Small Fiberglass Parts

by DanH via VansAirforce.com forums

Example 1 - Simple Ducts

Sometimes small fiberglass parts have complex shapes. The shape may not allow neat wrapping in gloss packing tape in order to facilitate mold release. You'll need to make a plug with a firm, slick finish of its own. So how do you do it quickly?

Start with a dense, small cell foam. You can order foam from the aircraft supply of course. I just hit the local big box home supply and buy a sheet of dense pink or blue wall insulation board, usually available 2" thick. Not expensive, and a whole lot more foam for your money. Cut a few sections bigger than your intended part and laminate them together with dry micro. That gives you a solid foam block of any desired size.

How to shape the plug? I use an ordinary crosscut hand saw for the big cuts, then a hacksaw blade for the finer cuts. From there use 80 grit paper to rough it out, then 180 to detail the shape. If there's a critical outside dimension, make the plug about a 1/16" small.

When you have the shape nailed, mix some epoxy. Pour a little off in another cup and mix in some micro. Use a little plastic squeegee to wipe some micro mix into any surface flaw. Now, without waiting, paint the foam surface with neat epoxy. The idea is to form a thin epoxy shell and seal the foam.

When cured, lightly sand the epoxy shell until smooth. Little defects don't matter much. They will be duplicated on the inside of the finished part, but a little sanding will remove them later. Do NOT sand through the epoxy skin.

Now wax the surface, two coats, fully dry between coats, no buffing. I've used the same old can of carnuba wax for ages. When dry, spray or brush over the wax with some PVA mold release.

If the part needs a mounting flange, cover a sheet of aluminum or wood with packing tape. Screw the foam to the sheet with a few coarse deck screws or similar.

Do your layups. Three or four plies of 8.9 oz 8-harness is typical.

When cured, dig the foam out. The epoxy shell-wax-PVA combination will peel cleanly and leave a finished surface. A little touchup sanding will remove any raised defect. If you accidentally allowed a few air bubbles between the plug and the layup, fill the indentations with micro and sand the surface flat later.

A finished part after 10 minutes of trimming and sanding, and a plug ready for layup.

Example 2 - Filter Airbox

It is also possible to build assemblies of moderate complication with simple foam block male forms.

This is the start of a filtered airbox. The idea was to package the maximum possible filter media area into the limited volume forward of an AF servo (standard cowl without a prop extension).

Here's the basic form. Sometimes a section of a form requires more detail than you can easily shape in foam, or the shape of the detail is critical. In this case the box needed a careful bell-mouth radius at the servo entry. A few minutes on the lathe resulted in a nylon block form with the required shape, which was then grafted to the foam block. Epoxy will not stick to waxed nylon.

The interior of the box needed "rails" to constrain the filter. The key here is to realize the form is really a mirror image of the inside of the finished part; cutting into the block results in a protrusion later. In this case I simply fired up a router and cut slots in the block. The inside of the slots are skim-coated with epoxy to seal the foam, just like the rest of the form, and get the same wax and PVA treatment before layup.

The basic layup to form the box is conventional. In this case there is one addition. The slots were spooned full of epoxy/flox mix and squeegeed off flush with the surface of the form. Then the shell layups were applied while the flox was still wet. This "wet-on-wet" method makes the filter rails integral with the shell; no bonding issue.

The box needs to come apart for filter maintenance. When cured the shell was cut into two sections without removing the foam core. All it takes is a fine cutting wheel on a Dremel tool. The cut is just inside one of the rails, which you can easily see through the glass shell.

Next step is an overlapping flange to seal and attach the two halves. One half of the box got a layer of slick packing tape to form a no-stick surface (a bit of vinyl electrical tape covered the corners where packing tape wouldn't lay down neatly). The other half of the box was scuffed for bond prep. Three plies of glass were impregnated between plastic sheets. The flange shape was drawn right on the plastic, then cut to size with a rotary knife (the "pizza cutter"). Peel the plastic off one side, place the bulk layup, peel the other side, and stipple with a brush to remove air.

When cured, dig out the foam. The wax and PVA coated epoxy "skin" placed on the foam form earlier will peel off the inside of the parts like a bad sunburn. A few sharp raps with a rubber hammer, a bit of compressed air blown under the flanges, and the two sections pop apart. Here we are after a bit of rough trim ... and with the filter inserted on one half. Part number is K&N 33-2124

If you look closely to the photo with the airfilter installed, you will see ordinary #6 nutplates imbedded in the layup. These are the method of attaching the two halves together. They were simply pressed into the wet flox prior to the shell layup. They're visible through the glass, so later I'll cut a little hole for the screw, clean 'em with a tap, whatever. If I was really picky about the threads I could have filled them with clay or wax. BTW, the formed-in-place flange is almost airtight without screws.

Anyway, here's a trial assembly of the box, with filter. Filter media area is roughly 2X more than a Vans snorkel filter.

The flat area on top of the box gets an alternate air door.

Here's the alternate air door, 5 x 2.25, plenty of area. The hole was cut in the top of the box and the inside perimeter of the hole was painted with PVA. Three plies of 9 oz was saturated with epoxy between plastic sheets, then cut to the desired size by marking right on the plastic and slicing with the rotary knife. Peel one side, carefully place in the box, peel the other side and stipple with a cheap acid brush.

(photo missing)

When cured, it was popped out, trimmed, roughed up on the back side, and laid back in the box after washing out the PVA residue. A length of .125" music wire was bent to shape and holes drilled for the hinge points. The music wire was floxed to the back of the door and while wet one ply of 9oz was placed as a cover sheet.

(photo missing)

With the flox cured, one end of the wire got a stainless washer as a thrust button and another small washer soldered on for a stop. The other end got the same stainless washer, a 1" long 4130 arm, and a stub axle with a sleeve and stop, again all soldered. The spring was sized and stretched so the door will open at about 2" water differential pressure. (Later note; on the flow bench it opened at 3"...close enough. It does disturb airflow slightly in its airflow-driven "'floating" position; you can tell from the fuel flow. If fully opened manually, it has no significant effect on airflow or fuel flow. I could switch to manual operation, but probably won't, as I like its instant, fully automatic operation with a blocked filter. The HP loss shouldn't be critical....we'll see.)

The arm is arranged so as the door opens, the required pressure becomes less and less with increasing door angle. The door stops in contact with the backside of the filter and will self-close.

Finished product - process was the usual; epoxy/micro to fill then 80 grit sanding, shell w/epoxy for scratches/pinholes then 180 grit sanding. Primer and two-part single stage color seems to cover 180 grit sanding ok. The exterior cowl surface got primer and K36 sanded to 400 grit as it will later get a two-part pearl topcoat.

So much for small parts made over foam cores. It ain't rocket science; jump in there and make what you want. Your airplane should include at least one totally custom part good for a satisfied grin when you think about it

POSTSCRIPT October 2011 The 1" long 4130 arm soldered to the end of the piano wire hinge didn't work out. The solder joint failed twice; too much torque. It was replaced with a one-piece hinge and arm all bent from a single length of piano wire.

POSTSCRIPT: Filter loss (loss in air pressure with the airbox assembly installed on an FM200 throttle body, as compared to a "perfect" test bell mouth intake on the same FM200) was 1.9" H2O, or 0.14" Hg. That's about the same as a butterfly valve in a bare tube.

BTW, if thes doesn't seem to fit your definition of "quick", consider how the work is scheduled. Cut and laminate a few foam blocks, ten minutes. Shape the plug and paint with epoxy, an hour. Sand, wax, PVA, and layup, maybe two hours, and some of that is waiting for the wax and PVA to dry. Remove the foam and trim, another half hour. Between these tasks you work on something else.

To do the shapes you just make plane cuts (draw them right on the block) and then round off the corners. If you screw it up, big deal. Throw away $1 worth of foam and do better on the next one. The real focus is how to easily fabricate a one-shot throwaway plug which releases easily from the finished part and leaves a near-finished surface.