

20. Tailplane mass balance and control stop

The all-flying tailplane of the Europa is to be fully balanced to give both correct handling and to prevent tailplane flutter.

A welded steel tube assembly TP18/6 is bolted to the torque tube assembly on TP9 and a weight is attached to the end of it to balance the tailplane after final painting.

To stabilize TP18/6 sideways, the weighted end will run within a slotted structure that also acts to support the pitch control stops.

To enable fine adjustment of the arm's vertical position, a threaded end fitting TP18B and adjuster TP18C are to be installed into the end of TP18/6's lower strut.

Figure 1 shows the general arrangement of the tailplane mass-balance arm.

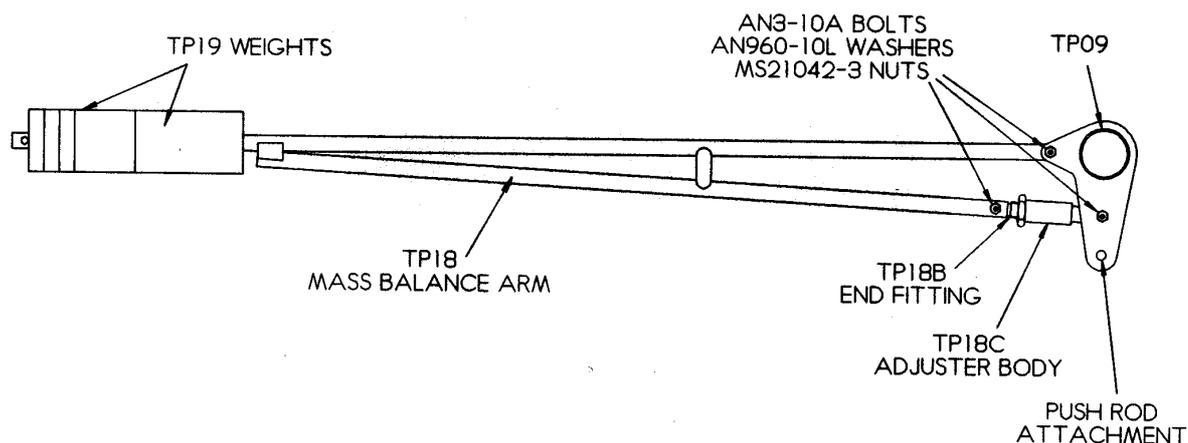


Fig 1. Mass balance arm installed on torque tube.

Step 1

Mass balance arm installation

Insert the plain end of the end fitting TP18C into the rear end of the shorter tube of the TP18/6 arm as far as it will go. Drill through the fitting with a 4.8mm drill using the pre-drilled holes in the tube as a guide - see figure 2.

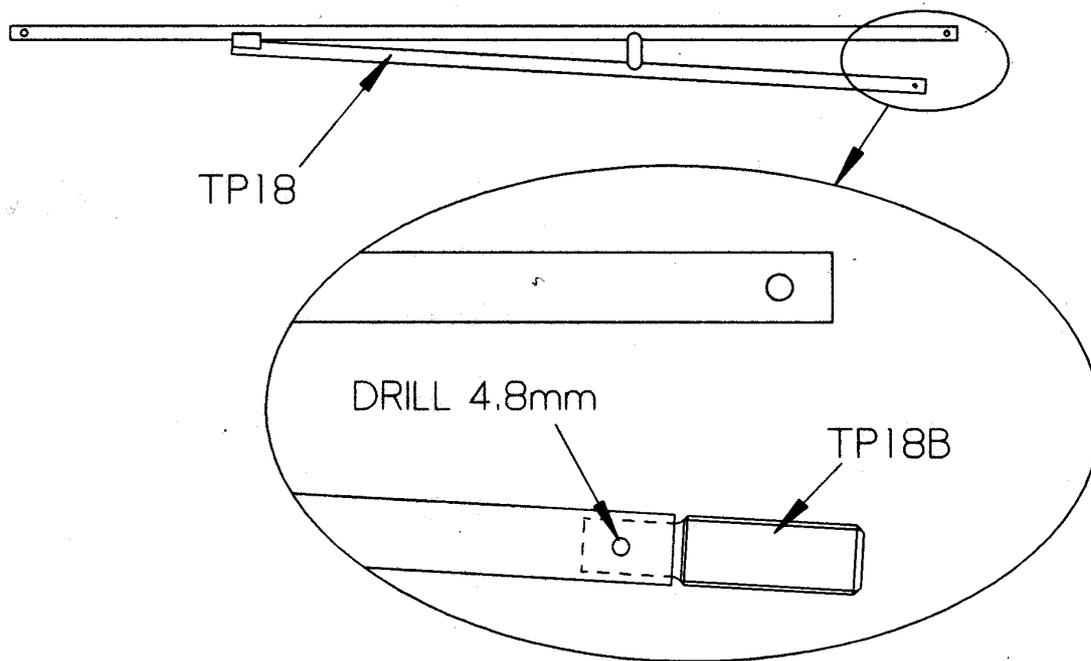


Fig 2. Adjustable end fitting assembly.

Using an AN3-10A bolt, AN960-10L washer, and MS21042-3 nut, bolt the TP18B to the arm assembly. Screw the adjuster TP18C and its checknut AN316-8R onto the TP18B. Check that there is at least one diameter engagement of the end fitting in the adjuster.

Install the TP18 assembly onto the torque tube assembly with its longer, upper arm attached to the short, forward pointing lugs of TP9, using AN3-10A bolts, MS21042-3 nuts and AN960-10L washers. Refer to figure 1.

Before tightening the nuts, however, adjust the end fitting so that, when the tailplane is at 13° trailing-edge up, the end of TP18 is approximately 65 mm (2.5") above the main pitch push-rod to allow for the lower pitch stop and the weights yet to be fitted.

Step 2

Weights

Slide on to the arm the TP19, TP19A, and three TP19B cylindrical weights and then temporarily insert an AN3 sized bolt with its head cut off to stop them from sliding off. The final amount of the weight will be determined after the tailplanes have been finish painted. Sliding them fore or aft will provide a certain amount of fine tuning but it is more than likely that some weight will have to be removed. One way to do this is to drill holes radially into the weights until sufficient material has been removed. If more weight is required, contact Europa Aircraft for advice.

The space behind the weights will be occupied by the spacer TP18D. Cut this to the appropriate length once the final weight is known, to stop the weights from sliding around.

Pitch control stop / Push-rod containment

To limit the tailplanes' movement, pitch control stops are installed in the rear fuselage against which the mass balance weight contacts. The lower stop can be installed now, however, the upper stop is mounted to the upper moulding and will be described later.

In case of the elevator jamming, and the pilot pulling hard on the control stick to overcome the obstruction, the main pitch push-rod would be in compression and could bow out of shape and become ineffective. To prevent this from happening the tube must be contained at some point along its length. This is achieved by a bulkhead with a close fitting hole through which the push-rod passes being added to the front of the pitch control stop. In normal service the push-rod will never contact the bulkhead, but it's important to include it as you never know when you might need it.

Step 3

Lower pitch stop

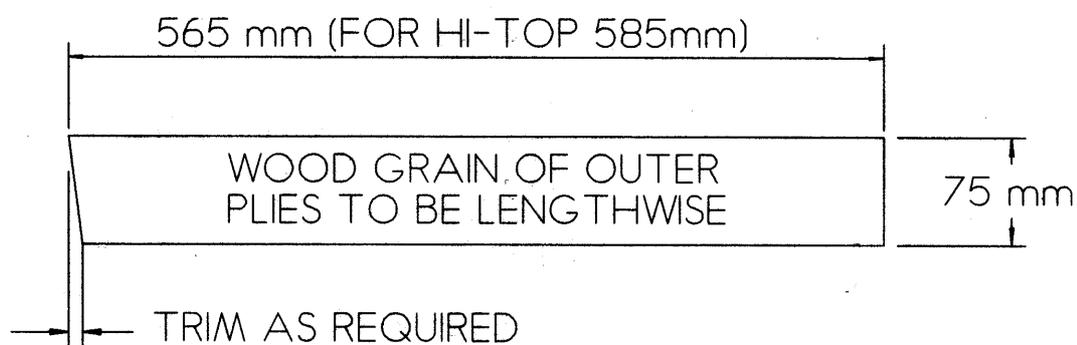


Fig 3. Pitch stop side pieces to be made from 3mm plywood.

To make the side supports for the stop cut two pieces of 3mm plywood to the drawing in figure 3. One end will require trimming to allow the supports to stand vertically on the sloping floor of the fuselage.

Make a spacer from 25mm diameter wooden dowel to be 64 mm (2-1/2") long and drill a 1/4" hole right through the centre for a long bolt. Cut a piece of 25mm bore rubber hose to fit around the dowel and slide it on. The dowel should be positioned about 1cm above the push-rod. Set the dowel so that the point the weights contact it is approximately midway along their total length. See figure 4.

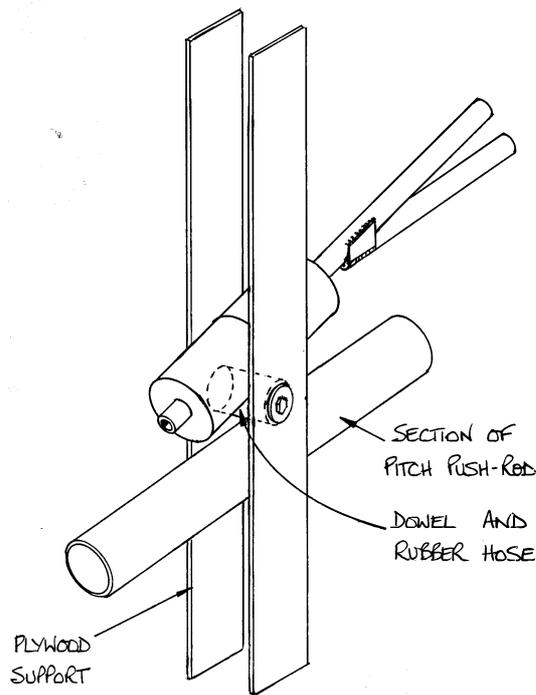


Fig 4. Position of tailplane control stop.

Clamp the dowel between the side pieces which should be set vertically either side of the push-rod and touching the fuselage floor.

Drill the side pieces with a 1/4" drill for the centre of the dowel and bolt the dowel in place using an AN4-31A bolt with an AN970-4 washer under both the bolt head and the MS21042-4 nut.

Step 4

Push-rod containment bulkhead

Cut another piece of 3mm plywood according to figure 5 to make the forward stiffening bulkhead and, using one of the pieces cut from it, make the smaller push-rod containment lower bulkhead.

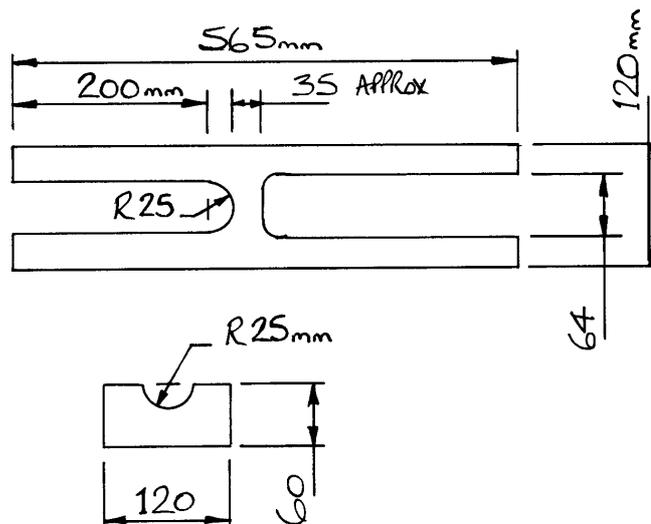


Fig 5. Forward bulkhead and lower containment bulkhead.

Referring to figure 6, position the forward bulkhead on the front edges of the side supports so that there is a clearance of *no more than 4 mm* around the push-rod and tack it in position with small blobs of rapid epoxy.

The push-rod rises and falls slightly as the tailplane operates through its full range, so take this into account.

Next locate the lower bulkhead and, holding it to give a similar clearance to the upper part, drill through both parts with a 4.8mm drill for an AN3-6A bolt each side. This part is detachable to enable removal of the stop assembly as required.

When you are satisfied that all is well remove the whole stop assembly. Layup 2 plies of 'bid' at $\pm 45^\circ$ on the front face of the forward bulkhead and also on each side piece, lapping onto the rear face of the forward bulkhead. Use a fillet of floc in the corner to eliminate air bubbles.

Paint the inside faces and any exposed wood with epoxy to seal it.

After cure, trim the glass fibre and reposition the stop assembly in the fuselage with the lower bulkhead bolted in place. Use AN970-3 washers under both the bolt head and the MS21042-3 nut.

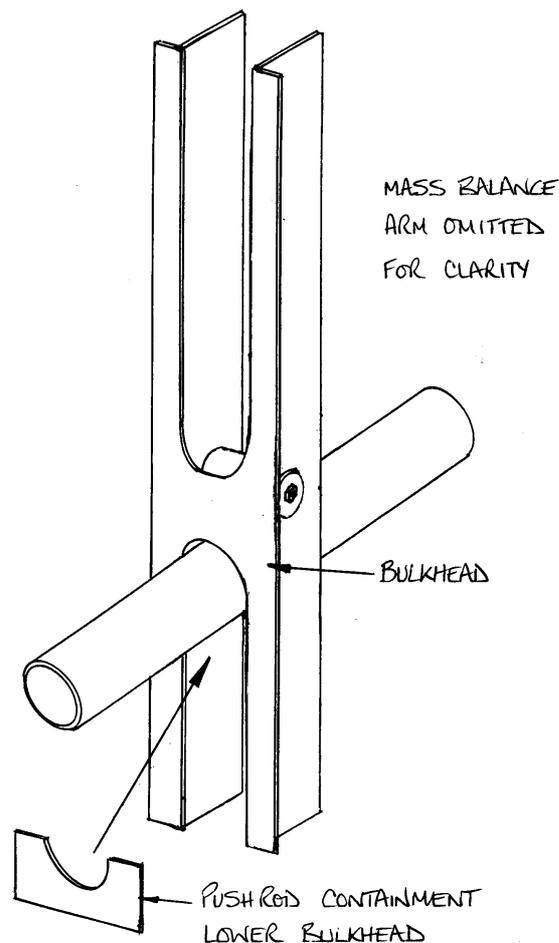


Fig 6. Forward bulkhead location.

Step 3

Guide strips

Three countersink screws, MS24693-C274, are used to secure each guide strip. Mark out and drill the 4.8mm holes in each strip according to figure 7.

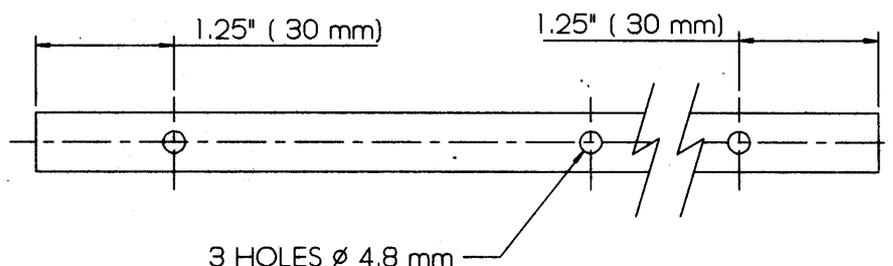


Fig 7. Drilling the guide strips.



With the mass balance arm out of the way, install the low friction guide strips, one to each of the inside faces of the pitch control support structure - see figure 8.

Countersink the holes on one side (using a larger drill spun between your fingers will be acceptable) ensuring that the heads of the countersunk screws will be below the surface of the guide strips.

Position the guide strips such that they cover the movement of the mass balance weights from the bottom stop to the top stop. Drill through the support structure with a 4.8mm drill and bolt in position with the countersunk screws, AN960-10L washers, and MS21042-3 stiffnuts.

The diameter of the mass balance weights is 50mm, and the nominal clearance is 2mm each side - check that the clearance achieved is between 1mm and 4mm each side.

Check that the weights run centrally within the slot.

Step 4

Scuff sand the fuselage floor each side of the support and, with plastic sheeting placed to prevent the stop assembly becoming prematurely attached, layup a 4 ply bracket of 'bid' at +/- 45° running from the floor to the outer faces of each side support, covering the edges with peel ply.

Make each flange of these brackets approximately 4-5cm wide.

Similar brackets will be made for attaching the stop assembly to the fuselage top moulding when it is permanently in place.

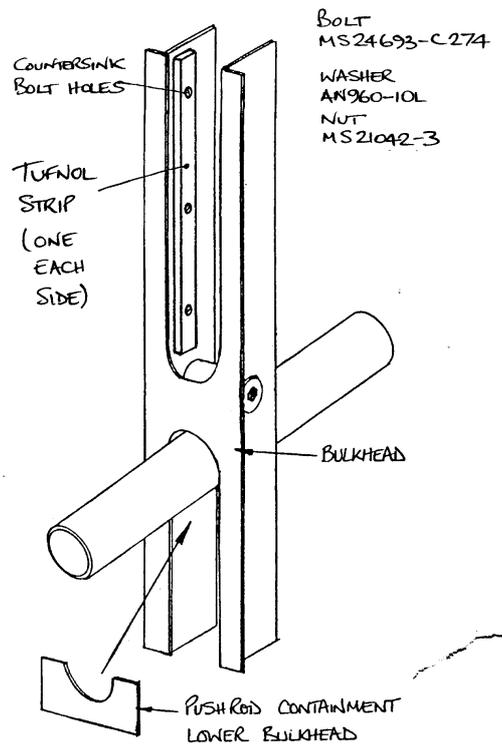


Fig 8. Position of guide strips.

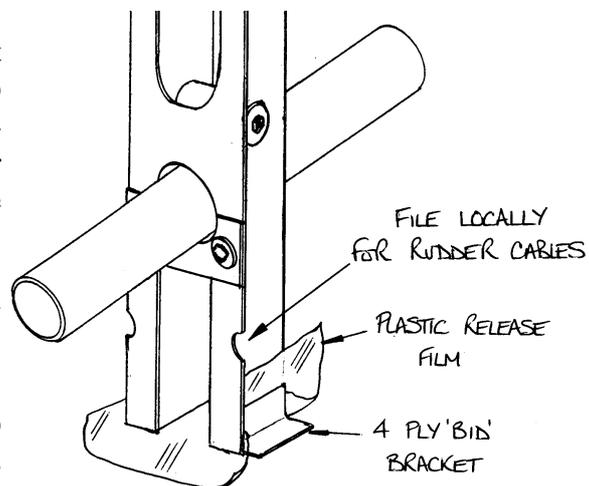


Fig 9. Tailplane stop lower mounting brackets.

After cure drill through both bracket and side piece with a 4.8 mm drill as shown in figure 10.

Remove the stop assembly once more to trim the brackets and remove the plastic.

Finally, bolt the stop assembly to the brackets using AN3-5A bolts and MS21042-3 nuts with AN970-3 washers under both the bolt heads and the nuts.

Although not necessary, bonding the washers in place could save a lot of fiddling if removal of the stop assembly was required.

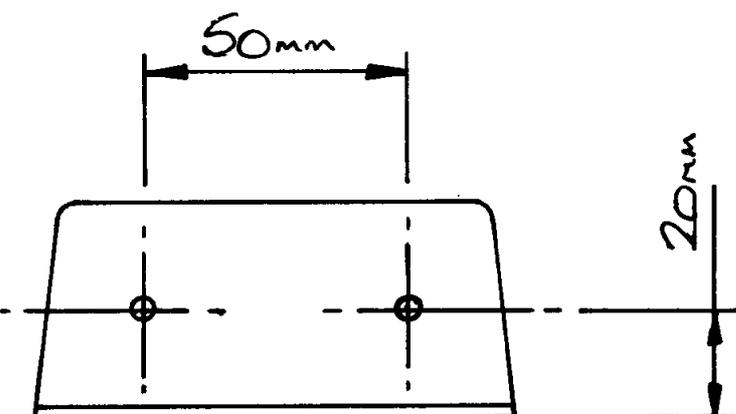


Fig 10. Attachment bolt hole positions through brackets.

Adjust the mass balance arm so that with the tailplane at 13° trailing edge up the weight is in contact with the stop.

Step 5

Adjusting the tailplane mass balance

This stage must be done after final painting to get the most accurate mass balance. Ensure that the weights are up against the temporary bolt and check for mass balance.

To do this, push and pull on the control stick to start the tailplanes moving, then release the stick and note if they stop more quickly in one direction than the other. With all the weights on the mass balance arm, you would expect the tailplanes to be over balanced, with the result that the stick will move aft more readily than forwards.

Alter the amount of weight, if required, to achieve best neutral balance. To reduce the balancing mass, drill holes in the front weight; in the unlikely event that extra weight is required, contact Europa.

Now measure the amount of space between the rearmost weight and the end of the support strut of the mass balance arm. Cut an appropriate length of the sleeve TP18D, remove the weights, install the sleeve, then reinstall the weights and secure them with the 6mm roll pin. Finally, if necessary, adjust the TP18C unit so that the tailplane movement range is between 12° - 13° trailing edge up and 4° - 5° trailing edge down when the weight is in contact with the fuselage moulding on the port side.

Check also that the movement of the weights runs parallel to the guide strips and that they are not rubbing. If the pitch stop support structure is not mounted parallel to the mass balance arm movement, the fixing brackets will require removal and re-making.



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