

## Pre-Paint>Fuselage>Fit cowling

### Objectives of this task:

To fit the top and bottom cowl to the fuselage. This is a big task that will require time and patience: the cowl will need several test fittings and small adjustments to get the fit just right: take your time and your reward will be a perfectly fitting, great-looking cowl.

### Materials required:

Card # J13 'Cowl components' and the piano hinges pack (pictured below)

Epoxy resin and flock

5-Minute Araldite



### Match the cowl joins and cut the propeller shaft hole



Start by standing the top and bottom cowls on their bases, align the front of each section carefully and then tape both sections together using cloth tape (circled above).

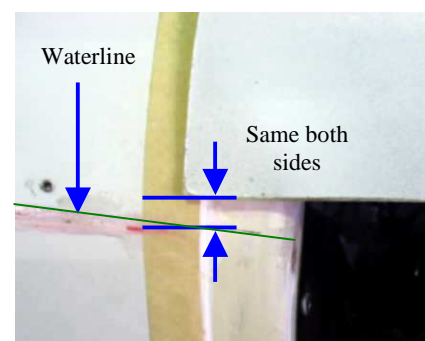
Look along the side joins and check the alignment: the top and bottom sections should butt up to each other with no gaps as shown at above left. Sand away any areas that overlap until each join is straight and true. Mark the centre front of the propeller boss area then mark a 105mm circle and use a jigsaw to cut the hole out. In the factory we use a circular jig as shown in the second photo but the hole can easily be scribed with a compass. Sand any rough edges.

### Fit the top cowl to the fuselage



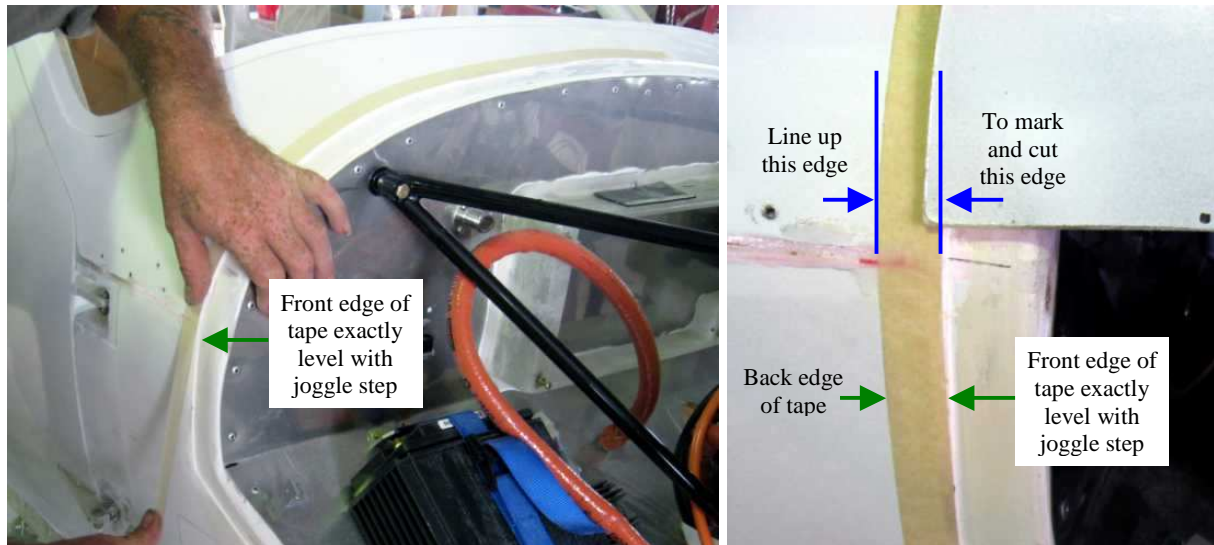
In this step we will need to make up a spacing jig (shown at left) that will keep the front of the top cowl 20mm behind the propeller flange and 15mm above and centred on the propeller shaft extension, plus a 3mm spacer on top of each ram air duct. Wooden blocks cut to size are fine for the purpose. Tape the jig into place and test fit the top cowl.

Once the front of the top cowl is correctly positioned and centred on the propeller shaft extension, move to the back of the cowl and ensure that it is centred side-to-side: mark the fuselage waterline on each side of the fuselage (photo at right) and measure up to the cowl from that line then move the cowl side to side until the distance is equal on both sides. Recheck that the front of the cowl is still centred. When the cowl is centred at the front and back, mark the centreline on the cowl and on the fuselage in front of the windscreen and then tape the cowl to the fuselage.



## Mark and cut the cowls to length

In the next 2 steps we will need to cut both cowls to length so that they will fit into the joggle.



In the factory we have a handy technique that we use to mark the cut: we run masking tape all the way around the outside of the joggle on the fuselage with the front edge of the tape exactly level with the step of the joggle (left photo above) and then when the cowl is in place we run another strip of masking tape around the cowl but with back edge of the cowl tape in line with the back edge of the fuselage tape (left photo below), so we use the width of the tape as a way to accurately mark where to cut.  $\frac{3}{4}$ " masking tape is ideal for the purpose.



In the photo above left the back edge of the cowl tape is being aligned with the back edge of the fuselage tape, while in the photo above right the cut is being made in line with the front edge of the cowl tape. Sand any rough edges away with a long sanding block and refit the top cowl, using the centreline mark to position the cowl at the back and checking that the front of the cowl is still centred, then tape the top cowl into place.

The same “masking tape” technique will be used to cut the bottom cowl to length.

Drill 3 x  $\frac{3}{32}$ " holes through the top cowl and into the fuselage: each hole should be 10mm in from the edge of the cowl, with 1 on the cowl centreline and 1 each side 30mm up from the cowl joint. Temporarily fix the top cowl into place with 6G stainless steel screws.

Now that the top cowl has been positioned we can fit the bottom cowl to match it.

## Fit the bottom cowl to the fuselage

Offer the bottom cowl up to the top cowl – a well padded saw stool can be used to hold the cowl up – and fit the locating section at the front of both cowls to position the bottom cowl.

Butt the joins together and tape the bottom cowl to the top cowl.

Using the same technique that you used on the top cowl, use masking tape to mark the cowl to the correct length then remove the bottom cowl and cut along the front of the masking tape. Sand all cut surfaces with a long sanding block.

Refit the bottom cowl and tape into place, then mark and drill 5 x 3/32" holes on each side, each 10mm in from the edge of the cowling and each at 60mm away from each bend plus one screw near the bottom of the cowl – the lines in the photo above show the positions.

Temporarily fix the bottom cowling to the fuselage with 6G stainless steel screws.



## Trim and finish the ram air ducts



Remove the top cowl and mark the front of the ram air ducts 10mm back from the inside of the bottom cowl as shown above left.

Remove the ram air ducts and trim to the mark, sanding away all rough edges.

Mix up a small batch of 5-minute Araldite and flock and bond the rubber sealing strips around the front of each ram air duct as shown above right, holding the strips in place at 12mm in front of the ram air duct with spring clips while the flock dries.

Remove the bottom cowl and take both cowls to a cleared workbench.

## Pre-fit the cowl hinges

You will need some Clecoes for this step. The objective is to position and pre-fit the hinges using the Clecoes and then flock and rivet the hinges permanently into place.

Lay both hinge pairs side by side on the bench. The hinge with the first loop at the very end will be the bottom hinge. Mark the "Top" and "Bottom" part of each hinge pair and then mark each pair "Left" or "Right". Mark and drill 3/32" holes along the centre of each hinge starting at 10mm in from the end and then at 100mm centres.



Assemble each hinge pair by sliding the long hinge pin through the full length of the hinge. Note that the hinge pin is much longer than the hinge – do **not** trim the hinge pin to length! The extra length will be used when the hinge pin is fitted through from the door jamb and into the hinge later in this task. Put a cloth tape flag on the exposed end of the hinge pin to prevent possible accidents.



Fit both cowls together, fitting the locating section at the front of both cowls first and then butt the side joins together. Tape the cowls together with cloth tape on both the inside and outside of the joins. Now roll the cowl so that one side join is on the bottom and place the appropriate hinge assembly 30mm in from the back edge of the cowl – shorten the hinge if required. Take care that the hinge is placed so that the hinge pin is exactly in line with the join and with the side of the hinge marked "Bottom" in the bottom cowl.

Hold the hinge firmly in place and drill a single 3/32" hole through the cowl at the back end of the bottom hinge and fix the hinge in place with a Clecoe.

Now align the front of the bottom hinge, drill and Clecoe into place. Repeat the process on the top hinge then drill and Clecoe every other hole. Drill the remaining holes through the cowl.

Roll the cowl around to the other join and repeat the entire process for the other hinge.

At this stage the hinges hold both cowls together as shown at right, with Clecoes fixing the hinges to the cowls.

Mark each hinge and the cowl half that it belongs to and then remove the Clecoes and the hinge pins.

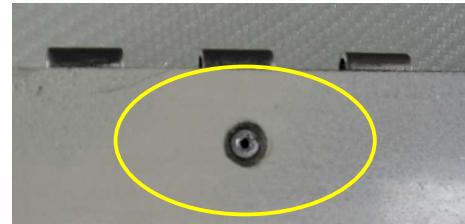


## Fix the cowl hinges

Sand the bonding surface on each cowl half and the backs of each hinge half to give the flock a good key to bond to. Clean your Clecoes in Acetone and dry them. Keep the tin of Acetone handy for later (in fact storing your Clecoes in Acetone can be a good idea because it keeps them free of oil and other contaminants that could affect an efficient bond).

Mix a batch of resin and coat the bonding surface of each cowl then add some flock to the remaining resin and then, working on one half of one hinge at a time, apply an even layer of flock approximately 2mm thick to the hinge and fix the hinge in place with clean Clecoes in every other hole and then rivet the remaining holes before removing the Clecoes.

Working on one hole at a time, drill a 3/32" hole and use a 120° countersink bit to carefully countersink the outside of each rivet hole just enough to allow a countersunk rivet to sit slightly below the surface of the cowl (example circled at right) then rivet each hole before moving on to the next hole.



Drop each Clecoe in the Acetone as you remove it to clean the flock out of it. Clean away as much flock as possible from around the hinge pin holes, smooth the flock along the other side of the hinge with a mixing stick and leave the flock to cure overnight.

Next day test fit the hinge pins and remove any remaining flock from the hinges.



In the factory we use a special drill bit (shown above) that is just a standard drill bit welded onto the end of a spare hinge pin and we clean the hinges through with that (top photo), using a low drilling speed to prevent any whipping of the long bit. It is important that the hinge pins fit easily into the hinges without any restrictions.

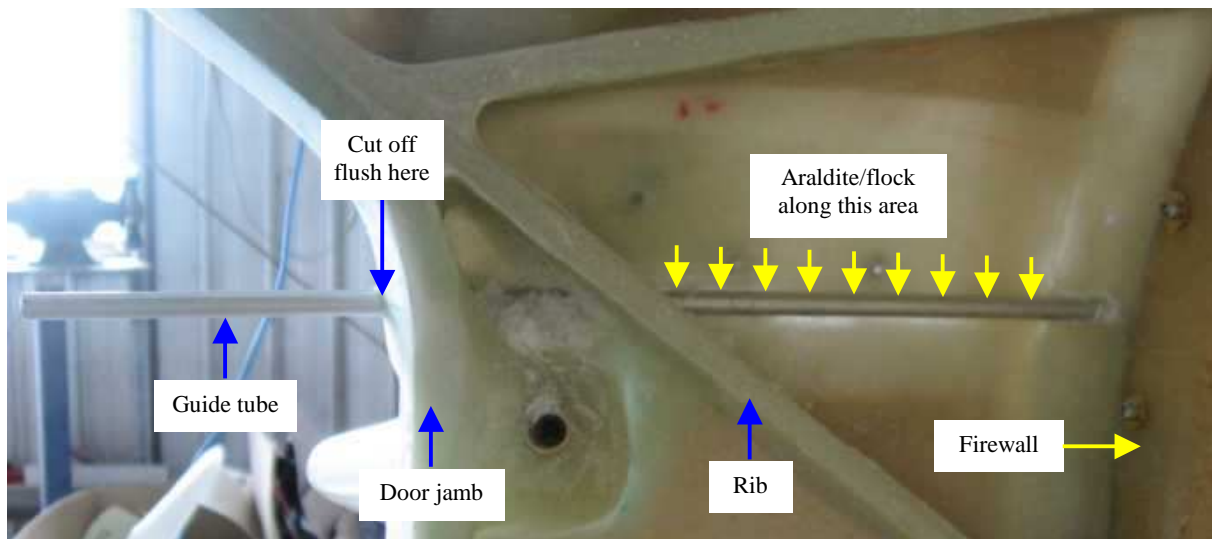
## Fit the hinge pin guides

These guides are the 2 lengths of aluminium tube on the Card that are used to guide the hinge pins through the door jambs and into the cowl hinges. When the cowls are finally installed the ends of the hinge pins will be bent in at right angles and the door will hold them in place.



Refit the bottom cowl to the fuselage and hold the hinge in against the joggle then mark a line beside the firewall and directly behind the hinge. Drop the cowl and drill a 1/4" hole at this point as shown above left: it will be just inside of the fuselage skin.

Mark a point on the front of the door jamb 10mm in and in line with the cowl join as shown above right, which will be very near to the waterline, and drill a 1/4" hole towards the hole that you have just drilled. Use a file to round the ends of the guide tubes slightly.



Continue to drill through the rib until the guide tube can be pushed all the way from the door jamb and through the firewall.

Allow the guide tube to protrude very slightly, about 1/4" as shown circled at right.

Check that the hinge pin will line up with the bottom cowl in place and then fix the guide tubes in place with 5-minute Araldite and flock.

*Hint:* a strip of masking tape under the tube acts as a dam to keep the Araldite/flock mix in place while it cures. Once the Araldite/flock mix has cured use a hacksaw to cut the tube off flush with the door jamb.

Clean any burrs and flock out of the guide tube.

Repeat the process for the other side of the fuselage.



## Final fit the cowling

Fit the top and bottom cowls to the fuselage and insert the hinge pins from the front door openings. Drill one 5/16" hole through each side of the propeller boss for a Camloc fitting (shown circled at right).



Starting with the bottom cowl, remove one 6G stainless steel screw at a time and drill the hole out to 3/16", then drill the 3 holes in the top cowl to 5/16".

Remove the cowls and fit the captive nuts (a complete captive nut assembly shown at right) to the 3/16" holes in the bottom of the fuselage.



Use the captive nut itself as a jig to drill the rivet holes as shown at above right – thread the screw part way through the captive nut from the back and fit the exposed end of the thread into the hole in the fuselage, then drill the 2 x 3/32" rivet holes.

Repeat this process for each captive nut and then fit the captive nuts to the inside of the fuselage, countersinking each rivet hole and riveting from the outside of the fuselage.

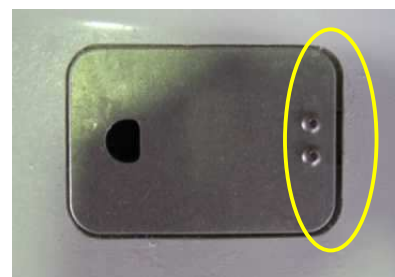
Use a similar technique for the 5 Camloc fasteners in the top cowl (3 at the back, 2 around the propeller boss): hold the captive part of the Camloc centred over the hole and drill the 3/32" rivet holes then fit the captive part inside the fuselage, once again countersinking the rivet holes on the outside of the fuselage. A complete Camloc assembly is shown at right:



Countersink the holes in the bottom cowl enough to allow the Tinneman washers to seat snugly. Do not countersink the holes in the top cowl, just deburr them.

## Fit the machined oil door

Locate the marked position on the right side of the top cowl. Lay the oil door on the marking and mark around it, then move the oil door forward 2mm and remark the front – this slightly larger gap (circled at right) is to allow for the forward movement of the hinge when the oil door is opened.



Assemble the door to the hinge and fit to the hinge surround. Sand around the inside of the oil door opening and then test fit the door assembly, taking care to keep the door centred sideways and to the rear of the opening with the hinge to the front. Tape the door to the cowl with 2 strips of cloth tape to keep the correct position.



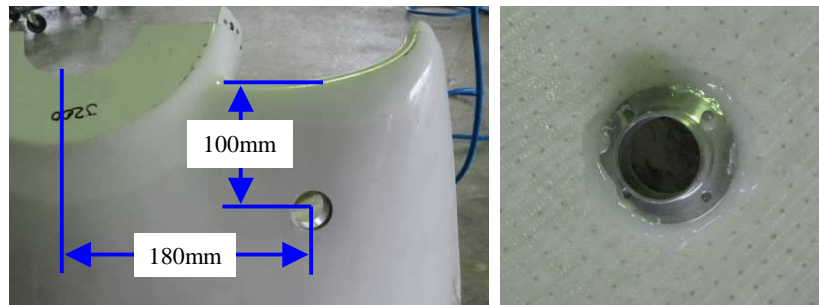
Mix a batch of 5-minute Araldite and flock, then lift the hinge frame up, apply the Araldite/flock mix to the hinge frame and seat the hinge frame to the cowl. Take particular care that no Araldite/flock gets into any part of the hinge.

## Fit the cabin air inlet flange

Drill a 30mm hole on the left front of the lower cowl, 100mm below the bottom lip of the air inlet and 180mm to the left of the propeller centreline.

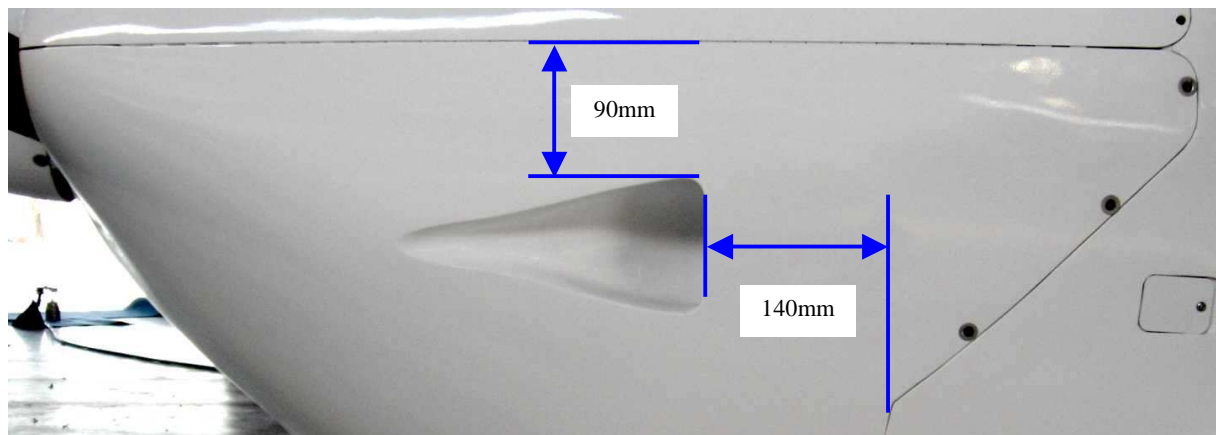
Sand the back of the flange (from Card # J25) and around the inside of the cowl around the hole.

Mix a small batch of 5-minute Araldite and flock and fix the flange into place.



## Fit the induction air (NACA) duct

The induction air duct is fitted to the left hand side of the bottom cowl.



Assemble the duct with 5-minute Araldite. Hold the scoop on the outside of the cowl in the position as shown above, keeping the rear edge of the scoop at right angles to the hinge line and mark around the outside of the unit and then make a second line inside the first about the size of the actual opening.

Cut the opening and fit the scoop to the inside of the cowl, holding it in place with 5 x 6G stainless steel screws and adjust the opening to match the shape of the scoop. Mix a batch of 5-minute Araldite and flock and fix the scoop into place, holding it in place with the screws.



When the Araldite/flock has cured, heat and remove the screws, mix a small batch of resin and apply a single layer of AF303 glass fibre cloth on the inside of the cowl over both sides and across the rear of the scoop. Leave overnight to cure.

Next day apply filler to blend the cowl opening smoothly into the scoop.

Do a final test fit then remove and store the cowls and hinge pins until you are ready to paint.

This completes the *Pre-Paint > Fuselage > Fit cowling* task.