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## 18. Tailplane torque-tube

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### Step 1

#### Fuselage rear bulkhead

Remove the three part templates of the rear bulkhead: an A4 size sheet from Annex A (page 5) and two A3 size sheets from Annex F of the manual, and glue them together making sure that the centre line remains straight.

Transfer the centreline and outline onto the 3 mm thick PVC foam (F04) and cut it out. You will need to use the scrap foam taken from the hole to extend the foam up to the tip of the bulkhead. Also cut out the area for the insert and make sure that it is able to fit into place snugly. The bulkhead will require further trimming on installation so don't waste time making it too precise.

The insert is made from 3 mm plywood and is for the pitch trim servo and bellcrank brackets.

### Step 2

#### Bulkhead lay-up

Cut 2 pieces of bid at +/- 45° large enough to cover the bulkhead. With the foam on a flat surface protected with plastic sheeting set the insert into its hole with flox, then slurry the foam with micro before laying on the two plies of bid to cover the entire bulkhead.

Make sure that the bulkhead remains flat, weighting it down as necessary. Apply peel ply to cover the edges for subsequent bonding.

After cure, trim the edges back to the foam, then lay-up the other side in the same manner as before with 2 plies of bid at +/- 45° making sure it remains flat. Again, add peel ply around the edges. Trim this lay-up after cure to complete the bulkhead.

### Step 3

#### Bulkhead installation

The front face of the rear bulkhead is positioned at Fuselage Station 171" (FS 171) which is 1 ½" behind the position where the tailplane torque tube's centreline will be. This centreline, at FS169.5, is marked by a cross on the lower fuselage moulding. Using a pair of compasses, scribe a 50 mm (2") diameter circle centred on the cross for later reference on both tailplane fairings.

Now drill through the crosses, square to the aircraft's centreline with a small drill, 3.3 mm (1/8") will do.

Insert a straight, rigid rod through both holes and measure from it to a reference, such as the cowling joggles, on each side to ensure that the hole centres are both at the same fuselage station.



First setting the fuselage so that it is level, mark a vertical line on the inside of the moulding 38 mm (1 1/2") back from the centre of the hole you've just made. This marks the position of the *front* of the rear bulkhead.

Scuff sand about 5 cm (2") fore and aft of the line all around the inside of the fuselage removing any epoxy build-ups.

Referring to figure 1 set up the rear of the bottom fuselage moulding to the correct widths attaching wooden spacing blocks with dabs of bondo or rapid epoxy. Ensure also that the width of the fuselage at the torque tube centreline, measured to the outsides of the moulding, is 255mm (+/-2 mm).

Try the bulkhead in place (ref. figure 1) and trim it as required to fit in the correct position. Once you are happy with the fit bond the bulkhead in place using dabs of rapid epoxy, having scuff sanded it ready for subsequent bonding. It's important that the bulkhead is set vertically, square and in the correct position.

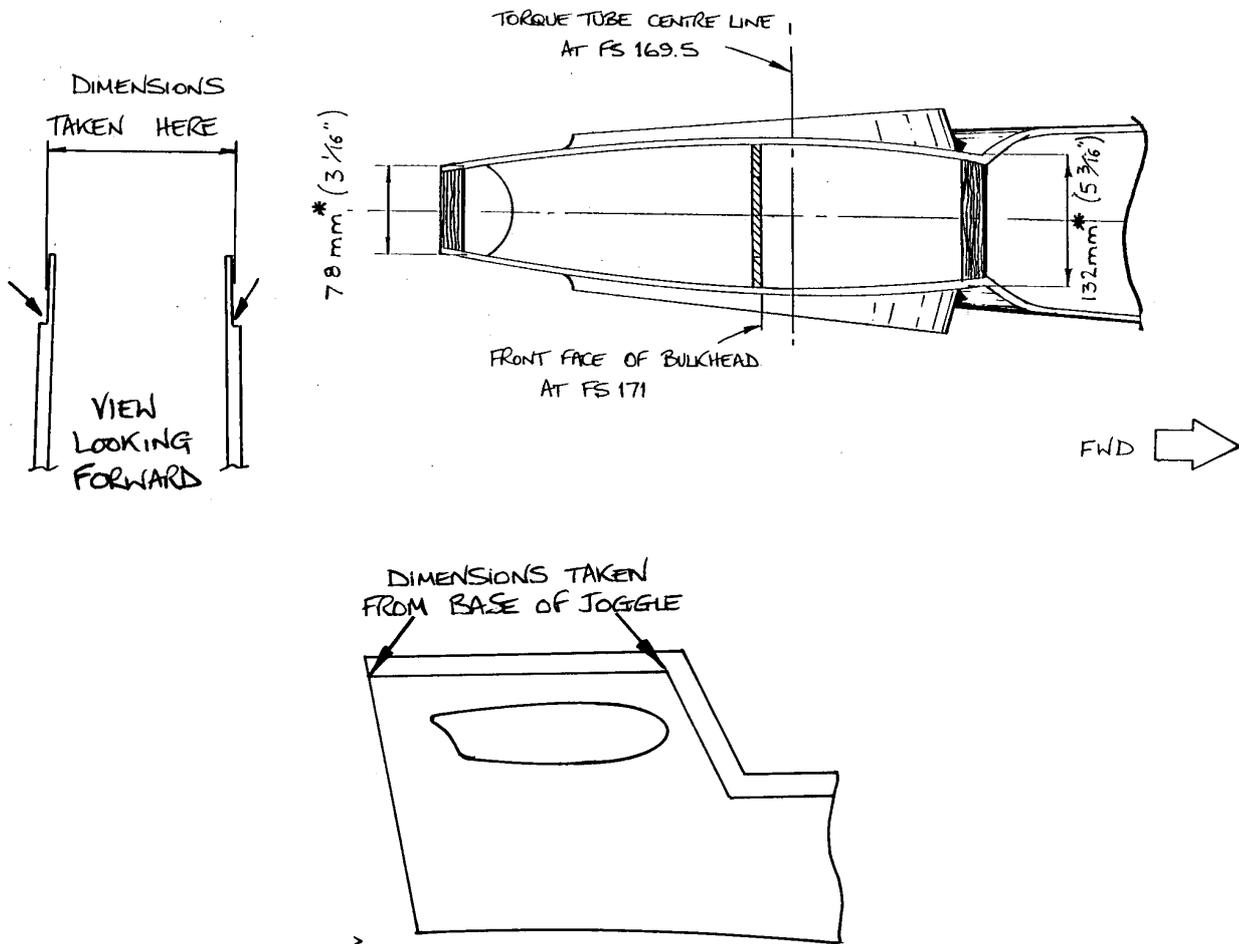


Fig 1. Rear bulkhead positioning in bottom moulding.

Scrape a fillet of flox into the corners between the bulkhead and fuselage sides, to aid the glasscloth around the corner and to fill any small gaps, then immediately lay-up tapes of 2 plies of bid at  $\pm 45^\circ$  into the corners all around both sides lapping up to the top of the joggle. See figure 2.

Finally lay-up 2 plies of 'bid' at  $\pm 45^\circ$  to cover the areas where the torque tube will be fitted, lapping onto the bulkhead 2-3 cm as the tapes are.

**Hint:** Lay-up these tapes up on plastic sheeting and scissor trim to size before applying them but don't forget to remove the plastic.

#### Step 4

#### Fitting the torque tube

Having verified that the pilot holes previously drilled in the tailplane fairings are correctly positioned, drill through with a 2" diameter hole saw. The torque tube can now be trial assembled in the fuselage with the bushes in the 2" holes. These will be bonded in position with Araldite 420 mixed with sufficient flox to make a non runny adhesive. First prepare the bushes for bonding by abrading the outer surface with coarse sand paper, or making shallow diagonal saw cuts.

Set the torque tube in place positioning it so that the TP12 drive plates have equal space between them and the fairings.

Make sure you level the torque tube, so you don't end up flying with one tailplane low, and also measure from the ends of the torque tube forward to each side of the firewall where it is bonded into the bottom fuselage to make sure that the sweepback of one tailplane will not differ from the other. You will need to make adjustments by enlarging the holes in the fuselage sides until you are happy with its position.

Make some small wedges and place them between the fairings on the fuselage moulding and the TP12 drive plates, the pins of which should be level, to prevent sideways movement of the torque tube.

To allow room for the adhesive which will bond the TP11 bearings in place, file several grooves in the edge of the holes in the moulding leaving areas untouched to aid repositioning of the bearing.

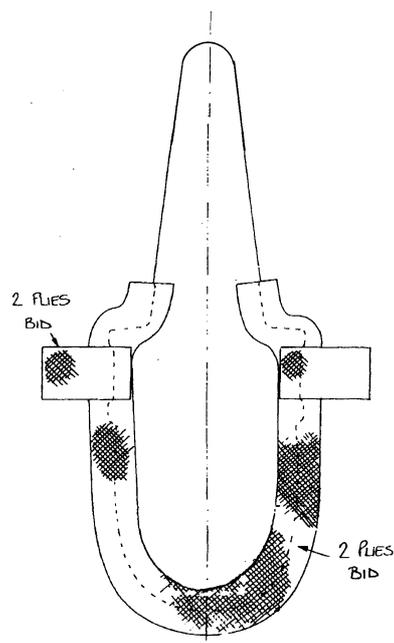


Fig 2. Rear bulkhead reinforcement plies and joining tapes



## Step 5

### Bonding in the tailplane bushes

Once you are happy with the torque tube location, mix up a small quantity of Araldite 420 and add just sufficient floc to the mix to stop it slumping.

You shouldn't aim to fully bond the bushes into the fuselage totally at this stage but make as much of the inside fillet of adhesive as you're able to secure the bearings into the fuselage. See figure 3.

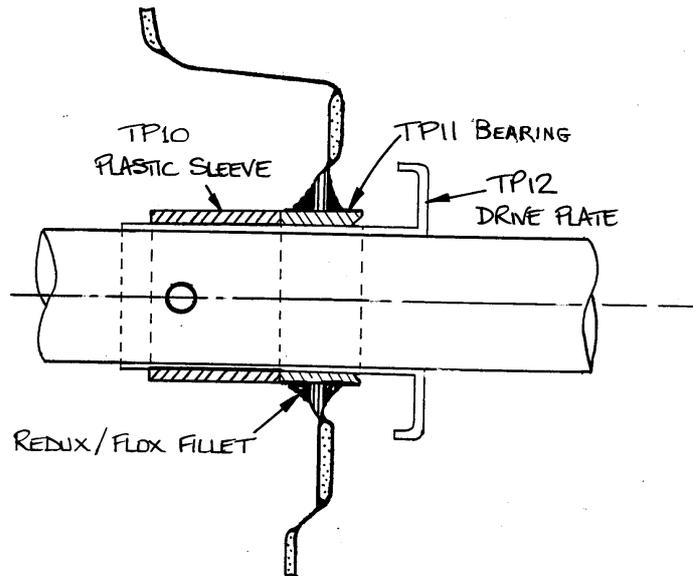


Fig 3. Section through tailplane torque tube bearing.

If you try to put in a really good fillet of adhesive all around at this stage you would more than likely end up bonding everything together in an untidy mess.

When you have bonded the bearings in place walk away and allow to fully cure taking your pet alligator (which has probably grown a bit by now) with you. Once fully cured, carefully slide the TP12 drive plates outwards sufficiently to give access to the outside of the TP11 bearings, leaving enough of the tube portion in the bearings, and pot all around them with a good fillet of Redux 420/floc adhesive.

## Step 6

### Tailplane torque tube securing

Before you can complete the tailplane assembly the TP10 plastic sleeves need to be fixed in place. These sleeves prevent the whole torque tube assembly from moving sideways within the fuselage by being located by the TP14D pins, which run through TP12 and the torque tube itself, so that they are in contact with the TP11 bearings. All this will become clear by viewing figure 3.



## Step 7

First relocate the TP12 drive plates, replacing their temporary bolts and set up the tailplanes to their correct position. Carefully measure the distances between the inside of the TP11 bearing and the centre of the hole for the TP14D pin each side, noting that these dimensions may be slightly different one side to the other.

## Step 8

Remove the TP10 sleeves, then carefully mark and drill a 3/8" hole through *one* side of them at the dimensions previously taken, noting which is port and starboard. Re-assemble the torque tube and place the bolts through the holes you have just drilled and through the TP12 and torque tube. Obviously you cannot push the bolts all the way through. If you have done your work carefully there should be no side movement on the assembly. The maximum side float allowed is 1.5 mm (1/16"). If at this stage you are pulling your hair out because you have drilled the hole in the wrong place then simply rotate the plastic sleeve through 90° and try again.

## Step 9

This step needs you to take great care;- remove one of the bolts and very carefully run your 3/8" drill through the assembly to spot the inside of the plastic bush. **DO NOT** drill all the way through without first removing the bush from the torque tube assembly. If you do you will almost certainly enlarge the holes in the TP12 and the torque tube ruining your whole day. You can now finally assemble your tailplanes, using the TP14C and TP14D pins for the first time - they should be a light drive fit. Fit the washers and split pins. **DISCARD** the temporary bolts, which must **NOT** be used for flight. Check for any play between the parts now. If new oversize pins are needed, now's the time to fit them.

## Step 10

Trim the tailplane's root flanges until there is an even 2-3 mm (1/8") clearance from the fairings when they are properly located with the pip pins.

## Step 11

### Pitch push-rod

The main pitch push-rod CS17 is the 45 mm (1 3/4") diameter aluminium alloy tube. End-fittings CS17A are installed in each end similarly to the end caps in CS10.



Before installation though, trim each EUR002 set screw's length to be 38 mm (1.5"), as measured from under the head, then screw one in each CS17A end-fitting from the cupped side. Apply Loctite 243 to the bolt's thread when it is about 1 cm from being tightened up. If you apply the Loctite sooner there will be none left on the thread by the time you get to the end.

Make sure the set screw is fully screwed in and tighten an AN316-5R check nut onto the bolt. Use Loctite 243 also on the nut, applying it in a similar manner.

Insert one of the CS17A end-fittings into the pitch push-rod tube, aligning the end of the tube with the position that the cone shape starts.

Drill eight 3.3 mm diameter holes equidistant around the end of the tube through both tube and end-fitting, then install the end-fitting with Loctite 638 around its circumference, riveting it in place using TLPD424BS rivets. See figure 4. Do only one end like this.

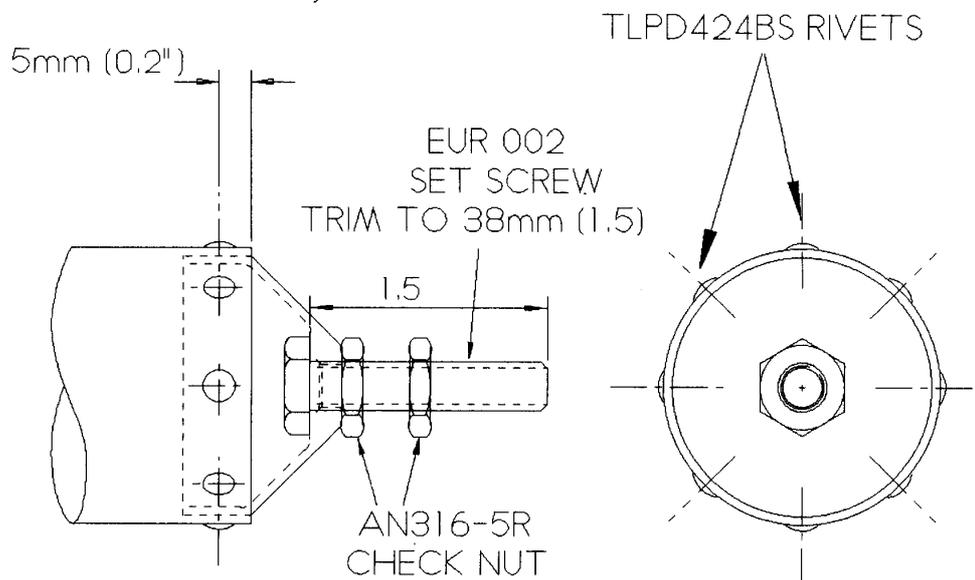


Fig 4. Pitch push-rod end fitting.

Before installing the other end-fitting the final tube length should be established:-

Screw another AN316-5R check-nut onto the setscrew at the end of the push-rod, then screw the push-rod into the MW5 rod-end, which should already be bolted to the centre lugs of the pitch torque tube, by about 15 - 17 mm (0.6" - 0.7").

Screw the second AN316-5R check-nut onto the loose CS17A end fitting, adding an MW5 rod-end, then slide the assembly into the open end of the push-rod tube and temporarily attach the rod-end to the tailplane drive arm with an AN5-11A bolt. Check that the tailplane moves at least 6° trailing edge down and 14° trailing edge up by moving the control column fore and aft. Check that there is no interference at each extreme of control column travel. The final movement of the tailplanes will be a maximum of 13° and -5°. Cut the push-rod tube as required, then rivet the end fitting to it as you did the other end. Attach the push-rod to the tailplane drive arm according to figure 5.

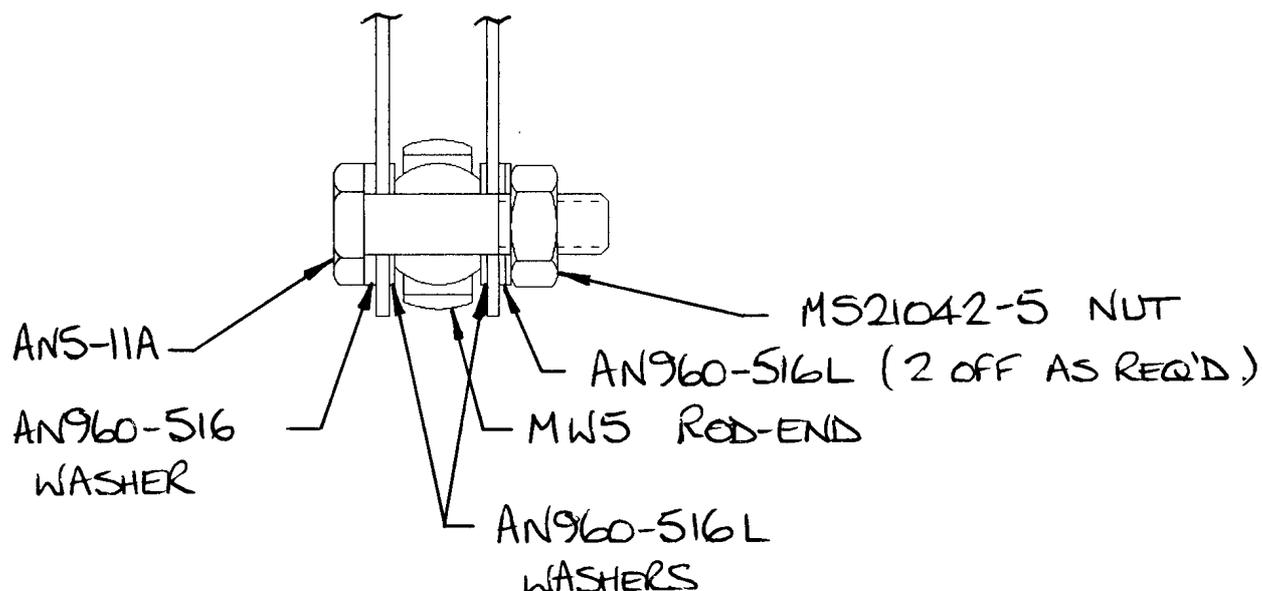


Fig 5. Typical section of push-rod end fitting.



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