

INTRODUCTION

“Why is it necessary to use WEST SYSTEM epoxy and glass cloth to sheath a structure?” This is a question we are frequently asked – sometimes on a daily basis. We explain that when a hull, deck or other structural part requires stiffening, strengthening, or added resistance to wear, then an epoxy/glass sheath is recommended. Furthermore, by using glass fabric with epoxy, the thickness of the epoxy/glass applied is at least double that of the epoxy alone, thus ensuring a superior protective barrier and enhanced resistance to moisture ingress. Another benefit of using glass cloth with epoxy is that a degree of flexibility is introduced into the coating, thus enhancing the impact and abrasion resistance of the epoxy/glass membrane.

Examples of sheathing:

- (i) To reinforce a GRP hull either damaged or suffering from a severe osmotic problem.
- (ii) To stiffen and strengthen a wooden hull or deck.
- (iii) To provide better impact and abrasion resistance to a structure, for example, below the waterline or on centreboards and rudders.

Having explained the reasons for sheathing, the next questions are normally, “How do I apply the glass fabric?” and “Is this something I can do?”

So regularly do these questions occur, it was decided to prepare this short publication to illustrate how simple the operation is and most importantly, how to select the right materials in the correct quantities.

Glass Fabrics used in sheathing operations

Biaxial:

- A non-woven fabric which consists of two layers of unidirectional fabrics stitched together. The unidirectional fibres are laid at $\pm 45^\circ$ orientation to the 0° plane.
- Biaxial fabrics offer improved performance over woven fabrics due to the fibres being straighter and eliminating crimp problems.

Plain Weave:

- A woven fabric where warp (0°) fibres pass alternatively under and over each weft (90°) fibre.
- Difficult to drape and high crimp (the weakness introduced each time the woven fibres in the warp and weft hinge against each other).

Twill Weave:

- One or more warp fibres alternatively weave over and under two or more weft fibres in a regular repeated manner. For example a 2 x 2 twill would have warp (0°) fibres passing over two bundles and then under two bundles of weft (90°) fibres.
- Superior wet-out and drape, over plain, with only a small reduction in stability.
- Reduced crimp gives smoother surface and high mechanical performance.

Satin Weave:

- This fabric is woven such that the weft (90°) fibres pass over a number of warp (0°) fibre bundles then under one warp (0°) fibre bundle. For example the WEST SYSTEM 743 fabric is a 4H Satin where the weft (90°) fibres pass over 4 bundles of warp (0°) fibres then under 1 bundle of warp (0°) fibres.
- Satin weaves are very flat, have good wet out and a high degree of drape. Low crimp gives good mechanical performance. Satin weave allows fibre to be woven in the closest proximity and produces fabrics with tight weave.

Woven fabric are easier to use, as they will wet-out more readily – the biaxial fabric is more heavy duty and requires more work to effectively wet-out the fibres.

We do not list Chopped Strand Matt (CSM) as this a low quality type of glass fabric and is designed for use with polyester resin. It provides little benefit when used with epoxy.

Estimating Quantities Required

When applying sheathing it is important to correctly estimate the material required.

- (i) Allow 15 to 20% excess in addition to the surface area for the glass quantity.
- (ii) Use the following estimates for calculating the quantity of epoxy required for each stage of the process.

Priming a porous surface: 140g of mixed resin and hardener per m².

Fairing: 600g mix of WEST SYSTEM epoxy/407 Low Density Filler will provide a 1mm thickness over 1m². (600g mix = 430g of 105/205 + 170g of 407 Low Density Filler).

Sheathing: Allow the same weight of epoxy as the fabric. For example if the cloth weighs 280 g/m² allow 280g of mixed epoxy per m² to wet it out. It is wise to allow approximately 15% extra for wastage.

Peel Ply: Allow approximately 80g/m² for wetting out peel ply.

Coating and weave filling coats: Allow 135g of mixed resin and hardener per m².

Selecting the Correct Fabric

There is a wide range of fabrics available in the market place. Within the WEST SYSTEM product range we have included the most widely used and easy-to-handle fabrics. Shown below are details of the glass cloths and their potential uses:

Product Code	Weight	Construction Style	Uses	Clear Laminate
736	300 g/m ²	±45° Biaxial	General sheathing will add some structural strength	Almost
738	610 g/m ²	±45° Biaxial	Biaxial general sheathing applications structural fabric	No
739	450 g/m ²	±45° Biaxial	General sheathing applications structural fabric	No
740	135 g/m ²	Plain Weave	For use in sheathing lightweight structures such as canoes and models	Yes
741	200 g/m ²	Plain Weave	For use in general sheathing work on hulls and decks, etc.	Yes
742	200 g/m ²	Twill Weave	For use in general sheathing work on hulls and decks, has good drapability	Yes
743	280 g/m ²	4H Satin Weave	For use in general sheathing and re-laminating work and general repairs to boat structures, has very good drapability	Yes
746	260 g/m ²	Woven Roving	General purpose economic fabric	Almost

Why use Epoxy?

A specially formulated marine grade epoxy offers many advantages over both base epoxy products and polyester resins (fibreglass resin). A formulated marine epoxy will tenaciously bond to the substrate whether it is wood, GRP or metal and will provide superior bond strength and toughness. Low cost base epoxies and polyester resins do not have the same ability to resist moisture ingress and may in time crack and peel from the underlying surface. The choice of resin is crucial, selecting a formulated epoxy product will, in the long term reduce costs and future maintenance requirements.

As a general rule WEST SYSTEM epoxy will be used in most sheathing operations. However, if the area to be sheathed is large, or a number of heavy weight multi-axial fabrics are used, the PRO-SET laminating epoxies may be considered.

For applying light-weight fabrics, WEST SYSTEM 105 Resin with 205 Hardener can be used to a working temperature of around 20/22°C. Above this temperature, or if a large area is to be sheathed, use 206 Slow Hardener. For working in very hot climates in may be worth considering 209 Extra Slow hardener. If a

transparent finish is required in order to accentuate wood grain we advise the 207 Special Coating hardener.

If you require assistance in selecting the correct hardener please contact our Technical Support Group.

Working Conditions/Environment

It is important to ensure the correct working conditions are maintained when sheathing. At warmer temperatures the resin and hardeners are more easily dispensed, more readily mixed and much easier to apply to the substrate. In addition, due to the lower viscosity of the epoxy at warmer temperatures, the fabric is easier to wet-out.

Working indoors with adequate heating is the ideal situation but, unfortunately, this is not always possible. Erecting a tent around the boat and providing warm dry heat will be adequate. A Tip here is to ensure the ground is also covered in plastic in order to prevent ground water evaporating into the tent and raising the humidity. Storage of the resin and hardener is important, keeping both components in a warm dry area or using a hot box, as described in the WEST SYSTEM User Manual and Product Catalogue, to store the epoxy will ensure the components are easy to use.

1. Work undercover.
2. Provide warm dry heat.
3. Try to maintain a temperature of between 18 to 25°C.
4. Store the products in a warm dry area.
5. Warm the surfaces to be coated to a similar temperature to the workshop to aid in applying the epoxy and when coating wood, this will eliminate any “out-gassing” from the timber.
6. Be wary of high humidity.

Surface Preparation

Always ensure surfaces to be coated are clean, dry and thoroughly abraded (80 grit paper).

(i) Oily Timber

In addition to the above, degrease oily timbers, such as teak, using a volatile solvent, for example pure acetone. Furthermore, sand across the grain to thoroughly roughen the timber face of hardwoods.

(ii) Metal

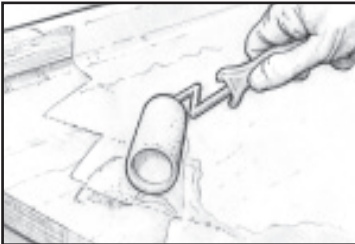
The minimum requirement is to degrease, abrade back to bright metal and degrease again. Either grit or sand blasting is the best method for surface preparation. Apply first coat of epoxy within 2 to 3 hours after second degrease to avoid oxidation of the metal surface.

(iii) Metal Alloys

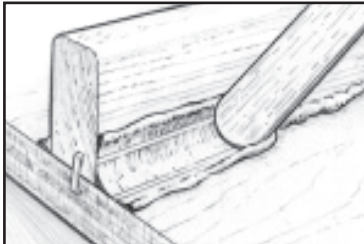
The preparation given above in (ii) is the minimum requirement, however, it is recommended that alloys are chemically etched in order to provide the best adhesion. Seek advice from West System International.

Filling & Fairing

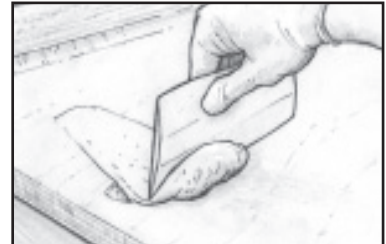
Fill & fair the surface to be sheathed using WEST SYSTEM epoxy and 407 Low Density Filler mixed to a peanut butter consistency. Crating radiuses on any external angles and applying an epoxy fillet to any internal angles will allow the fabric to be more easily applied. When the epoxy/filler has hardened, sand fair before application of the epoxy/glass sheath. (We recommend applying peel ply tape over the fillet joint as this eliminates the need to sand before applying further epoxy).



Apply epoxy without filler to primed areas that are to be filled.



Applying an epoxy fillet to any internal angles will allow the fabric to be easily laid.



Trowel epoxy mixed with 407 Low density Filler to peanut butter consistency into voids.

Applying Glass Cloth

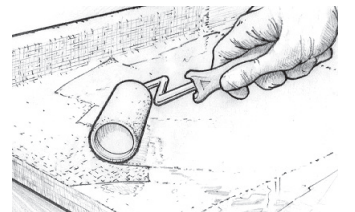
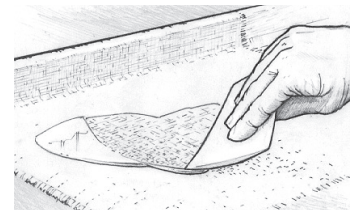
There are two methods for sheathing – the “dry” and “wet” method.

There is a variation to these methods, wetting out the fabric either on a flat polythene covered table or by using our impregnator, rolling the wet fabric on a plastic pipe and then laying out the fabric onto the surface. Squeegees are then used to remove air and any excess epoxy from underneath. This variation is particularly useful when sheathing large areas.

The Dry Method

For best results the surface must be pre-coated with one or two coats of epoxy, allowed to cure and sanded (60-100 grit). This will reduce the problems associated with “out gassing” under the fabric, by sealing a porous material such as wood. If sheathing the hull, the surface should be coated and faired prior to applying the fabric. The dry method is ideally suited to sheathing flat areas, decks etc. or inverted hulls. Generally, the dry method should only be used with lighter weight fabrics up to 280 g/m². Above this weight, or when using multiaxial fabrics, it is difficult to wet through the cloth.

- (i) Cut fabric to correct lengths and roll onto cardboard or plastic tubes. Position fabric, if necessary using either staples, tacks or tape to temporarily hold the cloth in position.
- (ii) Mix enough epoxy to wet-out the fabric. On flat surfaces pour epoxy directly onto the fabric in small puddles and work epoxy into the fabric using plastic squeegees and/or foam rollers to removed trapped air.
Caution: Do not over work the fabric as this will disturb the weave of the cloth. Do not use excess resin/hardener as the fabric will “float” on the epoxy, i.e. the glass cloth must be in contact with the substrate surface.
- (iii) Ensure the cloth is thoroughly wetted out. Do not leave any “white” spots – these are areas of dry fabric.
- (iv) When the cloth has a dull semi-matt finish it is wetted out. If the surface appears shiny, too much epoxy has been used.
- (v) Move onto the next piece of fabric, either butting or overlapping the fabric. If using WEST SYSTEM 743 280 g/m² Satin Weave cloth this fabric has tapered edges producing clean overlapped joints.



NOTE: If working on uncoated wooden surfaces, ensure the timber is warmed before application of epoxy. Remove the heat source before applying the epoxy. This will eliminate the “out-gassing” produced when expanding air is released from the wood fibres. If the surface is to be clear finished, use lighter weight fabrics. Although one layer of 280 g/m² Satin weave fabric will become transparent when wetted out, the weave of the cloth may still be visible.

Wet Method

Once the surface is prepared and the glass cloth cut to size:

- (i) Roll a heavy coat of epoxy onto the surface.
- (ii) Carefully unroll the glass cloth into position over the wet epoxy. Surface tension will hold the fabric in position – if applying to vertical or overhead surfaces, allow the epoxy to become a little tacky, say after 30 to 45 minutes, as this will help to hold the fabric in position. Work out wrinkles and excess air using either a plastic squeegee or foam roller.
- (iii) Re-apply epoxy to any dry areas.
- (iv) Squeegee out any excess epoxy.
- (v) Once fabric is wetted out move onto next section.

When using the wet method, it may be advantageous to cut the fabric once wetted out. This will ensure accurate placement of the fabrics and stability of the cloth from the roll. Use an adapted clothes rail, taugth rope or a broom handle to allow free dispensing of the cloth from the roll. Clean scissors etc., with WEST SYSTEM 850 cleaning solvent.

Joining Fabric

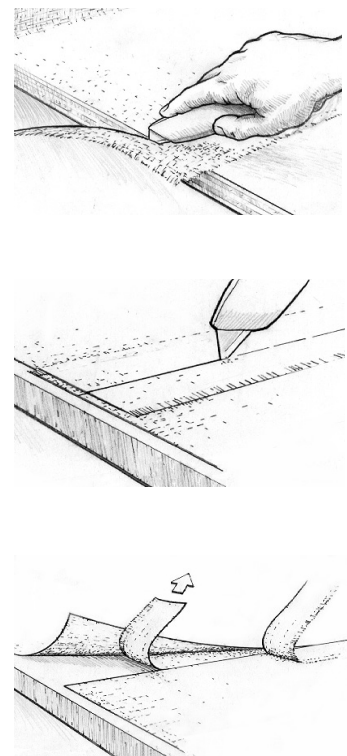
Trim excess and overlapped cloth after the epoxy has reached its initial cure. The cloth will cut easily with a sharp utility knife. Trim overlapped cloth as follows:

- (a) Place a metal straight edge on top of and midway between the two overlapped edges.
- (b) Cut through both layers of cloth with a sharp utility knife
- (c) Remove the top-most trimming and then lift the opposite cut edge to remove the overlapped trimming.
- (d) Re-wet the underside of the raised edge with epoxy and smooth into place.

The result should be a near perfect butt joint, eliminating double cloth thickness. The disadvantage of joining fabric in this way is that the knife will mark wood and this is not suitable when a transparent finish is required. However, a lapped joint is stronger than a butt joint, so if appearance is not important, it may well be advisable to leave the overlap and fair in the unevenness after coating.

Any remaining irregularities or transitions between cloth and substrate should be faired by using an epoxy/filler fairing compound if the surface is to be painted. Any fairing completed after the final glass cloth layer should receive several additional coats of epoxy over the faired area, once surface preparation has been completed.

If using WEST SYSTEM 743 280 g/m² Satin weave fabric, a perfect joint is achieved as this cloth has tapered edges. When a transparent finish is desired this fabric is a good option.



Using Peel Ply

The use of peel ply in the sheathing process is extremely important. The closely woven nylon cloth is a release fabric, to which epoxy will not adhere and is applied as the last layer of the sheathing process. The peel ply fabric is thoroughly wetted out and must be in full contact with the underlying laminate. Why use peel ply? These are the major advantages of using the cloth.

- (i) The epoxy/glass sheathing is evenly consolidated as more pressure can be applied without disturbing the fabric.
- (ii) Excess epoxy is brought to the surface and is removed from the laminate.
- (iii) The epoxy/glass surface is protected and any amine blush will occur on top of the peel ply. Furthermore, the peel ply will allow walking over the sheathed area as the peel ply will protect the underlying epoxy/glass sheathing.
- (iv) When the peel ply is removed the textured surface will not require sanding, thus allowing further layers of glass/epoxy, fairing compounds or coatings to be applied. (Only remove peel ply just before the application of subsequent coating).
- (v) Overlap joints, and stitching on multiaxial fabric, are feathered out by using peel ply.

The additional cost of using peel ply is far outweighed by the reduced labour involved in sanding a cured epoxy coated surface. The peel ply can remain on the surface for a long period of time as it will still be easily removed, thus protecting the epoxy/glass sheathing.

Peel ply is applied as the last layer in the sheathing process, or the last layer applied in a single day. Layout the fabric on the epoxy/glass surface. Wet-out the peel ply using foam rollers and/or squeegees. There will probably be sufficient excess epoxy in the laminate to thoroughly wet-out the fabric. However, if there are any dry areas wet-out by applying more epoxy. Overlap the peel ply where necessary.

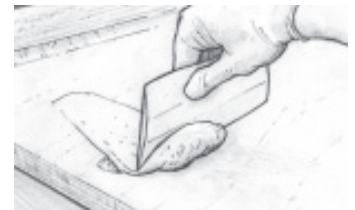
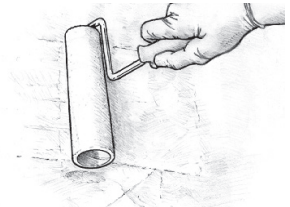
Important: Ensure there is an un-wetted overhanging edge of peel ply. When cured this dry edge will ensure the peel ply is more easily removed.

Overcoating Sheathing

If not using peel ply, the last layer of epoxy/glass should be either:

- (i) Overcoated with one or two coats of epoxy to fill the weave of the fabric, but only when the epoxy/glass laminate is touch dry.
- Or
- (ii) Filled with one application of WEST SYSTEM epoxy/407 Low Density Filler.

By completing either one of the above, when the epoxy is washed and sanded prior to overcoating the sanding should not cut through to the epoxy/glass laminate. If applying epoxy/filler, once cured and sanded, two further coats of epoxy should be applied.



Please refer to the WEST SYSTEM User Manual and Product Catalogue for further information.