

Build Instructions for Wood Epoxy Optimist Kit 2006

Use of epoxy materials

I have used the West System 205 product with great success for bonding and filling joints. The SP epoxy adhesive will work just the same.

Bonding; if you have a joint with little gap or clearance then use the parts A and B as mixed without the filler powder. Wet out both sides of the joint and put it together, clamping or holding until it has gone off, generally 24 hours, maybe less in the summer. If you have a bit of gap to fill up, and it often adds strength to the joint to have a small gap (adds weight too!) then use the filler powder added to the mix after it is mixed to stiffen the mix up to what they like to call “mayonnaise” stiffness. It is best to wet out both sides as before with unthickened mix then add the powder and assemble the parts with the stiffer mixture in place and remove the excess with a wooden stick radiused at the end to give a neat fillet radius. If you spot that a joint has a gap after it has been glued, or if the glue has been drawn back into the joint whilst going off, you should clean the surface of the set epoxy with a damp rag, dry it and apply some filled epoxy and create the fillet as above. It is important to clean the set epoxy as when it goes off it exudes an oily substance to the surface, which will not allow the next layer to bond to it. A light abrasion helps a lot as well.

Woodwork

- 1 Carefully identify all the parts you have received in the kit using the parts list and noting the thicknesses of each part to help identify it.
- 2 Lightly mark up all the centre lines of the lateral parts, bulkheads, transoms etc.
- 3 Mark on all the plane to chamfer guide lines as detailed in the drawing.
- 4 Mark onto the MDF jig parts all the centre lines and the lower base line, it is essential to get this right as it forms the basis of getting the boat through RYA measuring successfully later on.
- 5 Put together the MDF jig outer parts using the “egg crate” slots, and check that they are in the right place and square. It will be useful to stiffen this structure up with some scrap wood braces so it will not move about during the build process.
- 6 Make sure that the two jig cross members are the right distance from the outside of the back of the aft transom, as it is only one face, the rear face, of each of these jig parts that is the datum at 500mm and 1500mm respectively from the back of the aft transom. It is best to write “datum face” on the rear faces in big letters so as not to forget! And don’t get them mixed up; the aft one is the wider one. The top outer corners of these jig parts on the sheerline, which will be useful later.
- 7 Ensure that the joints between the long jig parts and the cross jig parts are entirely flush, and that the jig is standing on flat ground at all times.
- 8 All the parts are sized so that the sides go on the outside of the bottom and both transoms, and the bottom goes under both transoms. If this is observed then everything will fit into the jig ok
- 9 It may be useful to put in some extra cross members onto the jig to stop the 6mm bottom from sagging when it is in the jig on its own while the hog and stringers are gluing. Just repeat the style of the two full jig cross members, but just under the bottom and not up the sides, making sure that all is flush, square and parallel to the supplied jig parts
- 10 Don’t worry about the top base line stick at the moment as this will become useful later on, although it will need stiffening up with scrap wood while you are doing jig jobs.

- 11 First bit with the boat parts is to drop the hull bottom panel into the jig, and after carefully aligning it to centres pin it down to the jig with small panel pins, the holes from which will need to be filled later on. Don't pin it in any of the areas that are to next be covered by the hog, stringers and crossmembers as getting the pins out will be tricky if there is a panel glued over them!
- 12 Next, trail fit the front and rear transoms, and cut the hog and stringers to length, they are supplied over long, so that they will glue to the bottom panel, and butt up against the inside of the transoms.
- 13 Glue the hog and stringers in place using the three bulkheads, two temporary and midship frame as guides. These will have to fit over the hog and stringers later.
- 14 Build up both the transoms with their frames, laminating the frames to the transoms, carefully aligning then for centre line and making sure that there is equal over hang each side. When they are fully set plane the chamfer onto the vertical edges making sure not to alter the width on the side that is to be the finished outside of the boat, only removing wood from the inside edge of the frame using the guide lines drawn on earlier.
- 15 Glue the front and rear transoms to the bottom and the hog and stringers, and pin them in place to the jig longerons, checking that they are flush at their lower corners with the hull bottom panel.
- 16 The small fillet left by the angle of the hull bottom to the transoms' square bottom edges actually serves to strengthen the structure when using epoxy adhesives, although the bigger ones left by the thicker transom frames is unsightly and you should have planed approximately the correct chamfer angle onto these edges so they join nicely.
- 17 Next mark out the position for the midship frame noting that the datum face for this crossmember is the *front*, which must be at 1005 from the aft side of the aft transom (don't write it on as this is a part of the boat, maybe just write it on a piece of masking tape stuck to the front face) It will need to be held with scrap wood supports in exactly the upright position using a spirit level (assuming that your jig is exactly level and the rear transom is also exactly upright). Just check that the line of the sides extended across the limberhole (radiused hole for water drainage at the bottom of the frame) is flush with the hull bottom panel. Glue in place to the bottom.
- 18 Check fit the two temporary frames, and get some scrap wood ready to hold them in place. Again they must be exactly upright. Pin in place and avoid getting any glue between them and any hull parts, as they will have to come out later on.
- 19 Mark out and fit the mast thwart bulkhead next, note that the datum face is the *aft* side this time. (There is no actual figure for this on the IODA plans but the section at the mast thwart bulkhead is drawn at $x = 1898$, $x = 0$ being at the aft side of the aft transom.) This bulkhead also needs to be exactly upright. Once successfully trail fitted, glue it in place to the hull bottom, hog and stringers.
- 20 Once all the above has set for at least 24 hours trail fit one of the sides, this is actually the trickiest bit of the build as there are loads of places to check the fit at and nothing is straight or square about the sides, so take a good while to trail fit them. Leave all the scrap wood bracing in place as the bulkheads are still only glued to the hull bottom as yet. The two internal temporary frames should jam the side panels against the external frames. They may need a bit of easing here and there as they are all squared edged as cut, whereas the hull at these points is just a bit off square. Make sure that the sides hang over the hull bottom panel just a little; this can be planed to finish later.
- 21 Once you are happy with the fit, one of the sides can be glued in place. I advise only doing one at a time as it is quite easy to upset the side you have just got right and glued up whilst heaving the other side about!

- 22 While all this is going on, and actually all the time during the build, keep checking that the hull is still sitting in the jig properly, and that the jig is always square and level and not sprung apart anywhere.
- 23 When both sides are on and set you can take out the scrap wood bracing and lightly pin either side of the temporary frames to keep them in place.
- 24 Now is the best time to fit the mast step block. This will either be simply a wedge shaped block that the stainless (adjustable) mast step will screw down to, or the budget version (not adjustable, so get it in the right place!) wedge shaped block with a hole bored in it the same diameter as the mast tube. In either case the centre of the mast step is at 1997 from the rear of the boat, as this will be measured inside the hull don't forget to allow for the thickness of the aft transom as the measurement is from the outside of the aft transom. It should be 24mm thick at the centre (6mm skin plus 18mm frame, but as plywood sizes are all nominal and subject to tolerances... CHECK IT) giving an internal distance of $(1997 - 24) = 1973$.
- 25 Before the mast thwart hides them, fit the 35 x 16 mast thwart side members, these go between the hull sides and the thwart bulkhead, on the front of the bulkhead, 35 side onto the hull inside.
- 26 Now fit the mast thwart which should be exactly level, and butt up to the mast thwart bulkhead at the aft side of the thwart. This part is cut a bit over size as there is no drawing for it and it should be made to fit your hull exactly. It will be a good idea to chamfer the left and right sides of the thwart to fit the tapering sides of the hull nicely, but the joint is entirely hidden by the gunwales later on. Don't drill the mast hole in it yet as it must be exactly 1997 from the back of the boat and is best measured when the hull is complete. When you are happy with the fit and alignment glue it in place.
- 27 This is the basic hull structure done, all the rest is fixtures and fittings, and of course the surface finish.
- 28 Now is a good time to check all your joints and make sure that you have a nice neat fillet of epoxy/filler mix in all the joints. This is not just to make a neat job, but also contributes a great deal to the strength of the hull structure, as this build method does not have a wooden frame (as does the Traditional Wood design). The other important thing to check is that there are no gaps under the hog or stringers, or under the mast step, and that the epoxy fillet is complete and sealed all the way round all these areas. If you miss a bit water will get in and rot the first ply layer. Also fill up all the holes left when the pins were removed.
- 29 Before you remove the hull from the mould it is a good time to fit the rubbing strips to the outside of the top edge of the sides. First check all your sheerline measurements to the RYA/IODA measurement sheet (if you are intending to class race the boat). The sheerline is the line along the top of the side of the hull not including the rubbing strips, and is therefore a right pain to measure (not to mention, correct) when the rubbing strip and gunwales are fitted. Using the top baseline stick, mark along its length all the measure points on the IODA plan (which are the same as those in the measurement forms) drop it onto the top of the mould longerons, (or the top of the transom centre lines if you have taken the boat out of the mould... don't!) and using a spirit level, first levelling the jig, measure the drop down to the sheerline at all the points along each side. If the sides are a little high, mark them and plane them down to the marks, blending them together. Actually it is easier to just mark them and glue on the rubbing strip to the marks, then plane down to that. If the sides are a little low, mark the point, making a note of how low it is, and when gluing the rubbing strip on make sure that it goes on that much higher. You can then fill the slot up with either epoxy filler, or better, with a strip of plywood and plane that down to the rubbing strip. Either way it is essential to get the rubbing strip top inner corner in the right place all the way along, keep checking the measurements and all will be ok. Make sure that the ends of the rubbing strip go past the transoms at each end to be trimmed flush later. You will need to cut a clearance slot

- in the mould outer crossbraces to miss the rubbing strips. (If you are hiring our mould, please don't cut it. Take them off before fitting the rubbing strips.)
- 30 When all that is set and solid take the boat out of the mould, it should be quite stiff by now and should not move around any more.
- 31 Daggerboard case is next. I believe that it is best to have the smallest hole possible in the hull bottom skin, so the part is supplied with the slot at its finished size with radiuses at each end ready to use. So you will need to cut the slot through the hog using the ready cut slot as a guide. The daggerboard case is then made to the correct height to sit on top of both the hull skin and the 12mm hog thickness. Glue the front and rear case spacers to one case side, flush to the outsides. Now is a good time to do the finish to the inside of the case, as it is really fiddly to paint when there is only a 18mm gap to do it in! When set fit the other side, having Eposealed that in advance. You can Eposeal it across the glue joint area just so long as you abrade the joint face afterwards. Make sure the tops and bottoms of the case sides are parallel and square, as correcting afterwards will lose height of the case need correcting for height. The case is designed to have a 6mm capping strip fitted afterwards to finish neatly and hide the end grain of the plywood.
- 32 Fit the daggerboard case to the hull. If the slope of the case bottom doesn't exactly follow the hull profile don't worry but make sure that the case is exactly upright for and aft and across ways, and well bonded to the midship frame. This is probably the strongest area of the hull and the bit that gets heavily leaned on during capsize recovery. Clamp it up tight and square.
- 33 Along the bottom between the case sides and the hog each side go the 27 x 50 side members to add strength. These will bridge any gap under the case. Make sure there is plenty of epoxy filler in any gaps as it will be difficult to seal up later.
- 34 Next fit all the pads for the fittings to hold the buoyancy bags in, and the mainsheet block, which is the odd one that is bigger. Get these in the right places, as they will be measured.
- 35 The gunwales are a bit of a big job, but can actually add a huge amount to the finish and comfortable use of the boat. If you make them exactly to the IODA drawings they will be nice and wide for the users bottom to sit on, but at each end they will disappear untidily under the corner braces. A better way to do it is to flare them out to flat at each end then cut the braces into them, this means starting with much bigger strips and cutting out a lot of wood along the length of the gunwales leaving enough thickness at the ends to cut the braces into. The supplied strips are not this big and so don't allow this much bigger job to be done. The midship frame will have to be cut away at the tops to fit the gunwales. It isn't supplied cut away as it is an important reference for the sheerline measurements. So glue them one by one by one starting with the thickest of the three each side, until they are all in place and using a power sander get them nice and smooth and even with a 15mm radius on the inside.
- 36 The corner braces need to be cut into the transoms and the gunwales but not the rubbing strips. They could just sit on top of everything but this is really ugly...
- 37 In all cases when fitting parts, careful clamping and gluing will remove the need for any nails or screws. Nails or screws will cause problems later in the life of the boat. If you find you can't avoid them use only stainless steel, not copper, as this will cause black stripes and patches in years to come.

Finishing; I do not recommend the application of the West 205 material as a surface coating as it will only go on thickly and adds too much weight to the boat in my view. I have use the SP Eposeal epoxy coating with much success. It is a very thin mix and soaks right in on the first coat. I do three coats with one mix of the epoxy, one after the other, only allowing the previous one to go tacky before re-coating. This removes the oily finish problem, as at the tacky stage the mix has just evaporated off its thinners content, but not yet started to epoxy set. The full set again takes 24 hours, after that it must be washed

and flatted off, the first time (first 3 coats) the wood grain is raised and flattening takes off all the raised grain and furry bits. Follow this with three more coats on to tacky previous coats. This will use far less material, as there is now no soaking in going on. For the best paint base do it all again 24 hours later to end up with 9 coats (3 lots of three). This is not such a big task as it sounds as the Eposeal goes on very quickly and you don't have to be particularly careful how it goes on, just thinly all over.

Painting the outside of the hull; In my view the only way to do this is to use two pack car finishes, sprayed on, starting with the appropriate primer onto the Eposeal finished and filled surface. Then use the same system gloss top coat to finish. Get a few thin coats on as this type of paint is very tough and will help withstand the rough and tumble of youth sailing! Of course mask up the rubbing strips first. If you do this yourself be careful to take all the correct precautions about wearing dust proof clothing and breathing filters etc., as this can be nasty stuff if inhaled. Best probably to get your friendly local body shop to do it. If you do all the rubbing down of the Eposealed surface and present it with as few blemishes as possible it won't cost too much.

If you decide not to spray on two pack paint you can use conventional brush on polyurethane Yatch primer and gloss, but it won't last more than a couple of seasons use. At least you will have the tough epoxy primer underneath to keep the water out of the boat structure.

The interior should be Eposealed as the outside, and then use SP Ultravar 2000. Again you could use old fashioned varnishes, but expect to be re-doing it every year!

On the weight, ours weighed in at 32kg in primer but without gloss paint, which is on the limit. we allowed 1kg for the paint and so it might be 33kg now. We are about to weight it again and may need to fit correctors to be ok at the Nats next month. So if you build it as described and go easy on the paint it will be a touch on the light side. Of course ply is made to a tolerance and we don't know what the density of your bits is, but it won't be far away...

Epoxy fillets

Epoxy fillets contribute quite a bit to the strength and more importantly, the stiffness of the hull. A useful technique is to not get the wood to wood joints at exactly the right angle when you plane the chamfers. If there is a bit of a gap in the joint on the concave side (inside of the boat) of say 2mm, and that is filled with thickened epoxy and a fillet formed on top of that with a radius of about 10mm it will be as stiff as possible. I have seen boats built with huge epoxy fillets, maybe 30mm radius, this is quite ugly and a waste of epoxy and adds weight. The other thing that is known to give over weight boats is using the SP or West epoxy glue as a coating. The Eposeal is designed particularly to soak into old wood and displace moisture, and can even be used in dried out rotten wood to good effect. But the best use is to seal up new wood as we are using it for. It doesn't add any size and is very light.

For a neat job on the fillets run masking tape all the way along both sides 5 or 6mm either side of the joint before putting any glue in, put the unthickened epoxy into the joint which will soak in a bit. Just wait five or ten minutes and you will see the glue disappear into the joint and leave a gap possibly needing a bit more glue. The epoxy does not shrink as it sets, but it does get soaked up into bare wood and this makes it look like it shrinks.

Before it is hard, using the same mix if possible, thicken it up with the powder, and run in the fillets up to the tape. Use a lolly stick or shaped wood piece to form the fillet radius. The excess will go onto the tape. Just before (have a practise first!!) it gets too stiff when hardening, carefully pull the tapes away, being careful not to get any glue on nearby bare wood. If you do get glue on bare wood that isn't part of a joint it will be there forever!