeners, 7 fl. oz. (each)	17.90
#207SA Hardener, 10.56 fl. oz.	34.97
#209A Hardener, 10.56 fl. oz.	31.03
#300 Mini pump set, includes both the 5:1 and 3:1 pumps	12.93
#650-8 G-Flex Epoxy, 8 oz.	17.97
#610 Six10 Epoxy adhesive cartridge, 190 ml. (6.3 fl. oz.)	20.50
#600-2 Two static mixers for Six10	3.57
#655-K – G-Flex Epoxy Repair Kit	27.35
#860-8 Aluminum Etch Kit, Two-part	16.54
#865-4 G/5 Epoxy, Two Part, 8 fl. oz.	18.26

Other commonly used WEST SYSTEM Products:

#320 Epoxy Scale	$40.57
#403-9 Microfiber Filler (6 oz.)	9.81
#404-15 High Density Filler (15.2 oz.)	13.24
#405 Filleting Blend (8 oz.)	14.37

#406-2 Colloidal Silica (1.7 oz.)	8.81
#407-5 Low Density Micro-balloons (4 oz.)	14.99
#410-2 Microlight (2 oz.)	14.27
#420-36 Aluminum Powder (36 oz.)	45.57
#423 Graphite Powder (12 oz.)	16.89
#702-12 Unidirectional Carbon Fiber Tape (1.5 in x 12 ft.)	52.12
#703-12 Unidirectional Carbon Fiber Tape (3 in x 12 ft.)	66.69
#800-2 Roller Covers (2)	5.08
#801-HD Roller Frame	3.98
#803-12 Glue Brushes (12)	4.89
#804-8 Reusable Mixing sticks	2.52
#807-2 Syringes (2)	3.97
#808-2 Flexible Plastic Spreaders (2)	4.03
#809 Notched spreader (1)	.88
#832-4 Disposable Gloves (4 pair)	5.18

Coastal Concepts Products and Packages:

#FS-2 Filler Sampler- (6) 3.25 fl. oz. tubs of 403,404,405, 406,407 & 410 fillers, instruction sheet $ 9.00

#320 Scale & Filler Sampler Combo 44.00 (save $5.57)

#FR-1 Field Repair Kit w/ G-5 or G-Flex (8 oz), plus:

- 1- .16 oz tub of #406 Colloidal Silica
- 2- .19 oz of #410 Micro light filler
- 6- 1 oz mixing cups
- 2- 2 oz mixing cups
- 1- mixing palate/notched spreader
- 6 - wood mixing sticks
- 1 – reusable plastic mixing stick
- 4- glue brushes
- 3- pipe cleaners
- 6- alcohol wipes
- 1- set instructions 22.00

Field Repair Kit (G-Flex)/ Filler Sampler Combo	28.00 (save $3.00)
Add a #320 Scale to the above combo	58.00 (save $14.57)
Add a #105A w/ #205A or #206A to the above combo	99.00 (save $26.12)
Field Repair Kit (G-5)/ Filler Sampler Combo	28.00 (save $3.29)
Add a #320 Scale to the above combo	58.00 (save $14.86)
Add a #105A w/ #205A or #206A to the above combo	99.00 (save $26.41)
G-5 **and** a G-Flex Field Repair Kit/ Filler Sampler Combo	43.00 (save $6.26)
Add #320 Scale to the above combo	74.00 (save $15.33)
Add a #105A w/ #205A or #206A to the above combo	115.00 (save $28.38)
Initial fill for the #320 bottles (4.8 total oz. of 105/205 or 206)	8.00
3 lineal ft. of #702 (1.5 in.) Carbon Tape	15.00
3 lineal ft. of #703 (3.0 in.) Carbon Tape	19.00

6 oz. of #420 Aluminum Powder	9.50
3 oz. of # 423 Graphite Powder	4.50

Other combination packages can be quoted separately

There are other applications where we can supply partial quantities of such items as #420 Aluminum Powder, #423 Graphite Powder and #702 Carbon Tape to meet the quantities needed for a small job that would otherwise be financially difficult to justify. Such needs can be quoted as needed.

Note: When 105 series resins and other WEST products are purchased with our fillers, field repair kits, and other related products, we can offer better package discounts. However, since the WEST SYSTEM company policy strongly encourages consistent pricing across the entire country, we must charge the standard WEST pricelist for orders containing only WEST products.

Our policy does allow us to provide a low shipping and handling charge of $5.00 for all orders totaling $20.00 or less and $8.50 for all orders totaling more than $20.00, *anywhere* in the continental United States. These rates are based on the current USPS rates. Florida residents add 7% Sales Tax. Orders to any other address will be billed at USPS standard rates. Terms are prepaid check or money order for the goods ordered plus the appropriate shipping.

Additionally, we are more than happy to provide whatever technical assistance you may require as regards the use and application of these products.

Orders can be placed by calling or emailing

Bob Smith
5136 White Ibis Drive
North Port, FL
(941)-426-9807
bobcoastal@aol.com

IV. Additional Tips for WEST SYSTEM Epoxy Users:

1. **The User Manual** – As previously mentioned the *User Manual* and the WEST website are excellent primers for these products and if one became familiar will all the tips and pointers contained therein, they would be to apply any of those products with confidence. We have added some other specific comments for modelers because they are usually working on a much smaller scale both for their final project size and the amounts of material used, and those are covered in the following paragraphs.

2. **Optimizing Epoxy Use**

The quality and integrity of any epoxy joint, bond or laminate is affected by cleanliness, humidity, surface conditions, temperature, dispensing, mixing, curing time, wetting ability and the resin/filler selection for a specific application. Let's look at these separately:

A. **Cleanliness** - as a starting point, every joint and surface must be clean and free of all dirt, dust, grease, oils (even skin oils) in order for any adhesive or glue to do its job. Alcohol wipes, acetone or mineral spirits do a good job of removing grease and oil.
B. **Humidity** – Moisture is an enemy to good bonding; not only surface moisture but internal cellular moisture as well. The ideal range for wood/epoxy joints is 8-12% moisture by weight. If you suspect the presence of moisture, heat the wood to about 220 degrees F. and allow it to dry overnight. Note that G-Flex epoxy, uniquely, can be used where the wood is wet as long as the area surrounding the joint can breathe. G-Flex is formulated to expel moisture away from the resin/joint interface.
C. **Surface conditions**- porosity and the surface condition of any materials to be joined have a huge effect on the how the epoxy can "key" into each surface, especially with dissimilar materials.

   Neat (or un-thickened) epoxy works well when joining two similar wood surfaces that wet out equally, however when joining a hardwood to a soft one or when end grain joints occur the harder, non-porous surface can become resin-starved. The harder wood (or metals) should be sanded with #60-80 grit sandpaper to give the epoxy a better "key". The softer wood surfaces, especially end grain-joints, should be pre-wetted with neat epoxy and then be recoated with epoxy thickened with the appropriate filler. If the surfaces have irregularities, it's even more important to have fillers in the epoxy to bridge the gap between the surfaces.

   Bonding surfaces such as fiberglass to fiberglass, wood to fiberglass and metals to either wood or fiberglass require at least a #80 grit, or coarser surface and the appropriate filler to make the strongest joint.

   One of the most common errors in full scale boat manufacturing and repair are related to hardware fastening through cored surfaces without preparing the holes correctly. Fasteners through wood, end-grain balsa and low-density foam coring in fiberglass construction invites a quickly drilled hole, a dab of bedding compound and the fasteners torqued down to finish mounting a typical piece of hardware. In a few years the bedding compound dries out, water seeps into the joint and then bad things happen. The quality builder prepares the hole by first drilling it oversize, fills it with epoxy, and then after cure, drills the fastener hole, applies bedding and mounts the hardware. Now, when

the bedding dries out, the worst that will happen may be a little leak. That little epoxy cylinder does one other thing – it adds compressive strength to the core so the fastener cannot crush and weaken it. That second benefit is more important to us as modelers because our boats will rarely rot from excessive rain and water on the deck, but we can weaken soft coring by crushing it with either excessive torque or inadequate backing plates, or both. A small dab of marine silicone is good insurance around any mast step, shroud or jib rack and backstay pad-eye.

D. Temperature – can affect us many ways; first the *ambient temperature* will affect our working time as any epoxy cures faster when it's hot (and slower when it's colder); fillers also reduce working time when it's hot. *Exothermic reaction temperature* can be very detrimental because thicker masses of mixed epoxy cannot dissipate heat easily, especially when it's hot out. It's always better to mix larger amounts of epoxy in containers that are larger in area and shallower than about ½ inch, and it's better to pour masses of epoxy into equally low height aspect ratios, or make more than one pour to avoid "cooking". Please note the warning on page 4 of the *User Manual*.

E. Dispensing – Virtually all epoxies are formulated in ratios of so many parts resin to one part hardener, either by volume or by weight. Since the most widely used 300 Series Mini pumps were volumetric in design, 105 resins were volumetrically metered out 5:1 with 205 and 206 resins and 3:1 with 207 and 209 resins. The ratio *by weight* is still the same 5:1 for 205 and 206 hardeners, but changes to 3.7:1 for 207 and 3.6:1 for 209. The 300 Mini pumps work great whenever 1 ounce of mixed resin is needed. The G-5 and G-Flex products are 1:1 mixes by volume and as such are metered out mainly by sight or by counting droplets. G-5 is 1:1 by weight as well as volume, while G-Flex is 1.2:1 by weight.

The relatively new 320 scale works much better for modeler's purposes because we (1) still need great accuracy, but (2) most the time need way less than I ounce of mixed epoxy. It's even better for the 1:1 epoxies because the accuracy is so much better than trying to "eyeball" two different viscosities equally. The 320 scale will work very accurately with any amount between .06 and about 5.0 ounces, and will wasted amounts for the modeler as compared to the Mini pumps. Remember it's always better to err toward the lean side for hardeners – the mixture will still cure well that way. If the error exceeds too much more than 5% on the rich side for the hardener, the cured epoxy will be soft or "plasticized" because the extra hardener molecules had nowhere to go to react with

F. Mixing – all epoxies perform best when thoroughly mixed. Most of the time we would be mixing in 1, 2 or 3.25 ounce serving size

containers that have a very small radius in the bottom corner and so it's important to square off the larger radius on the mixing stick – usually an ice cream or popsicle stick – to ensure that it sweeps that bottom corner well. The mixing action can be enhanced by rotating the stick back and forth from the center of the cup out toward the edge, and occasionally scraping the sides and bottom of the cup, wiping off both sides of the stick on the edge of the cup and pushing that small amount back down into the mixture. All of the WEST epoxies should be mixed for one minute or a bit more, except for G-5 which should be mixed faster because of its short pot life.

Always mix the resin and hardener together first, and *then* blend in the fillers a small amount at a time until the desired consistency is reached. Its very bad to try mixing a filler into an unmixed batch of resin and hardener for two reasons; one, because its easier to blend solids into the resin because of its thin viscosity compared to the hardener and two, if the hardener becomes isolated from the resin the end result will be poor properties because of inconsistent curing. If the resin and hardener are already mixed before the fillers are added, the fillers will more readily blend into an already uniform viscosity.

G. **Curing Time-** Since the 105/200 series have somewhat similar physical properties the choice for the hardener will be largely dependent upon the amount of time needed mix, make a neat coating, add & mix fillers apply assemble & clamp and cleanup or squeegee off excess mixed epoxy for a given set of ambient temperature conditions. The *User Manual* is a great starting point as it shows pot lives and working times that basically double as you go from 205 to 206 and 207 to 209. Remember the 10-20-40 minute pot lives are based on ambient temperatures of 72 degrees F. and are reduced by adding fillers and higher ambients. Having lived in both the cooler climate of Northern Michigan, where 205 was the general-purpose hardener and now in warmer Florida, where 206 & 207 is the norm, the change is about equivalent to a shift of one full family going from cool to hot.

The introduction of the G-5 and G-Flex lines has opened a completely new group of pot lives, working times and as will be discussed later, a new family of physical properties as well. For example a 50/50% mix of G-5 and 105/205 will give a 5-6 min. pot life and cures to sandable in 30 min. The same blend with G-5 and G-Flex has a pot life of 8-10 min. and cures to sandable in 3.5-4 hours. If the 320 or equivalent scale is used to more accurately weigh the proportions, an increase of 5-7% of the G-5 component will speed up the cure time by about 20%. Please note, when mixing G-5 hybrids, always mix the 105/205 or the G-Flex component first, *then* blend in the G-5 set. Also if the 320 or equivalent scale is used, you can weigh and mix the first component and then with the same mixing cup weigh in the G-5 portion. It's very

tough to mix a small quantity of G-5 in a cup and empty it completely, because of its high viscosity.

Every epoxy job's working time is enhanced if all the preliminary work is done before you start the mixing;

+ surface prep and clean-up
+ double & triple check your fit-up & pre-assembly
+ mask off any area where a spill is unwanted
+ solvents & rags are handy for minor drips & spills
+ masking tape, weights and clamps are handy

H. **Epoxy/Filler Selection-** before the introduction of the G-5 and G-Flex products the 105 resin was matched with a 205, 206 or 209 hardener based on cure time and ambient temperature. This was an easy choice because these hardeners all resulted in about the same physical properties. The 207 UV-resistant hardener was added later to provide natural finish over wood which was sometimes covered with a lightweight fiberglass yielding a natural finish, which was made very UV-resistant by adding 3 or more coats of high quality varnish.

G-5 is not recommended to be used in the bilge unless blended with a 105 mixture, as it is not as moisture resistant as the other WEST epoxies.

G-5 is not as easy blended with fillers as any105 series because of its high viscosity, and therefore is not recommended unless the job can be done very quickly, or the G-5 is blended with a 105 mixture.

As previously mentioned, G-Flex is a super product for bonding into wet woods, and has great tensile elongation - 32.7 %. It's tensile and compression strengths, in the neat state are only half of the 105 products, but increase to 75% when blended with 406 fillers, or the Six10 mixture is used. G-Flex thickened with 407 micro balloons makes an excellent bow/stem reinforcement because elongation and flexural modulus – it will give without breaking and the micro balloons will keep the structure light.

The best room temperature wetting quality is achieved with the 209 hardener, which is very useful for fiberglass laminates. 205 hardeners are the least effective for wetting, with 205 and 207 in between. The wetting ability of any epoxy can be improved by heating it to about 120 degrees F., noting that working time is dramatically reduced. You can also preheat the area to be glassed

prior to wetting out. Do not use a heat gun on the wetted-out fiberglass surface.

Carbon fibers are best wet out with the 206,207 or 209 hardeners. When applying carbon fiber (CF) to other surfaces, brush on a thin coat of epoxy, apply the CF and then wet the top of the CF by dabbing a light amount on top the CF. Use the least amount of epoxy possible to keep weight low, remembering that any epoxy in excess of that to just barely wet the fibers only adds weight.

Excellent hull-to-deck joints can be made with WEST epoxies;

+ Three Epoxy Options are available;

1. A thickened 105/205, 206 or 207 will produce the highest strength joint, but with the least elongation.
2. A thickened G-Flex will produce a toughened, flexible joint, having the highest elongation, with more working time than the 105s.
3. A 50/50 blend of a thickened 105 series and G-Flex will produce the toughest joint of these three, with a working time in between the first two.

+ Three filler options are suggested depending upon the joint;

1. For fiberglass decks to fiberglass hulls use the 406 filler, thickened to a heavy catsup consistency.
2. For wood decks to fiberglass hulls use a two parts 406 and 1 part 403 filler mixture, thickened as above. Pre-wet the wood surface with neat epoxy
3. For wood decks to wood hulls use a two parts 403 to 1 part 406 mixture, thickened as above. Pre-wet the wood surfaces with neat epoxy.

All of these three fillers will work with any of the above resin Choices.

The 406 filler is the most versatile of the adhesive fillers as it can more jobs better than any of the others. 403 works best for laminating wood and 404 is the best filler for bonding hardware. 406 is also the filler of choice when laminating with fillers. Large fillets can be made lighter by blending 407 with 406.

Sandable fillets and repairs can be made with peanut butter consistency thickened epoxy using either 407 for strength or 410 for sand ability fairing), or a mixture of the two for intermediate properties.

Common sawdust can also be used as a filler for cosmetic repairs, fairing and large non-structural fillets. Remember to seal a 410 or sawdust-filled fairing with a light coat of epoxy after final sanding

3. **Parchment paper and Release Agents**

Common cooking parchment paper is a great protective barrier/anti-stick surface. It can be used to isolate materials adjacent to a joint/ bonding/laminate area (a great EC-12 application would be to insert a small piece of parchment paper between the top the spacer wood and the underside of the hull's deck flange to prevent an inadvertent epoxy drip onto the wood, when bonding the deck to the hull). It's a great surface to place a freshly epoxied assembly onto for curing. Parchment paper also works well as a barrier between a sandwich of say, a freshly laminated composite between one or two pieces of glass, clamped or weighted together. It can create a flat smooth surface and can also be used with conical and cylindrical surfaces too.

High quality automotive waxes will work well as a release agent on large and small molds or to protect other finished parts from becoming bonded. Pam and Vaseline work well also.

3. Carbon Fiber- the WEST 702 and 703 carbon fiber tapes are bundles of .075" wide *tows* each containing about 10,800 individual fibers (there are 144,00 fibers in each 1" of tape width). It's very easy to separate a 1.5" wide 702 tape into 20 tows of whatever length is desired, and thus one could divide their 1.5" (or 3") tapes into lengths of that width and have the remainder be many feet of .075" wide tows to be used as stiffeners as will be shown later. Although many class rules prohibit the use of carbon fiber in the hull, deck, mast and boom structures, there are many other uses for carbon fiber in sailing models, where the builder wants strength and light weight, such as:

A. Radio boards and end support frames
B. Masthead cranes
C. Booms
D. Spreaders
E. Jumper spreaders
F. Bulkhead stiffeners – see photo #1
G. Transverse rudder tube support
H. Servo mounts

I. Bow block struts
J. Receiver mounts
K. Mast step & backing plate
L. Deck hardware backing plates
M. Chainplates
N. Miscellaneous gadgets, i.e. Tensiometer – see photos #2 & 3

4. Typical Examples of Epoxy in Sailboat Models

A. Bow Block Support Bulkhead – See photo #1. This structure and the rectangular tube fitting only weigh 0.04 oz., yet provides a stiff end anchor for the recently developed removable bow block tube assembly as used in the EC-12s. In this case, the bulkhead is 1/32" basswood stiffened by vertical and transverse carbon fiber tows that surround the 3/8"H x 5/16"W hole that a tapered hardwood block fits into the CF arrow shaft strut. This device will allow the hauling line and bungee cord block bolt to be tensioned without deforming the arrow shaft and will transfer torsional forces back into the hull. The tapered end fitting makes reassembly easier.

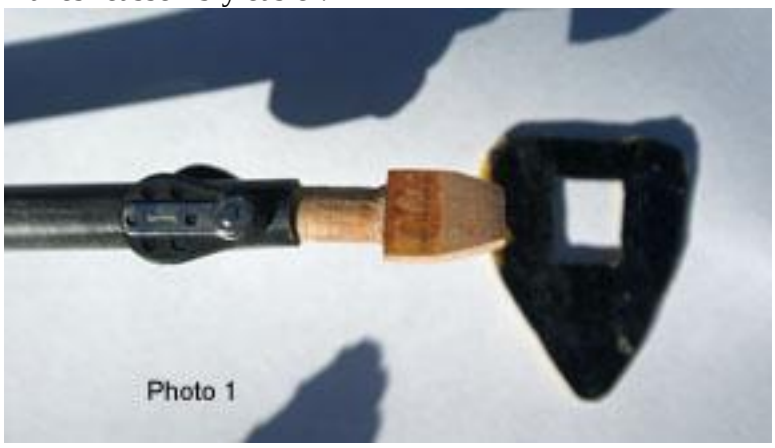

Photo 1

B. Tensiometer – See photos #2 & 3. This was built basically from the plan in *Optimizing the EC-12 Meter*, except the main board is an epoxy laminate of two 1/32" basswood sheets lightened as shown and stiffened with 3/32" x 3/16" basswood strips and covered with lengths of carbon fiber tows. The pointer is an epoxy laminate of four 1/32" strips of hardwood (I also precut the inside two panels to form the pocket for the cable hook & loop). The .015 styrene meter board was reduced in height from 3.5" to 1.38". This design accomplished three things; (1)-the carbon fiber stiffening forms a perfectly flat structure that will not warp, (2)-the laminated pointer will not warp or bind and (3) the entire assembly only weighs ¾ ounce, making the tension readings a bit more accurate by reducing the torsionally-induced cable tension caused by the weight of the meter.

Photo 2

Photo 3

C. We will submit additional epoxy-related ideas as they develop, to the Class Secretary for his approval and dissemination.

5. <u>Safety</u>

A. Please refer to the Safety section at www.westsystem.com.
B. Always work in a well-ventilated area, which will dilute the small products of the chemical reaction between the resin and hardener.
C. Wear protective gloves and clothing if your skin is at all sensitive to the liquid resins and hardeners. Even if not have towels and acetone or lacquer thinner handy to clean your hands and body, not to mention minor and major spills.
D. Wear protective masks when sanding epoxy surfaces.
E. Also refer to the cleanup and removing section in the *use guides* section of the WEST website.

Very truly yours,

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