# Mould Making Guide

Production moulds made from glass reinforced plastics are widely used in hand lay up, spray up, cold press and resinject production methods throughout the reinforced plastics industry. They have the advantage of being relatively low cost, easily repaired or modified and simple to manufacture. The disadvantages of these moulds are their short life compared to say matched metal moulds and the strength / flexing limitations in cold press or resin inject moulding.

There are three main stages leading to the production of an article in GRP:-

A) The design and manufacture of a master or pattern usually from the combination of wood, plastics, metal, etc. It is at this stage that the high quality surface finish is achieved.See article on Pattern Making

B) The manufacture of a production mould from the master pattern, closely checking dimensions and surface finish.

C) Mould treatment and manufacture.

## MAKING A QUALITY MOULD

## GELCOAT

The actual thickness of gelcoat applied for mould making is a controversial subject and each mould maker tends to have his own preferences. The process described below should prove to be most suitable. Please remember that a thin gelcoat layer results in quick wear and tear and exposure of the laminate behind, whereas a thick gelcoat layer can lead to cracks and star crazing during handling and mould release. (These will of course be transferred as permanent marks on any subsequent product made from the mould).

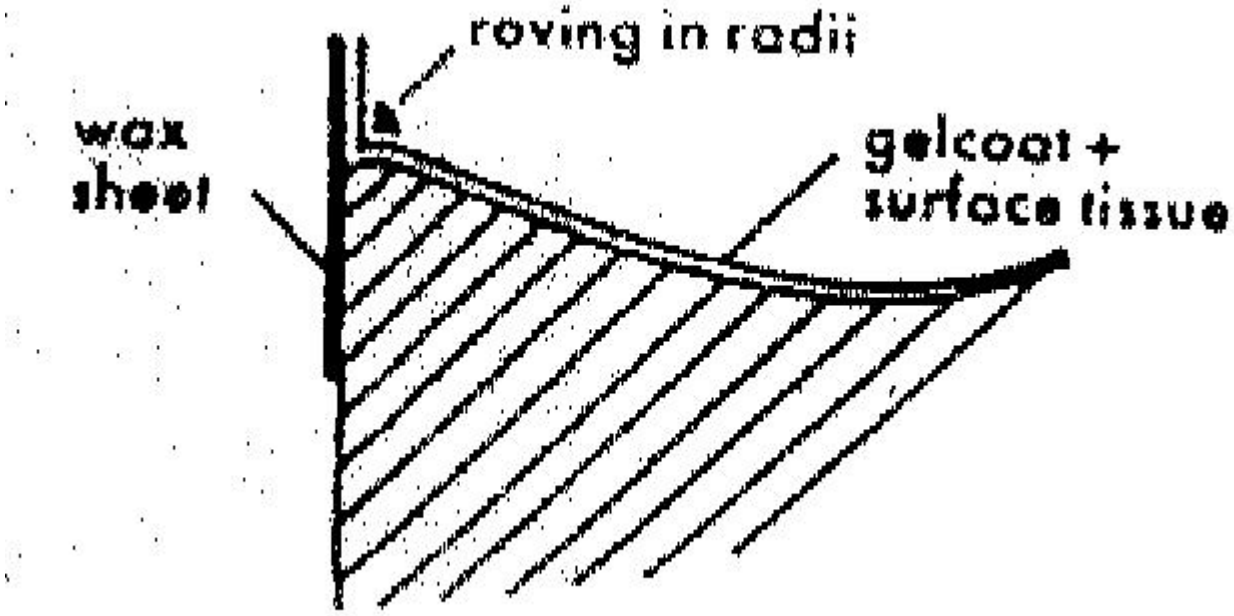
Apply a layer of pigmented ( maximum 2%) catalysed tooling gelcoat (GT5000) at 350gm/m2 over the area in question. allow to cure to a state where the layer is just tacky to touch but when touched with a clean dry fingertip the finger comes away cleanly. Repeat the process with a second layer of gelcoat preferably pigmented a different shade of the same colour. Make sure in both cases that gelcoat does not collect in sharp corners or radii. It will also be advantageous if the moulds are made a different/oposite colour than that of the production articles.

When the second layer of gelcoat has reached a nearly tack free stage as with the first layer, paint a thin coat of catalysed tooling laminating resin (VE001) on the back of the gelcoat. Place a layer of glass surface tissue on top of this using a brush to consolidate, bringing the resin up through the tissue and removing any entrapped air. Do not use a roller at this stage unless absolutely necessary as too heavy pressure could result in lines being transferred through the gelcoat. Make sure that no air is entrapped at sharp radii, such as where the max flange meets the pattern. The surface tissue is used to stop any fibre pattern from the chopped strand mat showing through the gelcoat and to minimize the risk of air entrapment immediately behind the gelcoat.

## APPLICATION OF LAMINATE

At this stage any sharp radii in the pattern should be dealt with. The reason for this is that however well laminated and wet out with resin the laminate tends to spring away from corners and there is a minimum radii to which a chopped strand mat laminate will conform without leaving air voids behind the gelcoat. A common method for laminating in sharp radii is to take a length of continuous glass roving (or to pull out some warp or weft strands from a glass cloth) and dip a suitable length in catalysed resin - squeezing off the excess. This length of resin saturated roving is then placed in the radii and gently prodded into place along its length making sure that any entrapped air is removed. This has the effect of filling the sharp radii out and making any

subsequent laminating easier and more accurate. Beware of pools of resin collecting which could cause exotherm problems.Another way can be by mixing resin with Duroplastic filler FIL839 - Wollastonite




After the surface tissue and rovings have sufficiently cured, the construction can continue. The first layer of chopped strand mat reinforcement should be as light as possible, say 300gm/m2, for good drapeability. A catalysed resin coat is first painted over the surface and a suitably tailored piece of chopped strand mat is placed over the top. The resin is brought through the chopped strand may by use of a brush and roller. The resin to glass ratio should be in the region of 2.5:1. Tailoring of the glass reinforcement is usually done by tearing rather than cutting, to fine neat overlaps and is tried out for fit on the dry pattern before the painting on of the resin coat.

This layer should be allowed to gel and exotherm before proceeding. If the pattern shape is complicated the process should be repeated with 300gm/m2 chopped strand mat. If the shape is simple go directly to heavier reinforcement of 450gm/m2 laminating two layers, the second layer directly after the first making sure there are no air voids.

After gelation and exotherm we now have the basic requirement for a mould. This amount of reinforcement will give a fairly strong but flexible mould. Another basic decision now has to be made, ie., **How thick and how robust should the mould be made?**

This largely depends on the size and shape of the product concerned. Usually the stronger the mould the better, but obviously cost has to be taken into account. A good general guide is that the mould should be approximately 2.5-3 times he thickness of the finished product. Moulds which are required to be dimensionally accurate are made robust by using alternate layers of chopped strand mat and woven glass cloth ( Duroplastics FGWR400 - A special tooling twill weave cloth) . Note that there must be a minimum of 900gm/m2 of chopped strand mat laminated between the first layer of woven roving and the gelcoat. This is to avoid the possibility of a cross hatching pattern being transferred from the woven cloth through to the

gelcoat. Woven roving glass cloth should never be used in adjacent layers because this will result in poor interlaminar adhesion. A minimum of 450gm/m2 chopped strand mat should be laminated between layers of woven roving.

The rest of the mould should be built up to the required thickness, laminating not more than 3 x combination layers of chopped strand mat/tooling twill cloth before allowing to gel and exotherm. This stops any excess heat build up which might cause excessive shrinkage or warping. After the main body has been laminated the flange area usually has to be strengthened over and above the requirements for the mould, probably half as thick again. The build up should be tapered as below to avoid a quick change in section on the mould. This step is to be avoided as it can leave a ripple mark on the product surface.

After addition of all ribs, stiffeners, etc. the mould and pattern should be left bolted together for at least 48 hours at room temperature. At this stage a moderate post cure can be given of 60deg C for 12 hours.

The actual separation of pattern and mould must take when both components have completely cooled after the post cure. On a simple mould the use of a few wooden wedges should be enough to ensure an easy release. Impatience at this stage can lead to damage to either pattern or mould. Move carefully and slowly using light tops only, with a mallet.

## MOULD PREPERATION

1. Remove bolts from flanges
2. Insert the wedges lightly between the flanges along the split line. Place about 15cm apart and use Hand pressure only, seating to a depth of say 1cm
3. GENTLY tap with a mallet all the wedges in turn and repeat taps until separation occurs or obvious forcing is taking place
4. If excess force is required slacken off the wedges slightly and use wedges in other positions between themould and pattern

If a PVA film has been used an easier release can be obtained by pouring warm soapy water between pattern and mould this dissolving the film.

## SURFACE TREATMENT OF MOULD BEFORE LAMINATING

1. Wash the mould with "just warm" soapy water and a clean cloth
2. Dry with a soft cloth and bolt the two halves together after waxing flanges
3. Apply was release barrier using a good quality silicone free mould release wax. **Follow the manufacturer's instructions.** Do not work on too large an area at once, wait at least half an hour between coats to let wax harden. Apply at least 7 coats initially.
4. Seal the split line if required with plasticine or similar. Roll the plasticine into long thin strands and press into the join. A very smooth finish to the seal can be obtained by rubbing mould release wax over the surface with a finger. This also feathers the edges.
5. Seal any air release points with plasticine of by covering with an adhesive paper disc (wax afterwards).
6. Leave for 24 hours at room temperature before laminating the first product to ensure wax is hard.
7. Apply PVA film if desired, gelcoat and laminate product.

## Notes

i) New moulds should be treated gently until they are run in. Do not use at maximum production rate immediately
ii) A fresh wax coating should be applied before every new product at first then every 2-4 depending on difficulty of release.

Mould preparations, resins, gelcoats, catalysts, glassfibre, tools, equipment and ancillaries are all available through Duroplastics