SAILSetc mould and hull moulding notes

covering

construction of moulds
preparation of moulds
finishing of moulds
preparation for moulding
suggested lay up
moulding process briefly

General

- These notes constitute a basic building specification designed to ensure a high quality of moulding.
- These notes are intended to help produce a mould, make the best use of it and avoid simple errors.
- It is not intended to give a comprehensive description of the moulding process. There are several publications which will assist.

Safety

- Glass fibres and carbon fibres, when incorporated into a cured resin system, are often sharp and are always dangerous when being handled.
- Wear rubber gloves when handling and working on the mould, initially until sharp edges are removed, and when cutting.
- Glass fibres and carbon fibres, when incorporated into a cured resin system, create dust when cut or abraded that is dangerous to breathe in.
- Use a mask and goggles when drilling, cutting or abrading without water and when cutting reinforcements for laminating.
- Use a vacuum cleaner with a micro filter to suck up dust from the work and working space.
- When using epoxy and/or polyester resins for laminating work in a well ventilated space and use gloves and/or barrier creams to protect the skin.

1 Construction of the mould

1.1 The mould is made by laying resin and reinforcement materials up over a hull plug. The plug is normally made in two halves so that the mould may also be made in two halves. This permits the creation of a flange around the deck edge which is an essential step for producing high quality, lightly built, easy to finish hulls that will be consistently shaped just as the designer intended. Release of a two part mould from the plug is also eased as is release of the hull mouldings from the mould.

1.2 A typical mould lay up based on epoxy resins is as follows:

for a One Metre mould

2 gel coats (normally brown followed by green – see below)
2 layers x 100 gsm twill glass
1 layer x 200 gram twill glass
several layers twill or plain weave carbon totalling 700 gsm or equivalent reinforcement to flanges and locally as required.

for a mould for a larger hull

2 gel coats (normally brown followed by green – see below)
2 layers x 100 gsm twill glass
1 layer x 200 gram twill glass
several layers twill or plain weave carbon totalling 1000 gsm or equivalent reinforcement to flanges and locally as required.

1.3 Follow the recommended post curing schedule for the resin system you are using. Alternatively follow the guide in 8.5.

1.4 For details of the gel coat and lay up used for making the moulds see the instructions for laying up the hull given in Section 2 to 8 of this document.

2 Patterns for reinforcements

2.1 Make paper patterns to the shapes required. It is important to minimise the overlapping areas in the first layers going onto the gel coat as the overlaps can create air traps where the overlapping layer fails to follow the 'step' created by the edge of the first layer.

2.2 In thin laminates any overlap will create a massive change in the stiffness of the laminate at its edges – these will be prone to cracking in the event of large distortions caused in collisions. They may also be evident in the well polished surface of the laminate because of un-even curing created by the exothermic reaction of the resin curing.

2.3 Make the reinforcement layer for smaller hulls from one piece of cloth wherever possible. On larger hulls arrange to have the overlap along the centreline where there is already extra stiffness and extra reinforcement is often needed in way of the forestay attachments, mast and fin trunking, sheet post trunking and rudder trunking.

2.4 Expect to adjust the patterns to fit properly in the way you want to use them.

2.5 When you are happy with the pattern shapes it may be worthwhile transferring them to timber. 2 mm or 4 mm MDF is a good material to use.

2.6 Use the patterns by placing them on the reinforcement material and taping around the edges with a narrow tape – fine line masking tape from body repair shops, masking tape, or the SAILSetc Mylar tape (TM-08) are all suitable for this task – cut along the centre of the tape with sharp scissors or a cutting knife on a cutting mat. The tape prevents the weave from unravelling in use and avoids a poor laminate at the edges caused by missing fibres or fibres out of place.

3 Moulding process - general

3.1 There are many methods and materials which individual moulders prefer to use. You should be prepared to experiment and adapt to find materials and a method which suits you.

3.2 Our preferred materials are outlined in the next sections.

3.3 As a general rule it is wise to obtain pigments, gel coats, laminating resins and hardeners from the same source so that you can be sure they are compatible.

4 Release agents

4.1 Apply at least six coats of release wax in turn. Polish with a clean cotton cloth and allow a time to harden between each. Avoid over polishing as this tends to remove wax from the high points and will cause sticking.

We use:

- pure carnauba wax (free of silicones)
- Simoniz (a Castrol product), available widely in the UK. Contact + 44 (0) 1637 871 171 for details.

4.2 Use of a carnauba wax will permit the application of PVA release solution as a secondary release coat. Before attempting to apply PVA release agent to the mould surface the mould should be thoroughly washed with warm and mildly soapy water. This reduces the surface tension of the surface and aids adhesion of the PVA. We found that allowing the PVA to evaporate increases the viscosity and reduces the amount of pull back (orange peel effect). Add a spot of detergent (soft soap) to the PVA solution itself and apply with a 20 - 25 mm wide sable flat section brush (watercolour brush from artists' supply shop). The pure sable brushes are hideously expensive (red squirrels are hard to come by) so buy one of the synthetic substitutes.

4.3 Achieving a smooth coating of PVA is very difficult. Plan to spend some time practicing on a piece of thick plastic and scrapping the result before making a coat on the mould. A smooth, soft brush is essential but technique is more important. As the PVA dries quickly it is important to work from the wet edge towards the un-coated area. Do not apply too much PVA. If too little is applied there will be dry areas. Try to avoid going back to re-touch dried areas.

4.4 Complete drying of the PVA coat will take only 1 hour in warm conditions. Before and during working on the mould keep all doors and windows closed so that dust can settle. Once coated with PVA store the moulds inverted and in a dust free cupboard until you plan to use them.

5 Resin systems

5.1 We recommend using epoxy resin rather than polyester resin for laminating. Hulls will be significantly stronger and more resistant to damage. They will retain their shape better and will not suffer from continuous degradation of surface finish and overall shape associated with polyester mouldings.

5.2 Follow the resin manufacturer's recommendations for the use of their products.

5.3 The following notes assume that an epoxy resin system is being used.

6 Gel coat

6.1 The gel coat is applied to the surface. It is made using pre-gel, pigment and hardener. It can be pigmented using up to 10% by weight of pigment. Ensure the pigments are compatible with the resin system you are using. You will need to determine the correct amount of pigmented pre-gel and hardener, allowing a little extra, for the area to be covered. Unless you are working very quickly, do not attempt to use more than about 50 grams of gel coat at a time as it will cure in the pot (the warmth of your hand will speed its cure). As soon as it begins to thicken dispose of the brush and gel coat and mix another batch. You can avoid heating the resin while applying it to the mould by using a pot holder of cardboard tube or corrugated paper similar to those supplied by coffee shops to prevent burning your hands/fingers.

6.2 Apply a gel coat which is thick enough and well pigmented enough to provide a good colour coat and minimise the print through from the reinforcement cloth. A low gel coat rate is 100 grams per square metre. 200 gsm would be a large amount. Initially you will use a larger amount to get a good, consistent cover. With practice this will reduce.

6.3 Ultra thin gel coats have advantages and dis-advantages:

- less 'parasitic' weight i.e. weight that provides no value
- more reinforcement for the same overall weight
- less likely to crack when bent
- more likely to be patchy and show the reinforcement beneath
- more likely to suffer from print through as the laminate ages

6.4 As the mould does not need to be light it should be made using two gel coats which can be generously thick. Add the 2nd when the first has cured to a tacky stage. The second should have a different colour to the first.

7 Lay up resin

7.1 When the gel coat has cured to a slightly tacky stage the lay up resin mix (actually resin + hardener) and its reinforcement should be applied. We almost always used un-pigmented lay up resin as it is far easier to see where the reinforcement cloth is not wetted out fully or has air bubbles present. The International One Metre class rule now permits pigmented laminating resin as do the other classes. Pigmenting the laminating resin helps to reinforce the depth of colour which is useful if the pigment used is not especially opaque.

7.2 When the gel coat is at the slightly tacky stage paint resin over the surface to be covered. Then lay the reinforcement over the surface. Lifting and re-applying the reinforcement can damage the gel coat already applied. So, it should be cut

oversize by about 25 mm all round so that its placement is not too critical. Place it carefully onto the coat of resin.

7.3 When it has been laid in place more resin is applied to wet it out thoroughly. Use a brush to apply the resin and stipple it into the reinforcement material. Do not user rollers or other mechanical tools to assist wetting out as they may disturb the gel coat layer. Trim off any large amounts of excess reinforcement cloth with scissors. When this has been done you should apply the next layer of reinforcement and repeat the process until all have been added.

7.4 If you are attempting to reduce the weight of the moulding, for example if it is a hull, you should now carefully remove excess resin. Do this by laying absorbent paper tissue on the surface and rubbing it in gently using a brush. Carry on doing this over the whole surface until the paper stops absorbing resin and the surface of the reinforcement has a dull finish.

7.5 Cleaning with solvent or wasting brushes can be avoided by doing the following:

- put 20 cc of laminating resin (no hardener) in a paper cup
- clean brushes by squeezing out excess resin onto newspaper
- clean the brush with Acetone applied to a paper towel
- thoroughly stipple the brush into the resin
- before the brush is used next time, just squeeze out the excess resin
- ensure the brush is thoroughly stippled into the new resin/hardener batch before using to apply resin

8 Reinforcements

8.1 Use the following or a close equivalent:

for a One Metre hull moulding

300 to 450 grams/m^2 of woven glass reinforcement made up of at least two layers e.g.2 x 150 gsm twill woven glass
local reinforcements where required
the laminating resin may be pigmented to assist the gel coat colour
DO NOT ALLOW THE GLASS REINFORCEMENT TO BECOME CONTAMINATED WITH OTHER FIBRES.

for a Marblehead or Ten Rater hull moulding

250 to 400 grams/m^2 of woven carbon reinforcement made up of at least two layers e.g. 2 x 125 gsm plain woven carbon for a sufficiently stiff but light hull moulding, 2 x 200 gsm plain woven carbon for a super strong/stiff hull moulding.
local reinforcements where required
the laminating resin used on the first layer may be pigmented to assist the gel coat colour

for a 6M or A Class hull moulding

350 to 450 grams/m^2 of woven carbon reinforcement made up of at least two layers e.g. 2 x 180 or 3 x 125 or 1 x 125 + 2 x 180 gsm plain woven carbon
local reinforcements where required
the laminating resin used on the first layer may be pigmented to assist the gel coat colour

for a A Class or 1/12 ACC hull moulding

400 to 550 grams/m^2 of woven carbon reinforcement made up of at least two layers e.g. 125 + 2 x 180 or 3 x 180 gsm plain woven carbon
local reinforcements where required
the laminating resin used on the first layer may be pigmented to assist the gel coat colour

8.2 On the first layer of reinforcement great care should be taken to ensure proper wetting out and that there is no bridging of fibres causing voids between the reinforcement and the gel coat. In particular check at sharp edges (between topsides and deck edge flange, across chines, and where the mould has heavy 3D curvature. The first layer should be resin rich to help avoid any voids immediately under the gel coat. Air trapped at this stage will be impossible to detect later. Subsequent layers can be applied with less resin which will soak up the initial surplus. Soak off any excess resin on the last layer by using sheets of tissue paper rubbed into the surface using the laminating brush.

8.3 Knife trim the excess material from the edges of the mouldings when the cure is at the correct stage. This makes release and handling the mouldings considerably easier.

8.4 Allow to cure – see 8.5 and 8.6.

8.5 Follow the post curing schedule recommended for the resin system you are using. This will impart best heat and fracture resistance.

8.6 Alternatively allow 48 hours, preferably 72 hours, and with a gradually increasing temperature as follows:

12-18 hours at 20 degrees C
12-18 hours at 30 degrees C
12-18 hours at 40 degrees C
12-18 hours at 50 degrees C

Allow the temperature to reduce slowly over a period of hours at the end of the cycle before attempting to remove the hull moulding from the mould.

end

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