Pre-Paint>Fuselage>Empennage>Fit rudder

Objectives of this task:

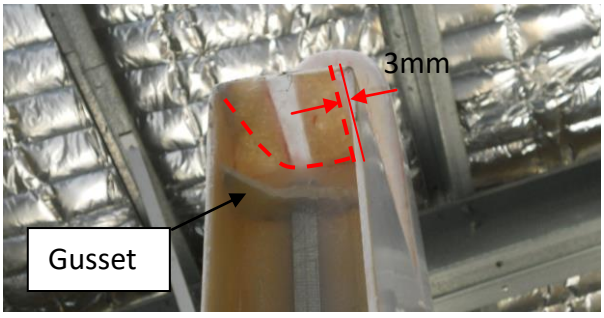
To fit the rudder to the vertical fin, align the rudder and fit the rudder stops and rudder cable.

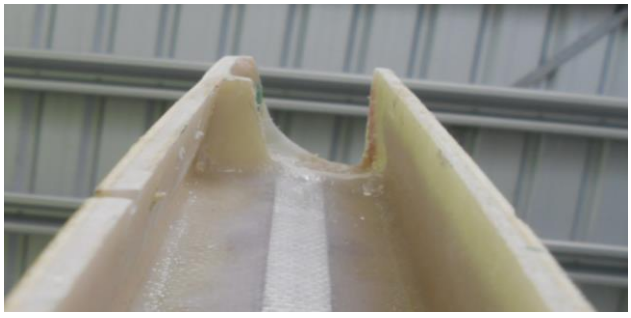
Materials required:

Card # 3J 'Rudder'
Epoxy resin and flock

Prepare the fin

In order for the rudder to correctly swing full travel both left and right, a cutout must first be made at the top of the vertical fin. Cut about 3mm in from the right side. On the left side cut a similar profile to the gusset below as the pictures below indicates.





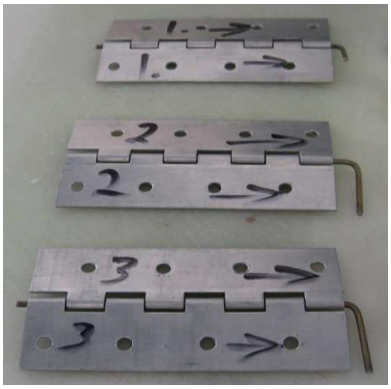
Align the rudder

The first step is to line up the top of the fin and the top of the rudder: the vertical alignment. Tape a mixing stick to the fin at the 2 positions indicated by the yellow arrows at right and sit the rudder in place.
Place mixing stick(s) as required at the bottom of the rudder to get an even gap.
It may be necessary to adjust the vertical gap slightly or sand the top of the fin or rudder in order to get a precise and visually pleasing alignment.
Once the vertical alignment is correct the fore and aft alignment can be addressed: the second step is to equalise the gaps between the fin and rudder and the top of the fin and the rudder horn.
It may be necessary to sand part of the forward section of the rudder horn and/or the back of the fin ahead of the rudder horn away, taking care not to make either area too thin.
Take your time and get this alignment exactly right – the tail fin/rudder is a very visible part of an aircraft and time spent now will reward you with the pleasure of a great looking tail on your aircraft. Leave the mixing stick alignment spacers taped in place at this stage.

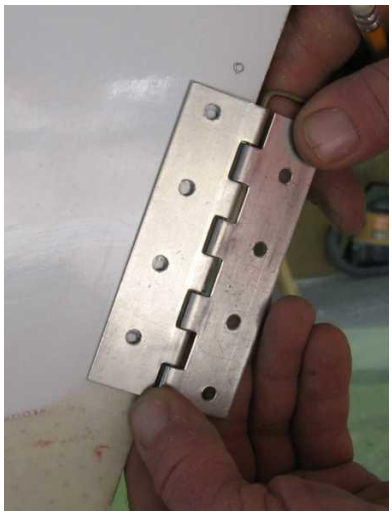
Use the photo of a finished example above as a guide of how the rudder should look.

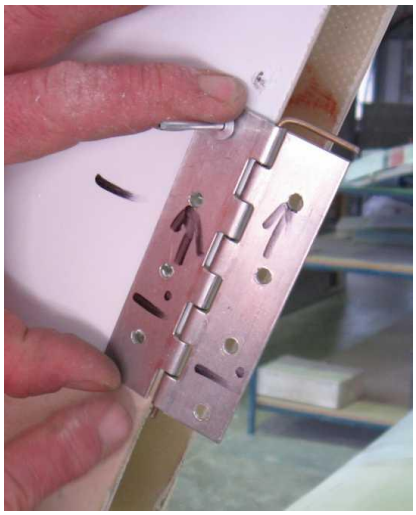
Pre fit the hinges, mount and swing the rudder

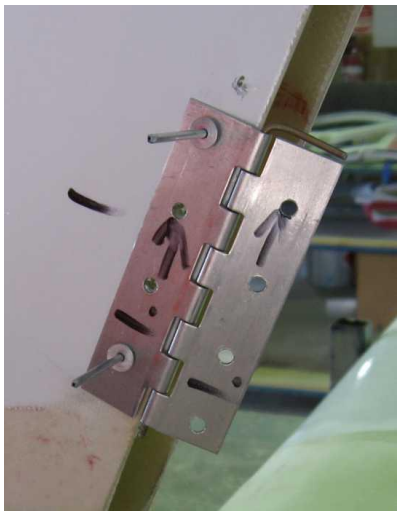
Mark the initial hinge locations onto the vertical fin from the drawing 2 pages down, then number the hinges on both sides as well as the matching positions on the fin, including an arrow for “up” on each hinge.
Notice that the flat side of the hinge faces out.
With the rudder still in place, hold each hinge centred over the gap between the vertical fin and the rudder and mark the final mounting position of each: the hinge pin should sit in the centre of the fin to rudder gap.
Remove the rudder and set it aside while the hinges are fitted to the tail fin.



Hold a hinge in position and drill the top hole only and temporarily fit the hinge in place with a rivet as shown above,

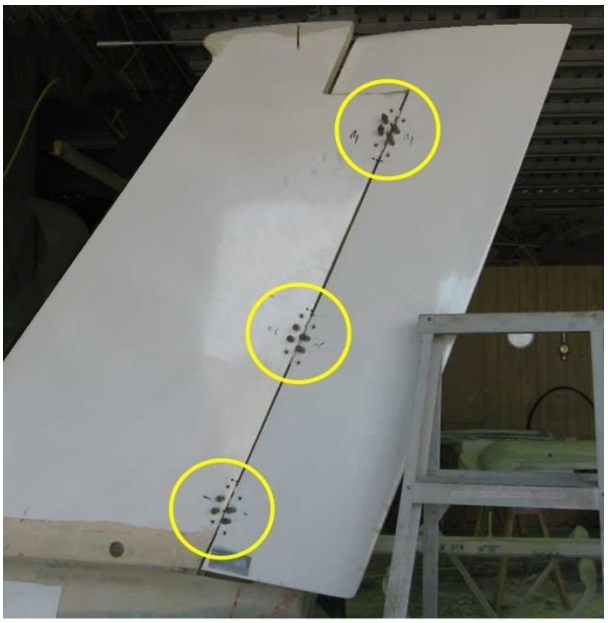






then carefully reposition the hinge so that the hinge pin is parallel to the back of the rudder and drill the bottom hole and fit a rivet in that hole, then drill the remaining 2 holes. Repeat this process for each hinge.
Put the rudder back in place using the spacers that you left taped in place. Make sure that the alignment is still correct, then drill the top hole of the top hinge and fix in place with a rivet, and then drill a hole in the bottom hinge and fix that in place with a rivet. Repeat the process until all holes are drilled and each hinge is temporarily fixed to the rudder with 2 rivets.

Test fit the rudder using Clecoes to hold each hinge in the final mounting position, which is inside the fin and inside the rudder as shown above. Remove the spacers and check that the rudder can swing freely left and right at least 100mm from the centreline as measured at the rear of the rudder. If there is any binding locate the source and correct it.
Mark the location of the end of each hinge pin (circled at above left), then remove the rudder and all hinges.



Fit the rudder

The objective now is to refit the rudder as before with Clecoes but with a 2mm bed of flock under each hinge, do a final check of the alignment and rivet the hinges into place.

Lightly sand the flat side of all hinges and the inside of the fin and the rudder where the hinges will be placed. Mix a batch of resin and coat the hinge mounting areas inside the fin and the rudder, then mix in flock and coat the fin half of each hinge. Clecoe the hinges in place on the fin as before. Now apply flock to the rudder half of each hinge and mount to the rudder in the same way: with Clecoes in the centre holes.

Check the rudder for free movement and once you are satisfied that there is no binding then countersink each hole with a 120° countersink bit and rivet each hinge with countersunk rivets – top and bottom holes first, rechecking for free movement at each step, then take the Clecoes out and countersink and rivet the centre holes. Take care to keep any flock away from the hinge pins during this step.

Do a final check for free rudder movement, then carefully remove the hinge pins and rudder, clean away any excess flock with a clean mixing stick and leave overnight to cure.

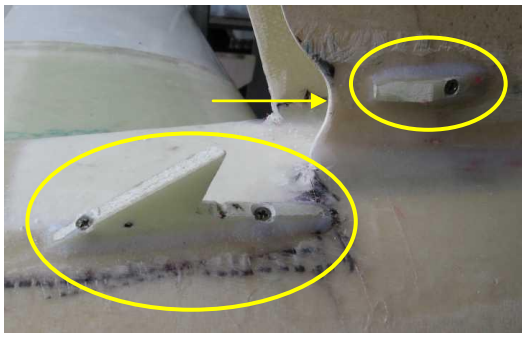
Next day use a rat-tail file to make a slot into the fin at each hinge pin mark, fit the hinge pin and the hinge pin retainer, mark the retainer screw hole and drill a 3/32” hole. Pop rivet an anchor nut under each screw hole using 2 x 3/32” countersunk rivets.

Fit the rudder stops

Make a template that will sit over the rear of the empennage and tape it in place. Find the

centreline of the fuselage and mark a 5mm offset to the right onto the template, then mark 100mm each side of the offset as shown above. Refit the rudder.

Swing the rudder to the left-hand mark on the template and mark the position of the rear rudder stop and fit it in place with 2 countersunk self-tapping screws. Swing the rudder to the right and fit the front stop the same way. It may be necessary to sand inside the right-hand side of the fin to clear the rudder at full right deflection.

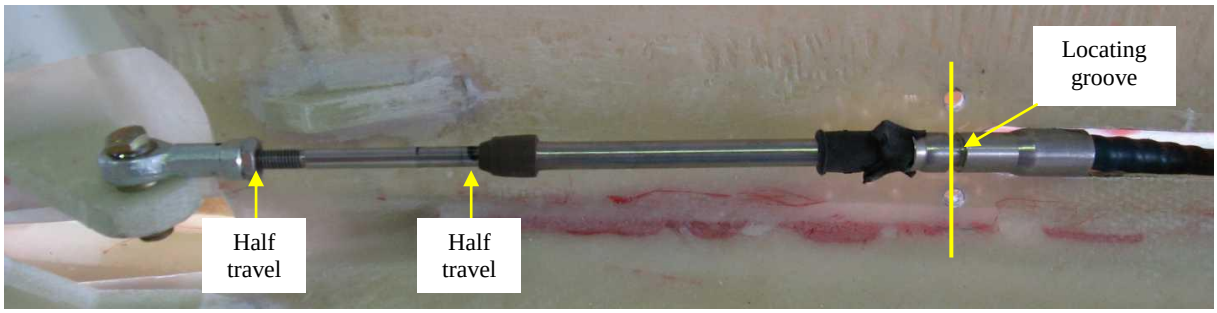


It may also be necessary to sand away part of the lower right of the fin (arrowed at right) to allow clearance for the rudder arm at full right rudder deflection.

Check the swing both ways and adjust the stops if required. Once the positions are correct remove the stops and sand the base of each stop as well as the position in which they will be mounted, then mix a small batch of resin, coat the joining surfaces and flock both stops in place, holding each in place with the self-tapping screws. Smooth away any excess flock and leave overnight to cure.

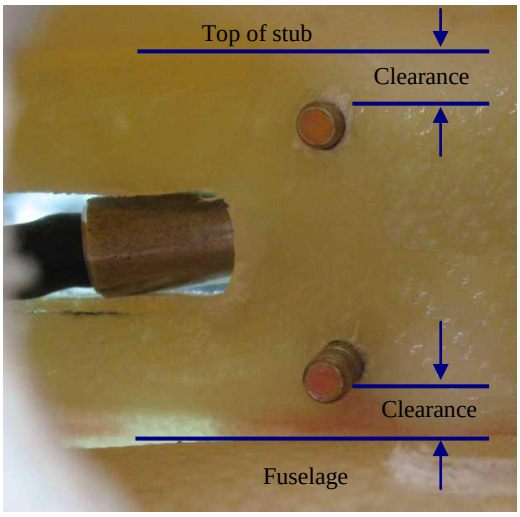
Fit the rudder cable bracket clamp

Fit a rod end to the rudder cable: thread it on to half the thread depth. The total cable travel is 80mm: pull the inner cable all the way out and make a mark at 40mm from the outer cable then push the inner cable in to that mark. This puts the cable at the centre of its travel.
Fit the rod end to the rudder arm with a bolt.



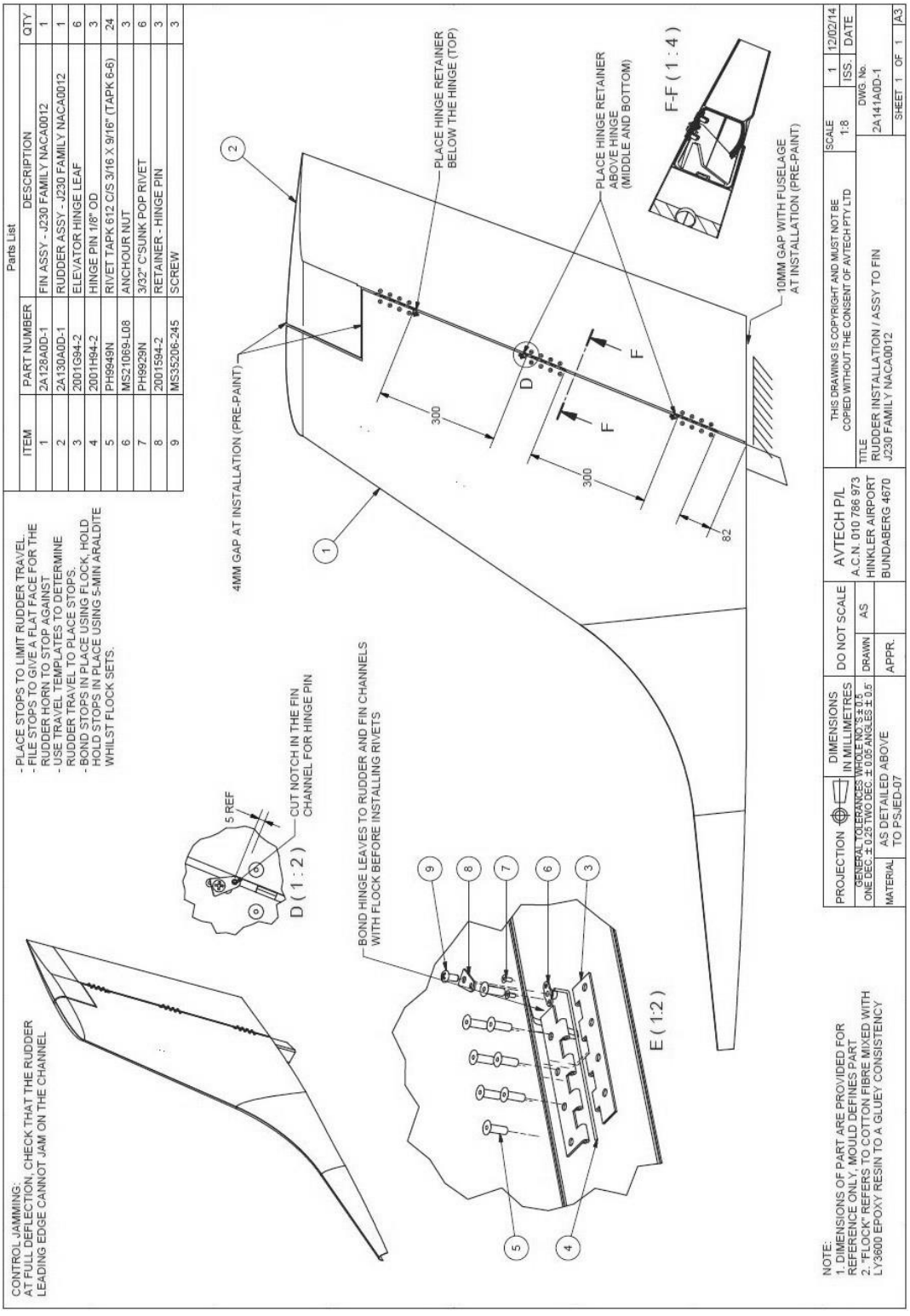
Secure the rudder in the '5mm right of centre' position on the template, then hold the rudder cable horizontal and mark the location of the locating groove in the outer cable.

Hold the cable clamp in place and drill a 3/32" pilot hole into the fin through each hole in the clamp, then check the holes from the back through the access hole (as pictured at right) – there needs to be enough room above the top hole and below the bottom hole to fit the head of the bolt in place.



Make any vertical adjustments that may be required then drill to 3/16". Test fit the cable clamp: feed the bolts from the inside and through the side of the fin, then place the angled cable clamp packer against the side of the fin with the wider part of the packer to the rear of the aircraft, then the cable clamp shim and finally the cable clamp. Secure temporarily with plain nuts – final assembly will require Nyloc nuts.

Test the movement of the rudder and rudder cable: make sure that the rudder can be moved to each stop by use of the cable without any binding.
Remove the rudder cable fittings and the rudder and set aside for painting, put all hinge pins, hinge pin retainers and rudder cable fittings into a labelled container for reassembly after painting has been completed.



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