

9M. Fitting ailerons & flaps to wing - monowheel

Mass balance horn slots

Before you can install the aileron to the wing, slots in the wing's bottom skin are required. Closing these slots will be the mass balance horn boxes XW52, which are fitted immediately prior to installing the top skin panel.

Line the aileron up with the wing and mark the bottom skin where the mass balance horns are, adding a clearance all around of about 5 mm (3/16"). Cut away the bottom skin following your lines and cut away also most of the aileron close-out, leaving the uppermost flange of it intact.

Hinge rebates

Mark the rebates for the hinges on the trailing edge *bottom* skin of the wing as in figure 1.

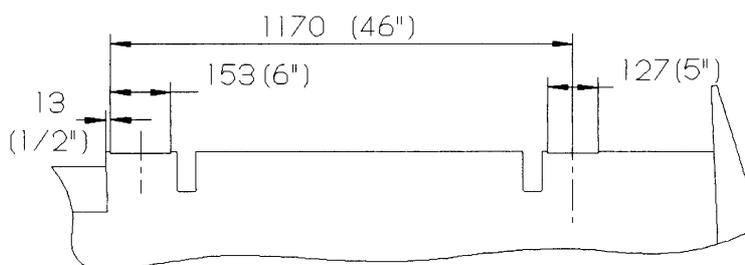


Fig 1. View of wing underside. Adjust dimensions to suit aileron.

Use the aileron to confirm these positions then cut the rebates out, as you did for the aileron itself, adjusting them to accept the hinge pivots and hinge pin ends.

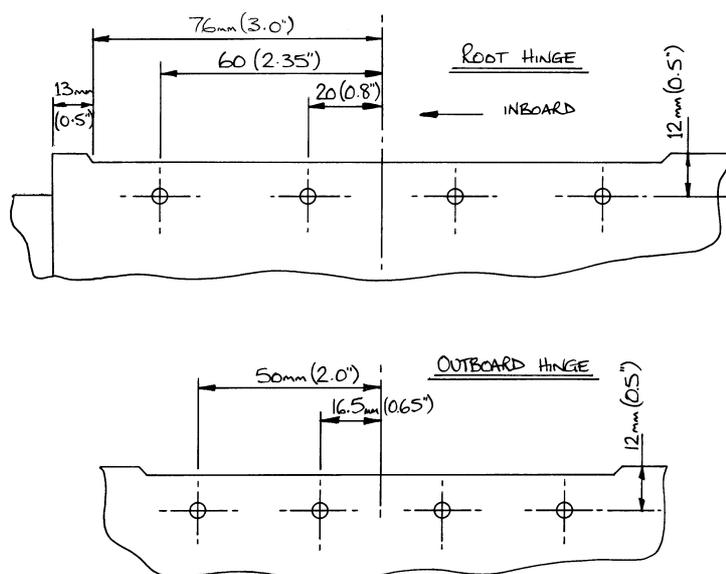


Fig 2. Underside of wing showing hinge screw centres.



Mark out the hole positions for the screws (see figure 2) but drill only 3.3 mm pilot holes through the glassfibre flange to start with.

Hold the aileron in position with the wing, the gap between the hinge flanges being approximately 1 - 1 ½ mm (1/16"), and drill through the hinge flange with a 1/8" drill in just one place per hinge, initially installing a cleco to keep it in place.

Drill the remaining holes to 1/8", putting clecos in some of them to give extra support, then carefully open them out to 3/16" (4.8 mm), taking care to prevent the drill wandering in the glassfibre flange until it has started cutting into the metal of the hinge.

Fitting anchor nuts to hinges

When the link-rod is attached to the aileron it will be impossible to get access to the nuts screwed onto the AN525-10R8 screws holding the aileron on the wing. Likewise, removing the link-rod would entail removal of the flap, and so it goes on. So, MS21047-3 anchor nuts are used to make life easier for you (aren't we kind). These have to be riveted to the hinge flange using two TAPK33BS 3/32" countersunk rivets each.

To attach the anchor nuts to the hinge, place one of the screws through one of the holes in the hinge and screw on one of the anchor nuts by hand until it tightens. By holding the screw with one hand you can position the lugs of the anchor nut and, holding it flat on the flange, drill through their holes with a 3/32" (2.4 mm) drill. Try and avoid drilling your fingers in the process, though. Having drilled the holes countersink the hinge flange (double checking that you do the correct side) by spinning a 3/16" drill between your fingers and trying a rivet in the hole to check for the correct depth. The rivet head should be flush to enable the hinge to lay flat against the wing's flange.

A typical pattern for the anchor nuts is shown in figure 3.

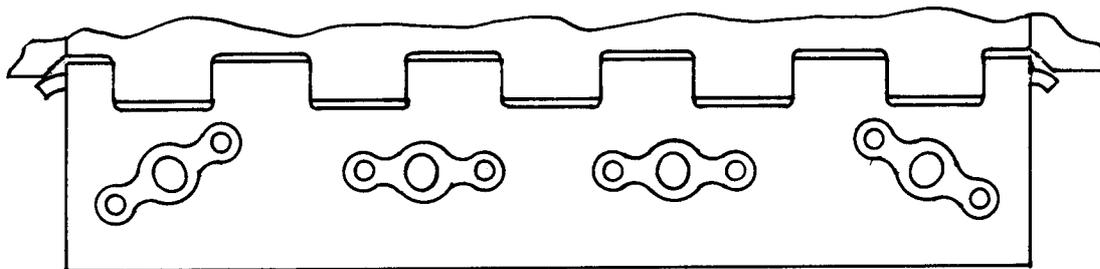


Fig 3. Typical anchor nut rivet pattern.

With all anchor nuts attached the aileron can be temporarily installed with a couple of screws in each hinge to check its operation.

Ensure aileron travel of 25° trailing edge up and 22° down is available. The final travel will be 23.5° up and 20° down. You may need to drill holes in the aileron leading edge to allow the anchor nuts to enter at 25° up.

Aileron link rod installation

To make up the aileron link rods the following will be required:-

- ½" o.d. Light alloy tube (TU2)
- 2 x AN490HT8P inserts
- 2 x MW4 rod ends (one already fitted to bellcrank W13)
- 2 x AN316-4R check nuts
- 4 x AN470-AD4-10 solid rivets

To establish the lengths of each link-rod (one is to be longer than the other) set the bellcrank W13 against its stop and the aileron with its trailing edge at 23.5° up. This angle of up aileron equates to 75 mm between the trailing edges of the wing tip and the aileron tip.

Measure the distance between the centre of the pin in the aileron root and the centre of the hole in the short arm of the bellcrank. Subtract 92 mm (3.6") from this measurement to obtain the length to cut the tube.

File the ends square then push in one of the AN490HT8P inserts. If you find the fit a little tight remove material from the insert and not the bore of the tube.

With the insert in place drill right through both tube and insert with a 1/8" drill staying as close to the centre line as possible. Place a rivet in the hole to prevent the two parts moving then drill a second hole at 90° to the first as in figure 4. Carry out the same procedure with the other end making sure all swarf is removed before riveting the inserts in.

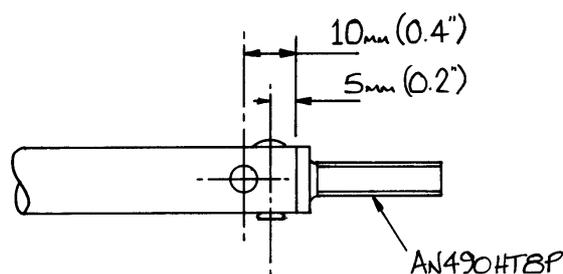


Fig 4. Rivet hole positions in ½" dia. push-rod.

Attach the link-rods to the bellcrank or aileron drive bolt according to the section in figure 5. You'll have to remove a portion of the flange at the aileron's leading edge to clear the link-rod. Cut also a hole through the wing's close-out to allow the push-rod to pass through.

It is important not to omit the EUR001 washer as this will prevent the rod-end housing coming adrift in the unlikely event of failure of the ball end. Also shorten the bolt as required to clear the bellcrank bracket.

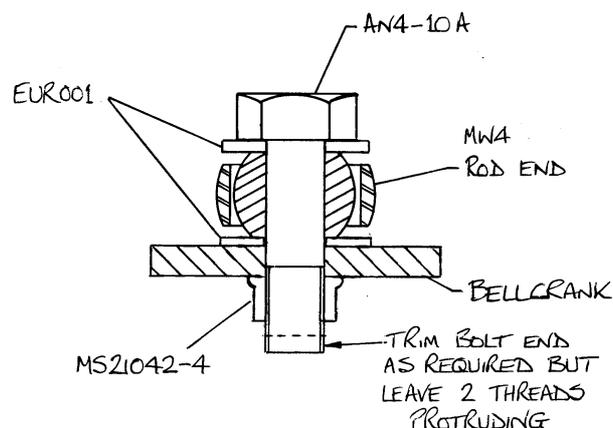


Fig 5. Typical attachment of rod-end to a bellcrank.



Flap attachment

To enable setting the flap up accurately for hinge attachment a template is required which is easily made.

The wing will be set up upside down to give access to the hinges but initially the template has to be fastened to the upper surface. The template is best made from a piece of faced board similar to that used for the wing's straight edge. These boards have good straight edges from which to work. You will require a piece about 145 cm x 20 cm (57" x 8") in size and about 12 mm ($\frac{1}{2}$ ") thick.

Setting the datum line about 1 cm ($\frac{1}{2}$ ") from one edge mark the co-ordinates set out below onto the board as in figure 6 then, having joined the dots with a smooth curve, cut out the profile, leaving a step with which to locate the flap's trailing edge. The section between chord positions 300 mm and 800 mm can be cut back a little as the main reference areas are the leading and trailing edges.

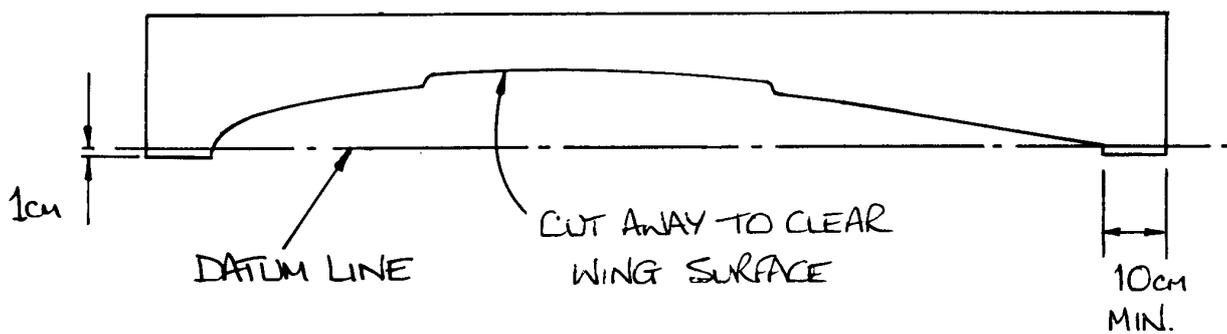


Fig 6. Flap setting template



Co-ordinates for template

Chord position from L.E. (mm)	mm from datum line
L.E.	0
10	22
20	29
30	34.5
40	39
50	43
100	58.5
200	77
300	90
800	77.5
900	62
1000	45
1100	28.5
1200	12
1270	0

Set the template onto the wing's upper surface, lined up with the *leading edge* root, and bond in place with blobs of bondo in two or three places to make it secure. Of course, don't make it so secure that you won't be able to remove it later!

Now turn the wing over so that the lower surface is uppermost and wedge it with blocks of foam to keep it steady.

Fit the flap in place with the wing noting that the flap's leading edge should not be pushed hard up against the wing's close-out but should be spaced 3 - 5 mm from the vertical part of the close out.

The flap's outboard trailing edge should be lined up with the aileron's trailing edge (set in its neutral position) both fore and aft and up and down. Also, the flap's outboard hinge arm (FL3) should be midway between the two W18 plates set into the wing at this location.

The end of the flap should be clear of the wing structure and aileron root by 3-5 mm. Trim the end of the flap, if required, to achieve this, not the wing or aileron.

Once in position, hold the flap in place by placing a few small blobs of bondo between the close-out of the wing and the flap's skin.

With the flap secure, assemble the flap connectors W19 (inboard) and W20 (middle) to their respective hinge arms set into the flap. Refer to the sectional drawing in figure 7 and the exploded diagram at the end of the chapter.

Figures 7 and 9 shown in the text are reproduced in a larger size and with more detail at the end of this chapter.

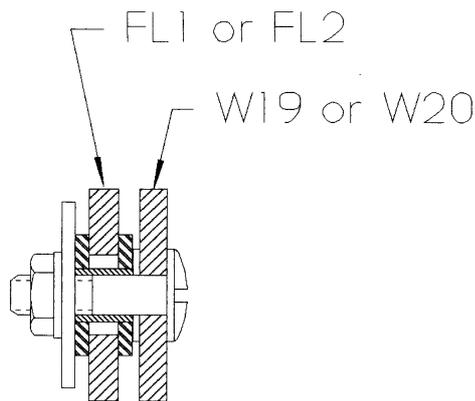


Fig 7. Section through inboard and mid flap hinges.

The principle of these hinges is that the FL10 spacer acts as the bearing surface on which the FL9 bush will run and also prevents over enthusiastic tightening of the nut and screw thus causing the hinges to lock up.

The outboard hinge will also house the outrigger mechanism, but for now only partial assembly is required

Cut the OR7A Tufnol block into two pieces. Referring to the sectional drawing in figure 8, assemble the two W21 plates with the OR6 and OR7 blocks (one OR7B sandwiched between two OR7As) between them using four AN525-10R32 bolts with AN960-10L washers under the MS21042-3 nuts. Also install an FL9 bearing into each W21 plate for the outrigger pivot. Use Loctite 638 to secure them.

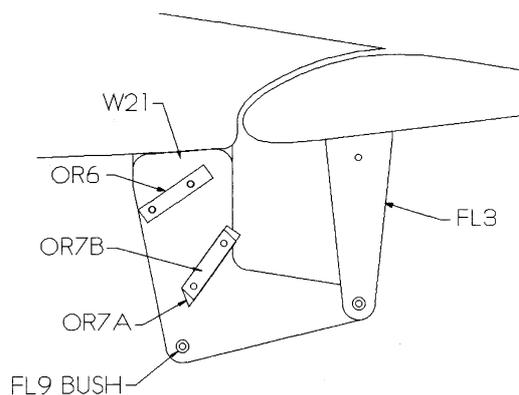


Fig 8. Outboard flap hinge/outrigger assembly.

Make up the hinge shaft around the flap's outboard hinge arm as shown in the sectional drawing in figure 9. Although it's not required yet, install also the spring OR11 to save dismantling the hinge for its fitment later. Now swing all hinge connectors over so they rest on the wing next to the W18 plates (set into the wing). The paired W21s will go between the two W18's. W19 and W20 should be positioned to the same side of the W18s as they are on the flap hinge arm, although this is not essential.

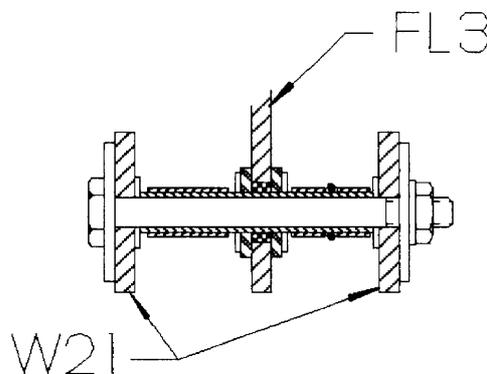


Fig 9. Section of hinge shaft between the W21 plates.

You'll notice that one of the bolts through the W21's interferes slightly with the W18's, so file them locally to allow a clearance as shown in figure 10.

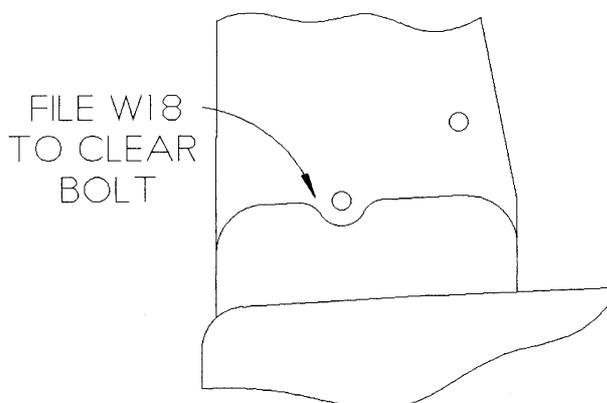


Fig 10. Detail of W18 filed to clear W21.

Securely clamp the hinge connectors to the W18 plates with G-clamps then crack off the template and break the bondo blobs holding the flap. The flap can now be checked for correct operation before fitting permanently.

Flap connector attachment

Mark the hole centres on the W18 plates for the attachment bolts as in figures 11 and 12.

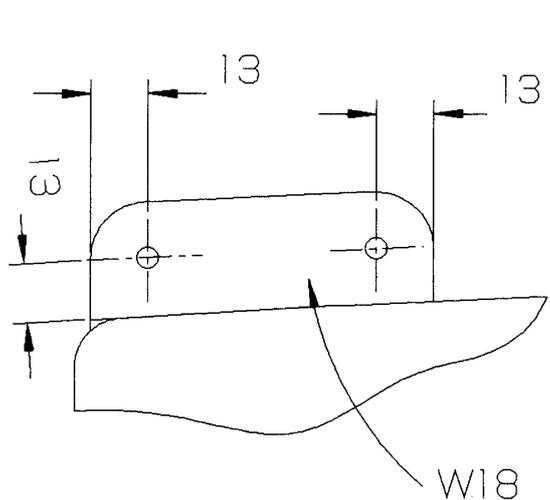


Fig 11. Hole centres (inboard and mid hinge connectors).

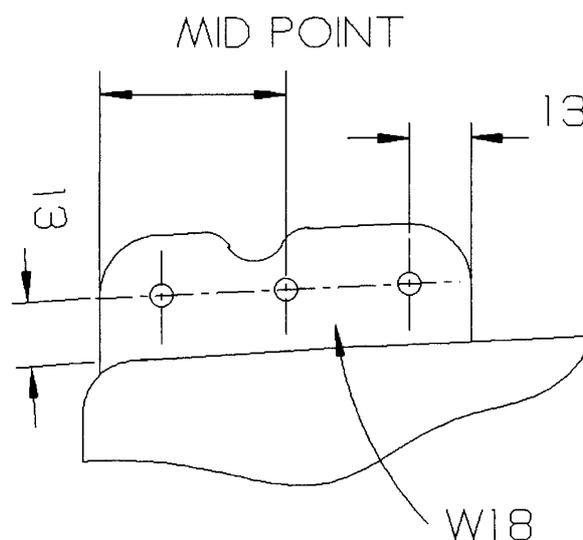


Fig 12. Hole centred (outboard hinge connectors).



Note: If you find that the hinge connector arms do not fall precisely in line with the W18 plates make sure the two holes near the edges are no closer than 10 mm (3/8") to the edges of either W18 or the hinge connector - see figure 13.

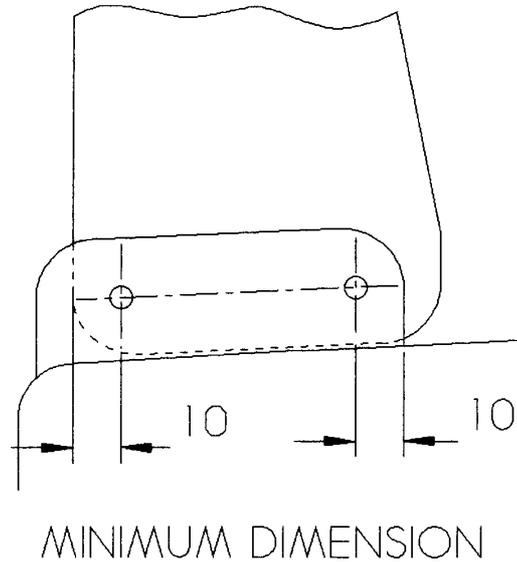


Fig 13. Hole centre with misaligned hinge connector.

A small chuck angle drill will be best for the following job but you can also use a small hand drill. What is important is that the holes you drill are square to the W18 plates.

Drill the holes 4.8 mm diameter, where the clamps are not in the way, and install a bolt (AN3-5A), washer (AN960-10L) and nut (MS21042-3) in each hole. See figure 14. Reposition the clamps, one at a time, to give access to drill the remaining holes. Before finally screwing the flap hinge connectors up, separate the parts and remove the burrs and swarf around the holes.

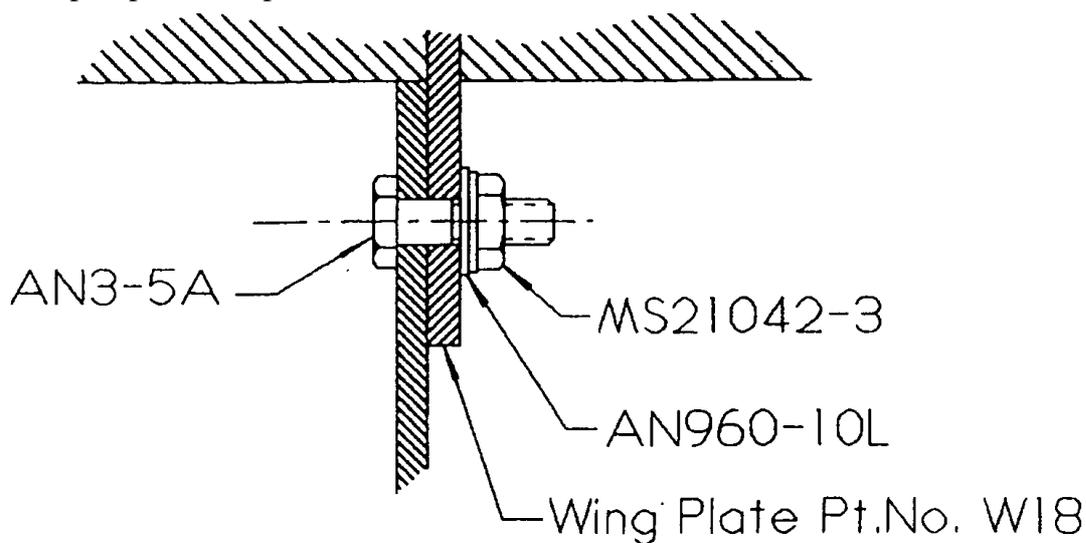


Fig 14. Section of attachment of hinge connectors to W18's.

Outrigger assembly

The assembly of the outrigger retraction mechanism components is depicted in the drawing in figure 15. The view shown is that of the port side outrigger mechanism looking towards the fuselage from the outboard end of the wing.

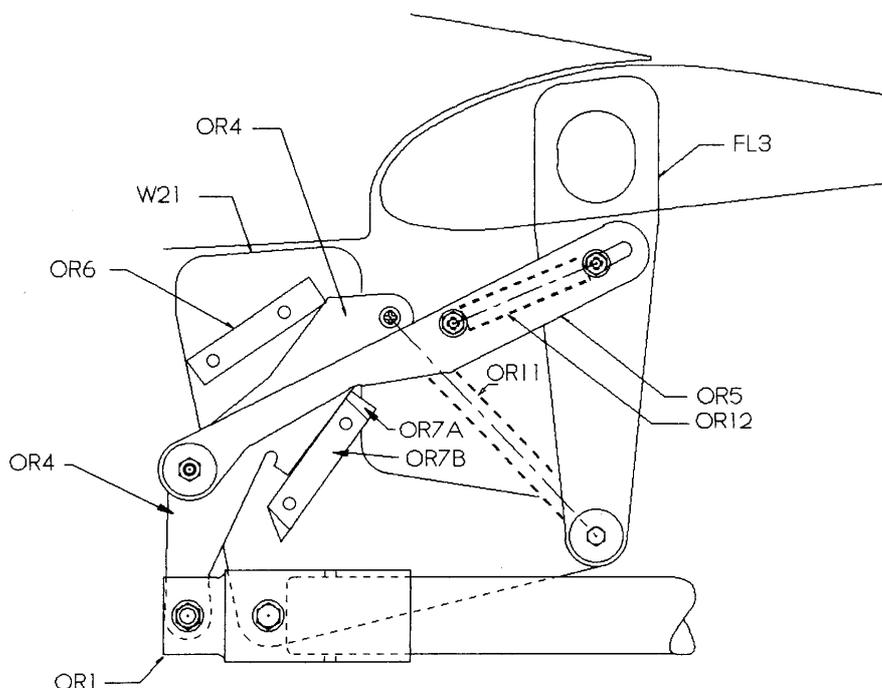


Fig 15. Section of outrigger retraction mechanism.

Note: Exploded diagrams and larger scale drawings of the outrigger retraction mechanism with sections through various places are to be found at the end of this chapter. Use these, along with the following text, to complete the assembly.

Before final assembly is carried out, a certain amount of filing of OR4 will be required to ensure that its latching face matches the latch block.

Assemble OR1 and OR4 together as detailed in section 1 and figure 15.

Note: There are two washers under the head of the AN4-11 bolt which connects OR1 and OR4. Also, two washers are required at OR1's pivot, on the opposite side. This is important to ensure good clearance between the AN4-11 bolt and the W21 plate. See section 1.



Using the AN4-21 bolt, install OR1 between the W21 plates mounted on the wing, with OR4 slotted between the blocks OR6 and OR7. There's no need to use the washers at this stage as you'll probably remove the sub-assembly several times to file OR4.

Rotate OR1 to the extended position (refer to figure 16 and check if OR4 will latch over OR7B). File the step of OR4 a little at a time until it can latch the mechanism securely. There will be a slight gap between the latching face of OR4 and OR7B which allows unlatching to take place. Keep this gap to an absolute minimum to ensure you don't have excessive play. Do not file the edge of OR4 which rubs against OR6. This contact prevents the outrigger leg from hanging down when retracted.

Completing the mechanism's assembly should be quite straightforward, however it may be advantageous to leave connecting OR5 to the flap hinge arm, FL3, until last.

The sub-assembly of OR1, OR4, AND OR5 can be carried out on the bench before installing into the main assembly.

Attach the short spring, OR12, to OR5 (section 5) then slot the two connected arms, OR4 and OR5, between the blocks spacing the W21 plates (figure 15) and attach OR1 by its pivot bolt (section 1) ensuring it is free to rotate once the nut has been tightened.

Next, connect the longer spring, OR11 (which should already be installed on the hinge shaft) to OR4. See section 3.

To link up the final part of the retraction mechanism place the bolt and spacer through OR5's slot (section 6), place the spring over the spacer then pull the bolt to locate it through the hole in the flap hinge arm, FL3. Tighten the nut and washer against the spacer.

Operating the flap will now drive the outrigger retraction mechanism. Don't be alarmed by the clatter when the latch arm drops into place, this is normal. Grease the latch arm and block before operating the mechanism too many times.

Setting up the retraction mechanism

To function correctly, the flap should move through 27°, causing the outrigger to extend and latch by at least its 25° position. The remaining flap movement will not affect the outrigger mechanism due to the slot in OR5. Do not be tempted to lengthen the slot to make adjustments.

Checking the required flap angles is most easily done using an inclinometer, a device that enables accurate measurements to be made. Alternatively, the following method may be used:-

Setting flap angle

Locate your flap setting template back into its original position on the wing but with the flap extended so it's not prevented from moving by the trailing edge step.

Mark a line 51 mm (2") back from the trailing edge step then, from the datum line and at 90° to it, measure 134 mm (5.27") towards the flap. This position in space is where the flap's root trailing edge should be at 25°.

The outrigger mechanism should be fully latched with the flap in this position, in other words OR4 should be fully down against the latch block OR7B as in figure 16.

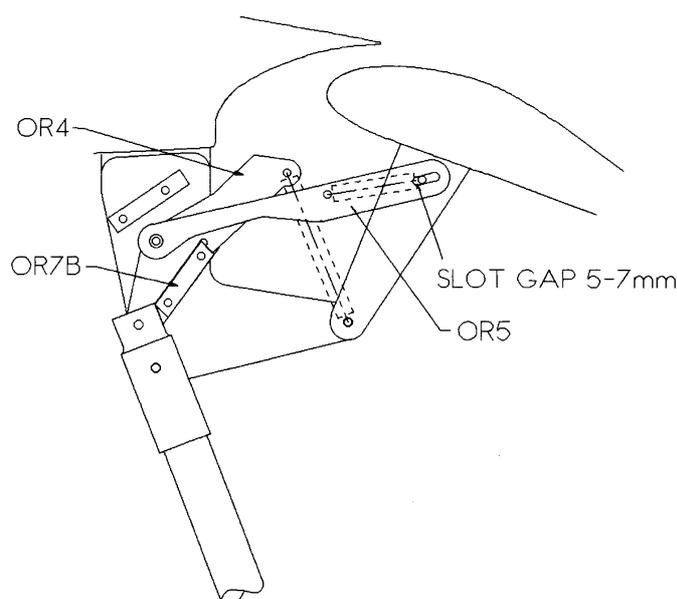


Fig 16. Outrigger fully latched at 25° flap

To prevent unintentional retraction of the outrigger due to vibration causing the flap to move, the flap will be set to extend to 27°, this extra movement being catered for by the slot in OR5.

To establish where the flap's trailing edge should be at the 27° setting, mark your template 53 mm aft of its trailing edge step then, again at 90° to the datum, measure 146 mm towards the flap. With the bolt through the outboard flap hinge arm FL3 and " to ! way along the slot in OR5, any vibration of the flap at this setting will not affect the outrigger mechanism.

The final step in assembly is to add the leg, wheel and fork. The wheel assembly comprises the wheel, a roller bearing, a spacer, and the nut and bolt. Pack the bearing liberally with grease and insert it into the wheel followed by the spacer. Install this assembly onto the wheel fork, OR3, and bolt up with the bolt and stiffnut.

Mark a line 40 mm (1.6") from one end of the nylon leg OR2, and another line 20 mm (0.8") from the other end. Remove the outrigger retract mechanism socket OR1 and push the leg into it up to the 40 mm mark; drill half-way through the leg with a 4.8 mm drill using the hole in OR1 as a guide. Aim as squarely as possible towards the hole on the opposite side. Now drill from the opposite side and you should find the existing hole quite easily. Run the drill through, if necessary, to enable the AN525-10R30 bolt through, securing it with an AN960-10L washer and an MS21042-3 nut.

Replace OR1 onto the retraction mechanism and slide the wheel fork OR3 up to the 20 mm mark on the leg then, with the outrigger extended, sight down the side of the wheel to check its alignment to the W21 plates which are aligned fore and aft. When you are happy that the fork is in alignment with the W21 plates, drill through the leg with a 4.8 mm drill using the hole in the fork as a guide.



Drill this hole in two stages as you did at the other end of the leg and install the AN525-10R28 bolt with an AN960-10L washer under the MS21042-3 nut. Check that there is 310-312 mm of nylon leg exposed between the top and bottom fittings.

See also exploded view at the end of the chapter.

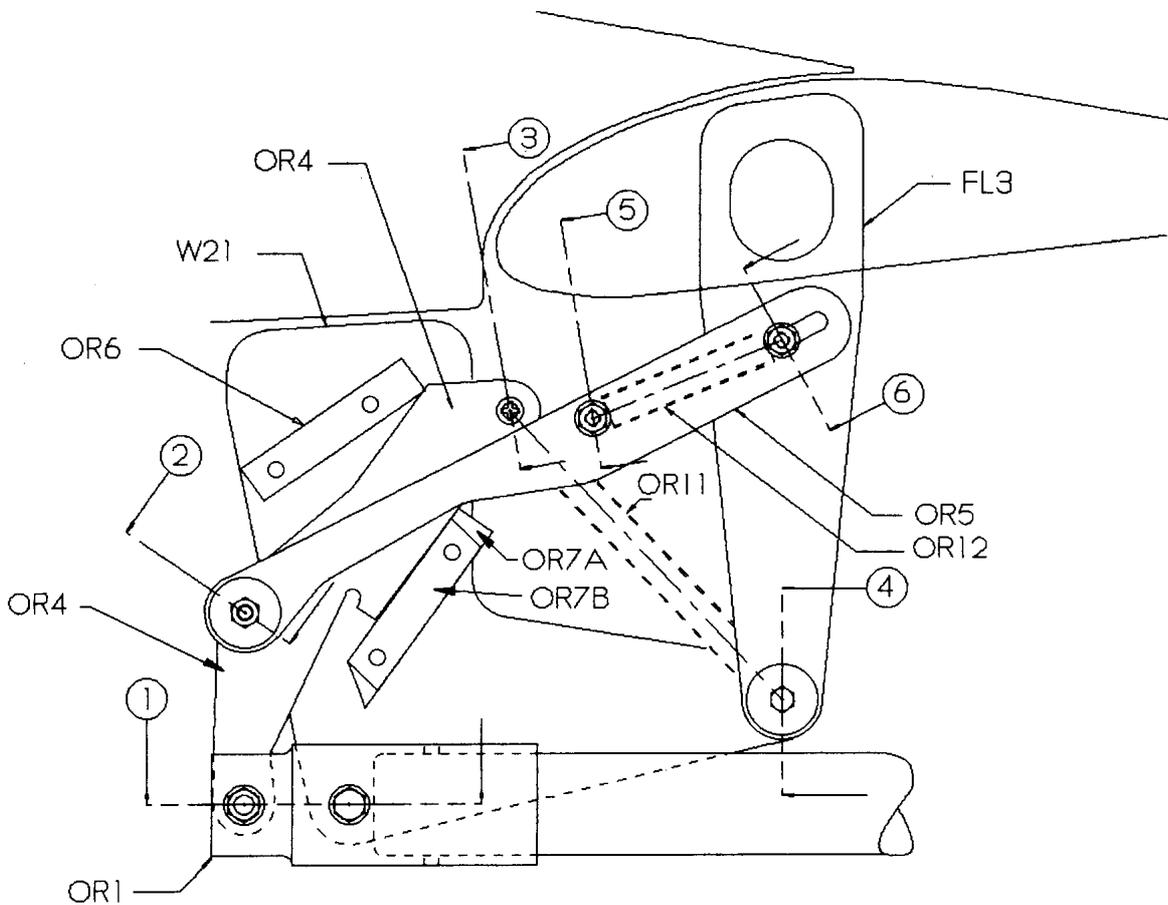


Fig 17. Outrigger mechanism showing section view locations.

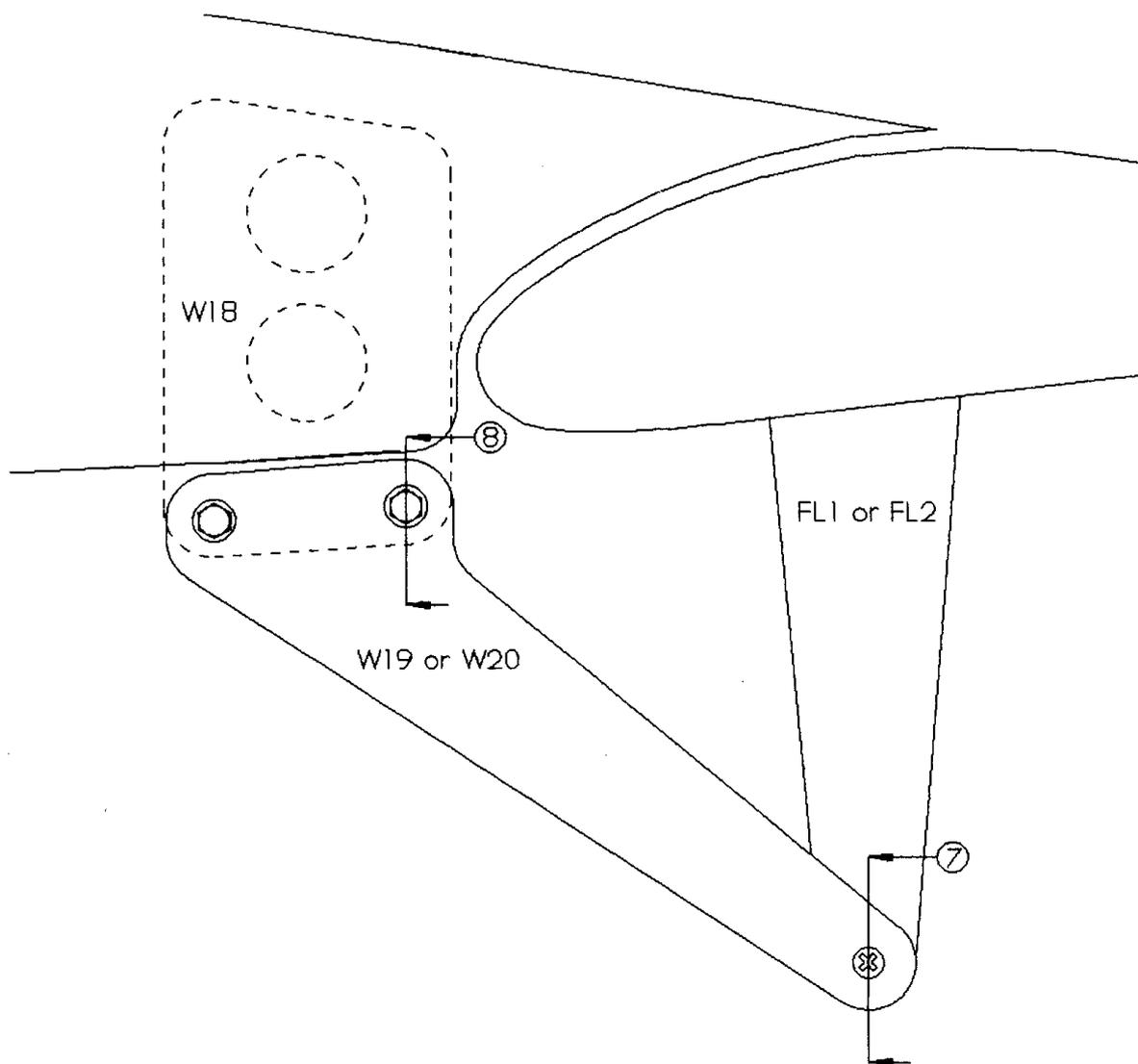


Fig 18. Inboard and mid flange hinges with section locations.

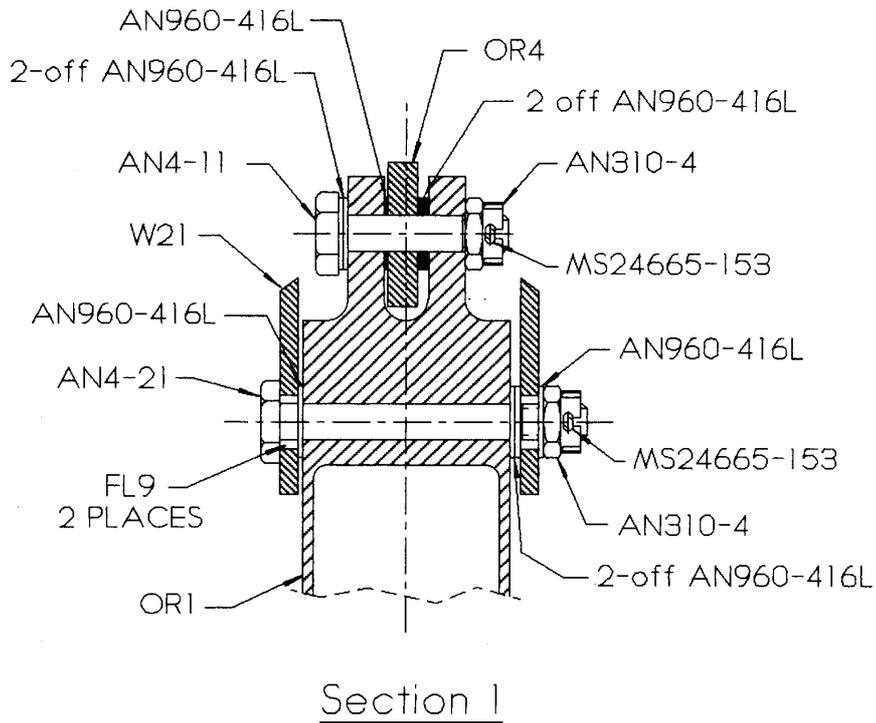


Fig 19. Section 1.

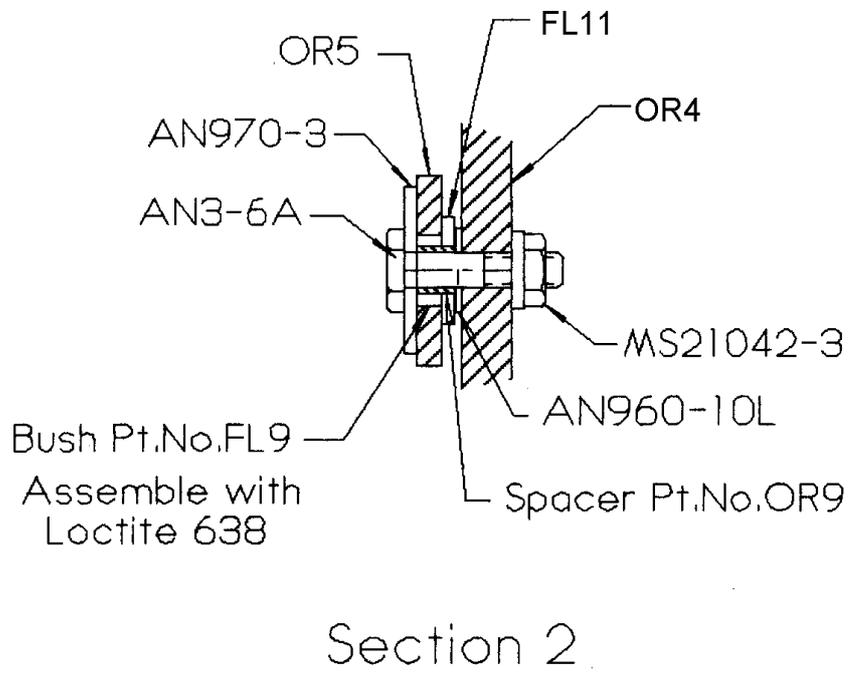
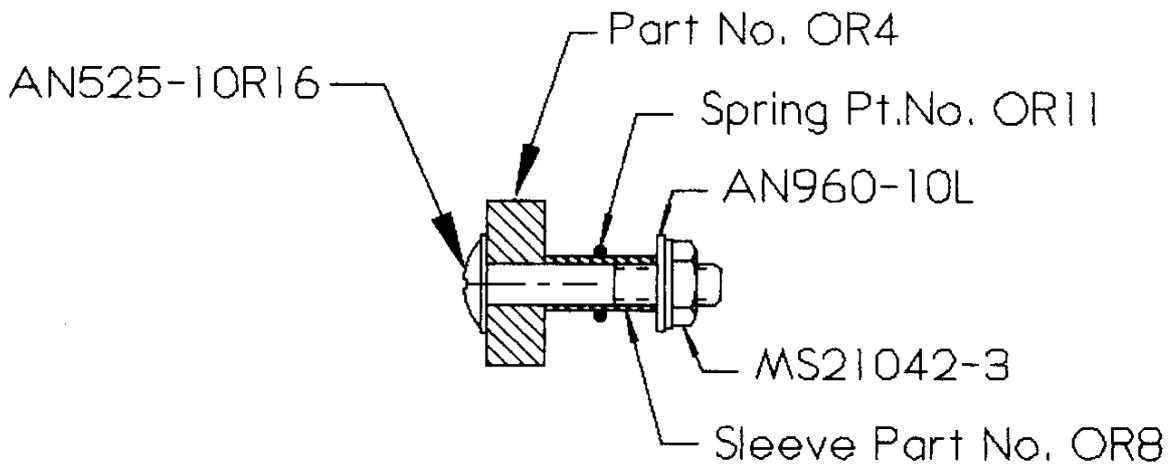
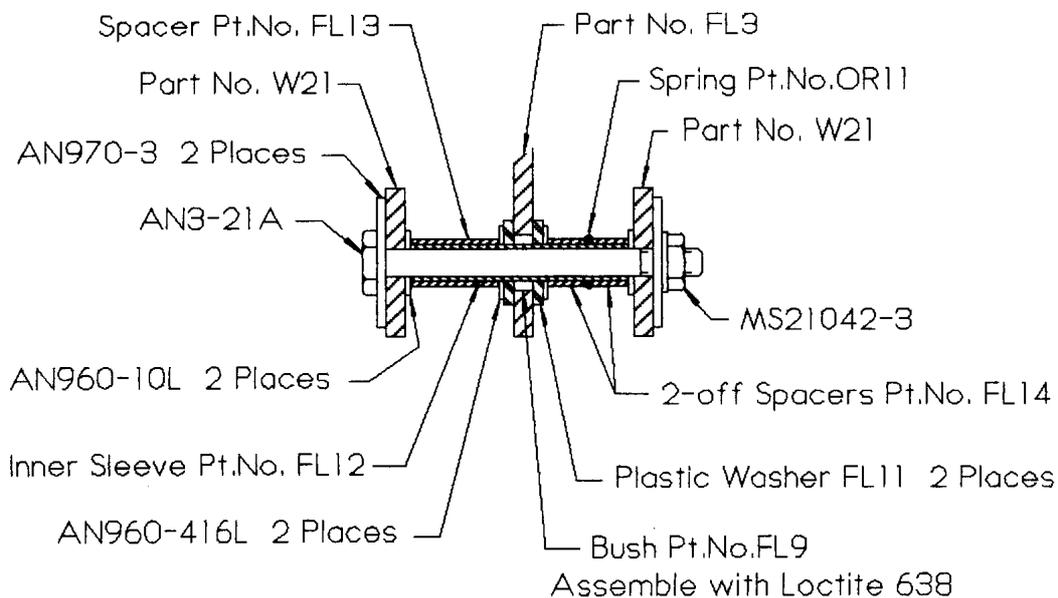


Fig 20. Section 2.



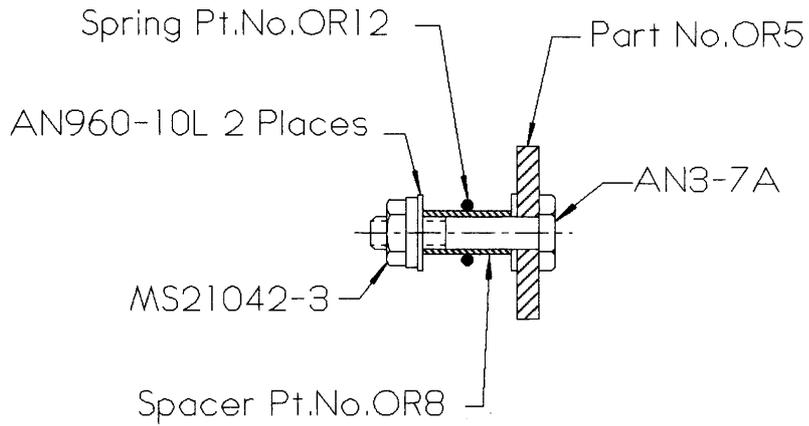
Section 3

Fig 21. Section 3.



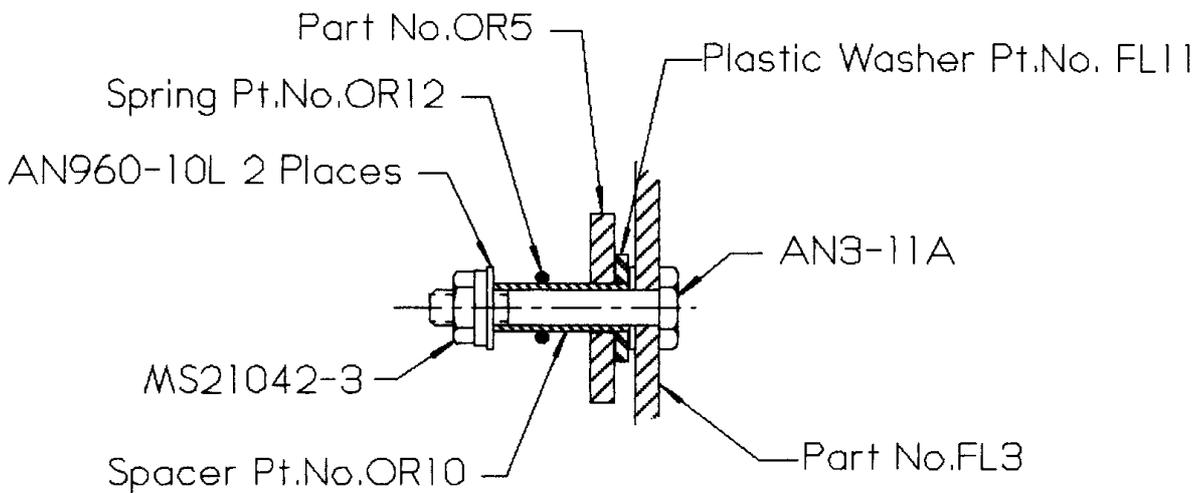
Section 4

Fig 22. Section 4



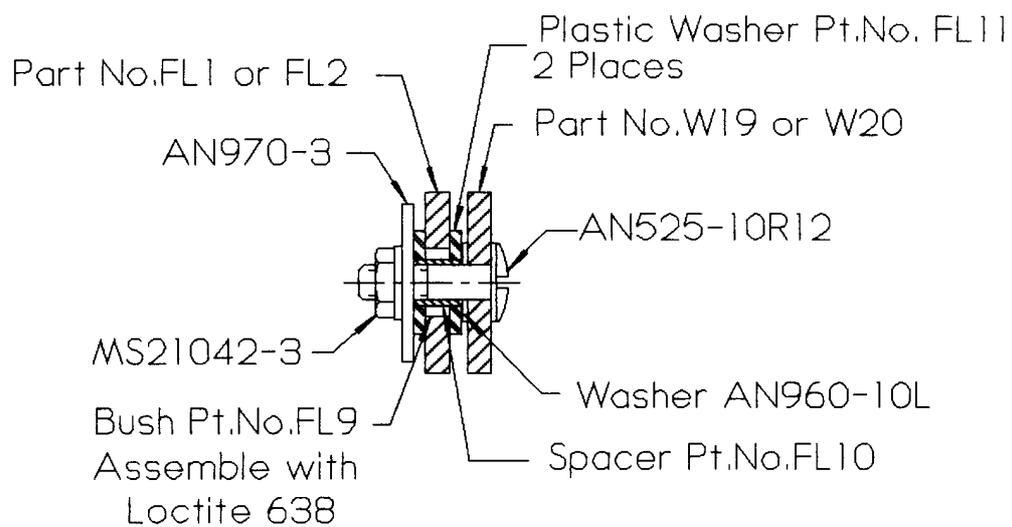
Section 5

Fig 23. Section 5



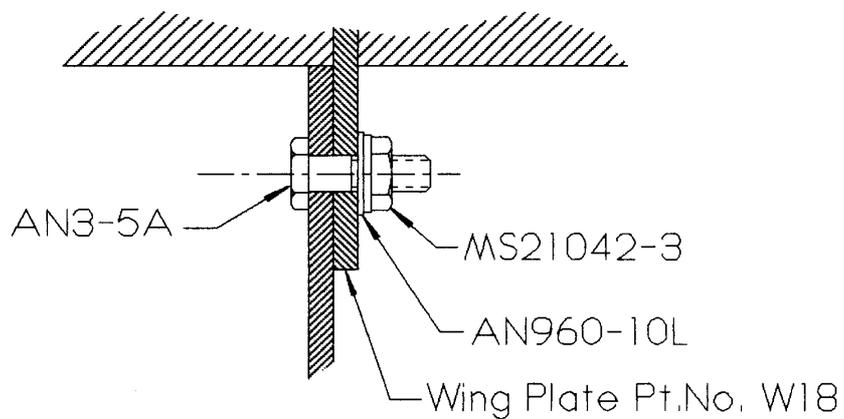
Section 6

Fig 24. Section 6



Section 7

Fig 25. Section 7.



Section 8

Fig. 26. Section 8.

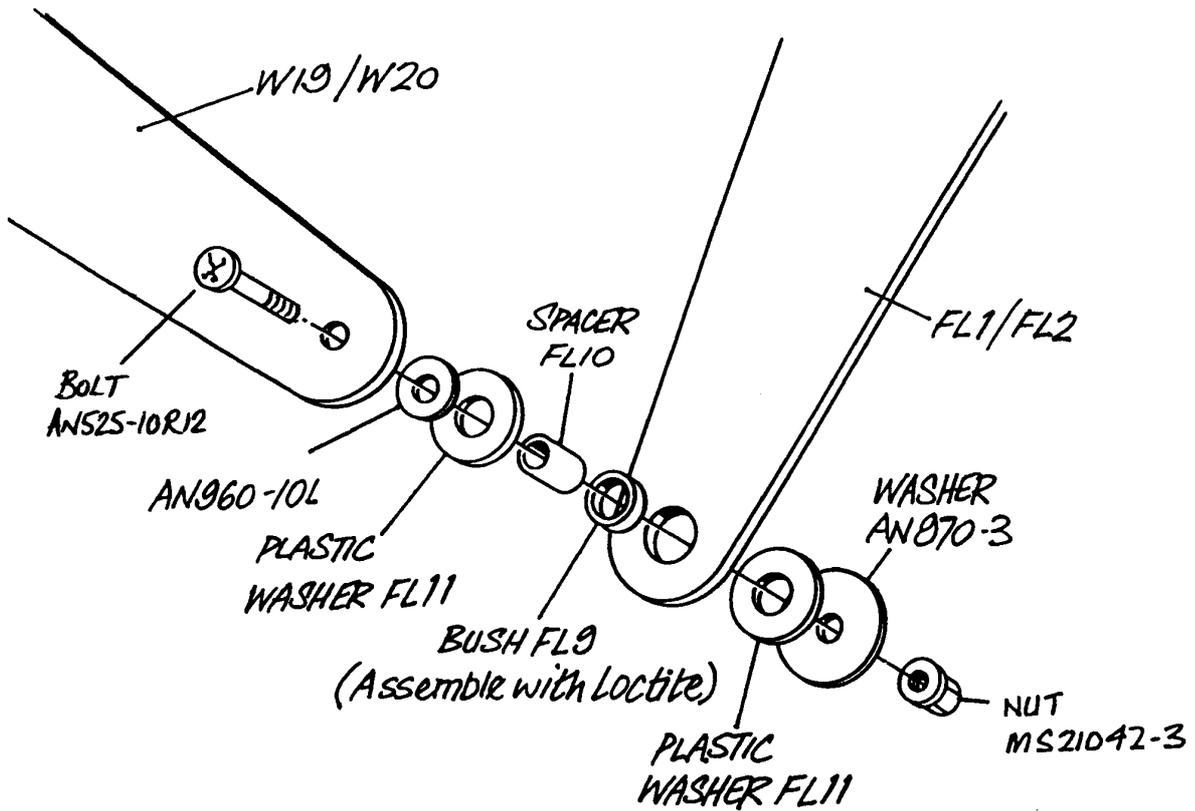
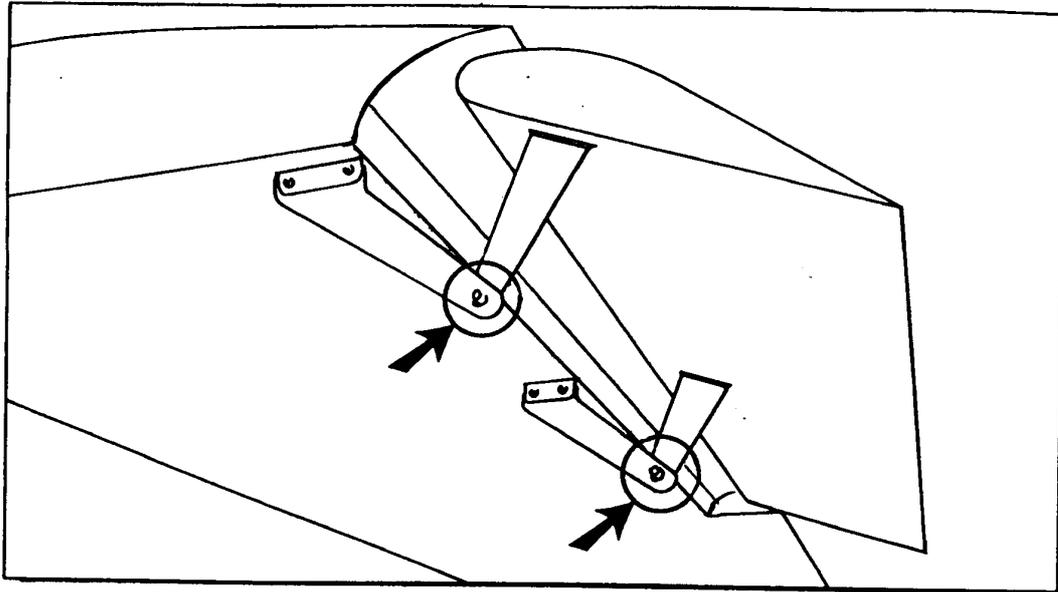


Fig 27. Inboard and mid flap hinge arrangement.

Trailing edge top skin closure

The next operation is to bond the top trailing edge skin onto the rest of the wing. It is important when doing this work to ensure that the flap and aileron close-outs are kept straight, and that the top skin correctly follows the aerodynamic profile. This is done by using the flaps and ailerons themselves, with appropriate spacers, to keep the wing rear close-out straight.

At this stage the wing tip trailing edges can be closed-off. Cut the diamond shaped moulding in half to produce a wing tip close-out for each wing and bond them in place. Refer to figure 6 on page 8-4.

Aileron mass balance boxes (part no XW52)

This operation is done with the aileron rigged to the wing. Note that the mass balance boxes are marked with a 'T' or an 'R' to indicate which is to be nearer to the tip or the root.

To fit the box it is first necessary to stiffen the lower close out. Fit a length of angle iron or square section tube under and just forward of the wing lower trailing edge close- out, and support it so that the bottom skin is stabilised. Tape spacers on either side of each aileron mass balance to ensure that the aileron boxes stay centralised when they are bonded in place.

Having scuff sanded the lower inner skin and the aileron boxes, bond them in place with Araldite 420 (mix ratio is 10 parts resin to 4 parts hardener by weight) making sure that none gets on to the mass balance weights themselves, and place a small weight on top of the boxes to ensure good contact with the Araldite, and leave to cure. Figure 28 shows an aileron mass balance box in place after bonding.



Fig 28. Aileron mass balance box bonded into place.

Bonding on the top skin

Where the aileron upper surface will pass under the wing top rear close-out, put a layer of parcel tape on the aileron top to ensure that you don't glue the ailerons to the wings. The close-out flange will be rubbing against the aileron upper surface at this stage; the upper skin will require trimming forward to allow clearance once it has been bonded in place. Now clamp the aileron in the neutral position - the tip end of the aileron should line up with the wing tip moulding. See figure 29.



Fig 29. Aileron clamped in neutral.

A similar exercise is done for the flap, but a slightly thicker spacer is used, and this is where the mixing sticks come in handy. Mark the flap with a line to show the trailing edge of the wing rear close out when the flap is fully retracted. Lower the flap and over this line place a length of masking tape with the sticky side up, and then place a number of the mixing sticks in line such that they become a flexible spacer. Stick parcel tape over this length to act as a release agent. Now set the flap fully retracted. A spring clip will hold the flap in the retracted position - see figure 30.

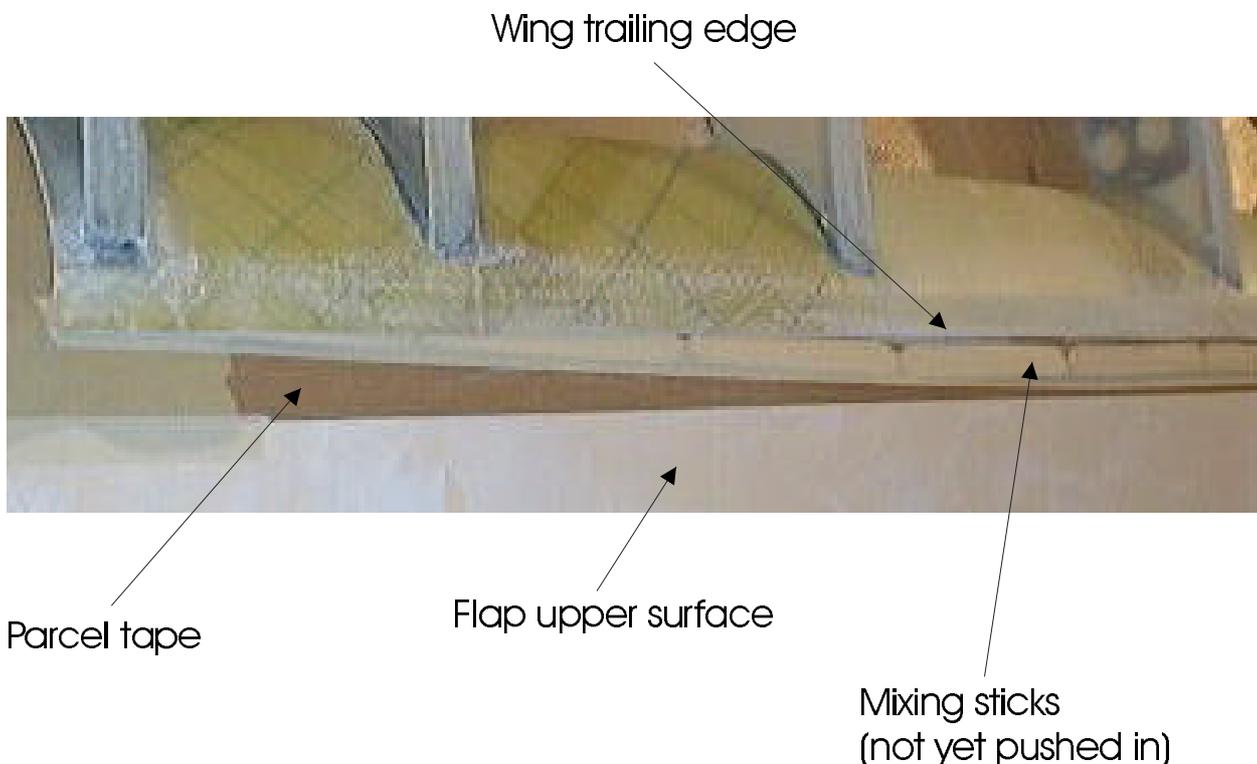


Fig 30. Mixing stick spacer arrangement.

Check that all joining surfaces have been thoroughly scuff sanded.

For the actual bonding you will need straight edges made of angle iron or square section tube to act as load spreaders.

Coat all the mating surfaces with Araldite 420 mixed with the flox, putting a fairly thick “ball” on top of the aileron mass balance boxes, and lay the top skin into position. Place lengths of straight edge along the aileron and flap close outs, and along the skin to spar joint. Position weights all along the mating faces; sight along the top skin to check that there are no creases or distortions of the skin, and if all is well leave to cure fully. Figure 31 shows a view of the top skin during bonding.



Fig 31. Bonding on top skin.

After cure check that the ailerons are free to deflect 22° trailing edge down without the mass balance horns contacting the XW52 boxes. Now go back to page 7-11 to permanently attach them.



Wing root plies

After fitting the trailing edge top skin there is one more job to do to finish off the wings: application of wing root plies.

Scuff sand an area at the wing root on the outside of the top and bottom skins 60 mm (2 1/2") wide by 72 cm (28") long), centred on the spar.

Prepare 50 mm (2") wide 'uni' tapes, and lay-up 4 layers on top and bottom skins as show in figure 32. The longest ply should be applied first, subsequent plies being shorter.

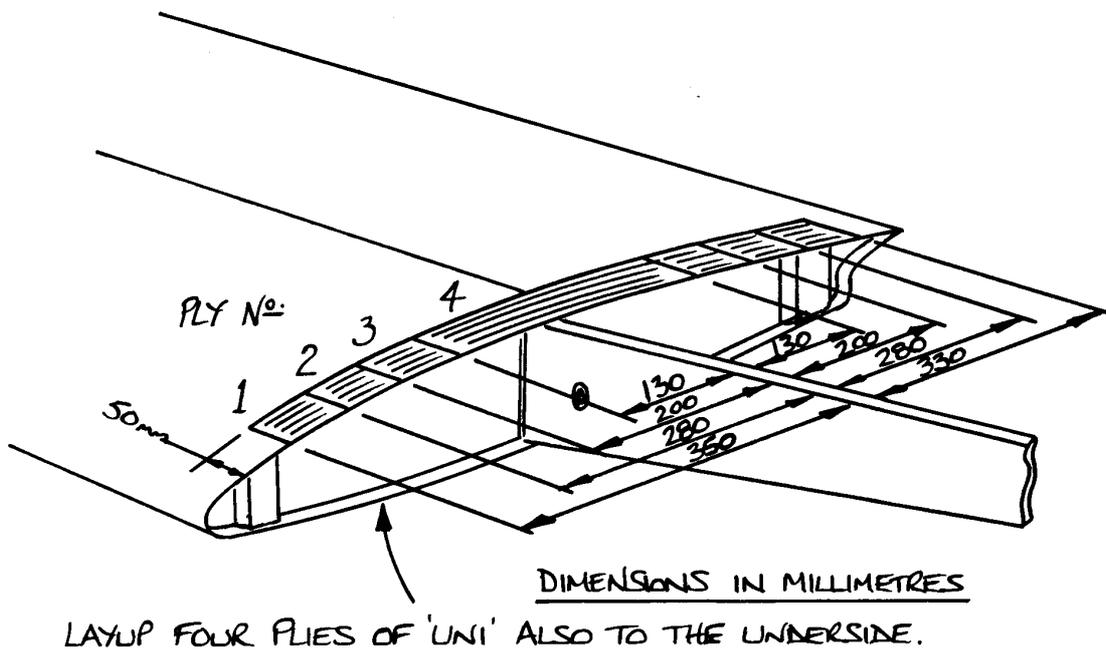


Fig 32. 'Uni' tapes at wing root. View of wing root area.



VIEW ON UNDERSIDE PORT
WING LOOKING INBOARD

