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## 27. Wing to Fuselage Assembly

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### Overview

In this section you will be setting the wings' angle of incidence which, measured at the wing root, is to be  $+2.5^\circ$ . The angle of incidence is the angle between the chord line of the wing and the waterline of the aircraft. When you are flying at cruise speed the fuselage will be level and the wing will be leading edge up  $2.5^\circ$  at the root.

The wing lift pins locate into sockets, which are to be attached to the fuselage sides, and these hold the wing at the determined angle.

Take care when setting the angle of incidence, especially that both wings are set exactly the same. Any small angular difference between them will result in an aircraft that always wants to roll one way, requiring a roll trim tab permanently attached to one of the ailerons.

### Step 1

Set the fuselage to be level, placing the spirit level on the door recess of the port side (which should be the only place you check the fuselage is level from now on) and ensure that it is secure and stable. You will need room not only for the wings to be installed, and left alone for sufficient time for Redux to cure, but also for them to be removed, so allow enough room for the spars to come clear of the holes in the fuselage sides. A total of 10.7 m (35 feet) across the wing tips will allow this.

### Step 2

#### Initial wing set-up

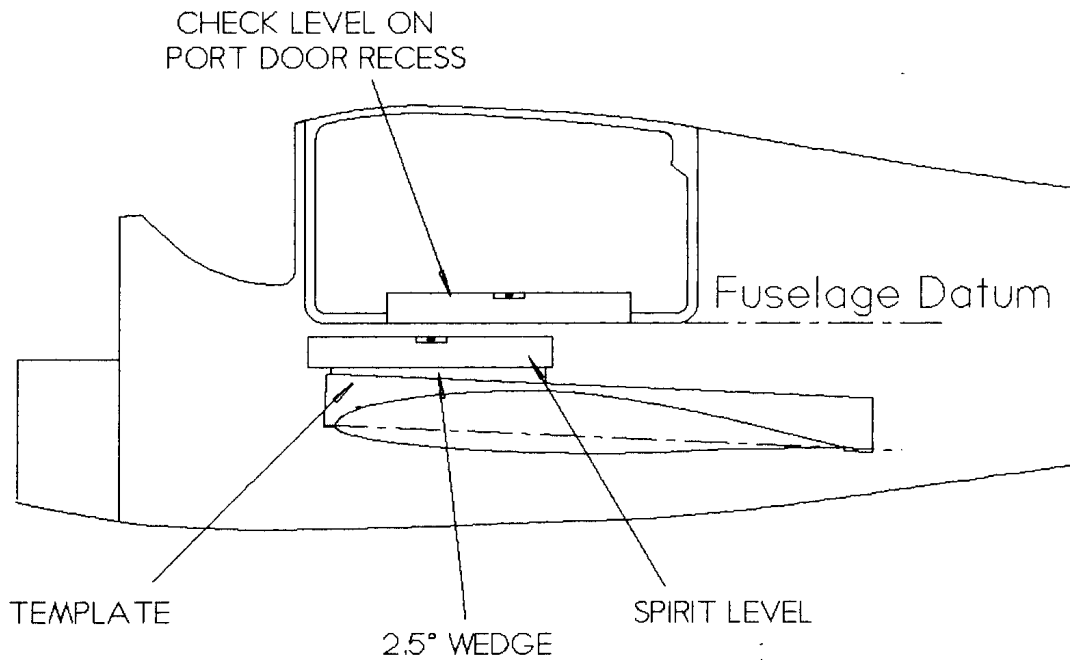
The following setting up of the wings will need to be temporarily disturbed after this step to allow access for local reinforcement plies to be added to the fuselage sides. Set the wings up so the spars are within the fuselage but not quite engaged in the spar sockets.

Dig out the template you last used to set the flaps to the wing, and set it onto the wing root.

The flat top of the template is parallel to the wing root chord so, to be able to set the wing root angle of incidence to  $+2.5^\circ$ , a wedge will be required to allow a spirit level to be used.

To save you doing the calculations, the wedge should be 22.9 cm along one edge for every 1 cm up the other. The larger you make the wedge the less the error will be so make it as long as practicable.

Support the wings so that the angle of incidence of  $+2.5^\circ \pm 0.05^\circ$  is set. See figure 1.



*Fig1. Setting wing incidence.*

Note that  $0.05^\circ$  equates to a difference in height of only 1.1 mm (.044") over a chord of 50". When setting the wings ensure that if the bubble in the level is a bit off centre for one wing, then the other wing should be set to replicate this off centre position. Mark the wing profile onto the fuselage side for reference, and also mark the position where the centre of the forward wing pin touches the fuselage. Remove the wings. Drill through the fuselage for the forward wing pin with a 13 mm ( $\frac{1}{2}$ ") drill, and subsequently file as necessary.

### Step 3

#### Reinforcement plies

Scuff sand both the inside and outside skins where the lift pin socket hard points are. On the outside skin, layup 4 plies of 'bid' at  $\pm 45^\circ$  to be a total of 4 cm (1 1/2") longer than the hard points and vertically as large as the wing profile lines marked on the fuselage sides.

On the inside skin, layup also 4 plies of 'bid', but extend the layup over the forward hard point down to lap onto the thigh support by 2-3 cm (1"). Run the rear hard point layup onto the forward bulkhead of the baggage bay by 2-3 cm (1"). Cover each layup with peel ply and leave to cure.

## Step 4

### Wing set-up

#### Wing root pin sockets

The front socket W27 is rectangular in section, and is shown in figure 2. Each rear socket is an assembly of a W26A, W26B and W26C. The W26A is the main body and is oriented with the smaller hole between the lugs at the bottom. W26B is the socket housing which slots between the two lugs of the body with the double chamfered face innermost. These chamfers allow the housing to rock a limited amount. Holding W26A and W26B together is W26C, the barrel. See figure 3.

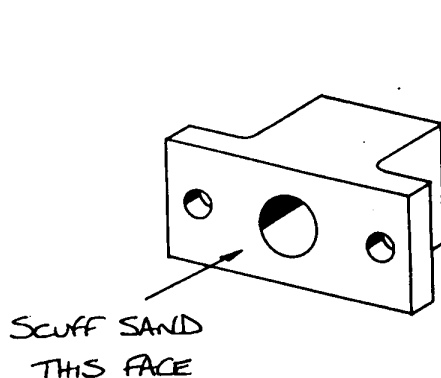


Fig 2. W27 front socket.

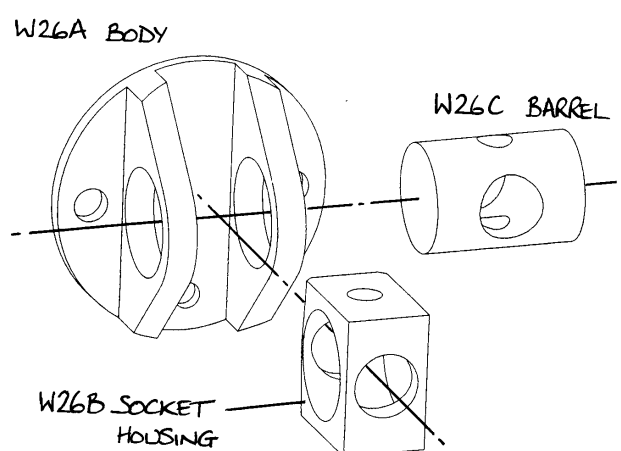


Fig 3. Exploded view of W26 wing rear pin socket assembly.

Slide the barrel in to the assembly from one side and rotate it so that the large and small holes align with the holes in the housing.

The socket assembly should be finally assembled using Loctite 638 to lock the barrel and housing together, but allow the barrel to rotate within the lugs of the housing. Make sure that the parts are clean and free from grease before this final assembly. If the barrel does become stiff in the housing, the use of a bar in the socket will enable it to be moved. It does not matter if the assembly remains stiff though.

#### Tie-bar fittings

Supporting the fuselage where the rear socket assemblies will be attached will be a tie-bar assembly, incorporating the fittings W34 and a steel tube W36. Refer to figure 5. In preparation for later assembly, hold the W26A and W34 fitting together so that their flat circular faces match each other. Drill one of the 1/4" holes into the W34 using W26A as a guide. The other two holes will be drilled on assembly in the fuselage. The holes are not pre-drilled in W34 as each assembly may be slightly different.



## Socket attachment preparation

Locate the W26 socket assembly onto the wing rear lift pins and secure it using a pip pin BLS4R11N. The pip-pins are sometimes supplied with a second ring attached to the pin's body. It is best to remove this ring and the lug which it's attached to. Now push the wings into place and insert the spar bolts through the seat back to locate them. Re-set the wing incidence. Make sure that the spars are together and that the port spar is up against the seat back bulkhead.

To check that there is no forward or aft sweep, stretch a string across from wing tip to wing tip, lining it up with the skin joint line of the port wing and a line 32 mm (1¼") forward of the skin joint line of the starboard wing (remember the spars are offset) and sight along it. Alternatively, check measurements between similar points of wing and fuselage on port and starboard sides.

The leading edge sockets W27, which are free to slide on the lift pins, should be able to move a little between the wing root and the fuselage side, whereas there will be a gap between the fuselage side step socket shims and the trailing edge sockets.

Measure this gap and, if it is less than 5 mm (3/16"), make a layup on the fuselage side, to reduce the gap to a maximum of 1 mm, from 'bid' pieces approximately 1 cm larger than the socket's rear face. Each ply of 'bid' will be approximately 0.25 mm (0.01") thick. Make this pad on a plastic sheet and apply it in one piece.

If the gap between the leading edge or trailing edge sockets and the fuselage side is greater than 5 mm (3/16") up to a maximum of 13 mm (½"), make a shim from good quality plywood to reduce the gap to approximately 2 mm (3/32"). The outer face of the shim should be at least the same size as the socket and have chamfered edges of 45° to 60°. See figure 4.

The rear sockets, positioned as they are on a part of the fuselage which curves away towards the rear, will require a shim regardless.

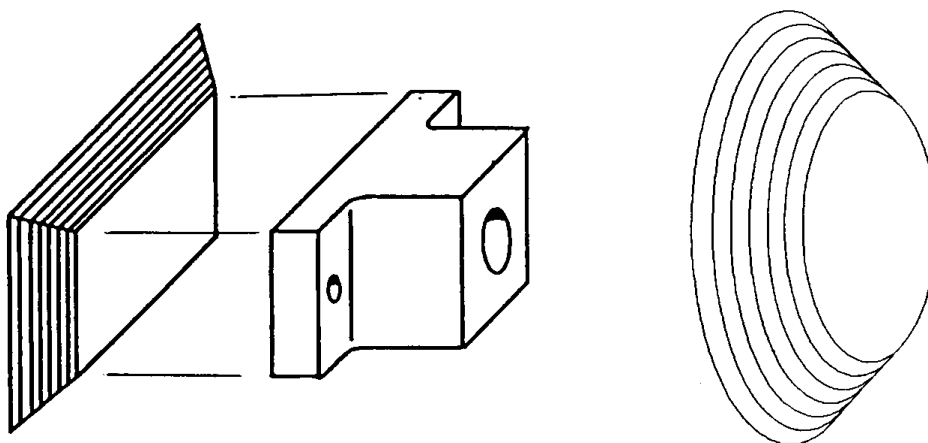


Fig 4. Plywood shim as required. (Both front and rear shown)



Separate the wings sufficiently far to gain access to the four socket pads. Using Araldite 420 mixed with floc bond the shims onto the fuselage sides in the relevant places ensuring that the gap of approximately 2 mm (3/32") between the socket and shim remains. Either immediately afterwards or after the adhesive has cured, layup 4 plies of 'bid' at  $\pm 45^\circ$  over the shims lapping onto the fuselage at least 25 mm (1") all around. Cover the entire layups with peel ply.

## Step 5

### Attaching the sockets

Scuff sand the rear face of the W26A socket body and remove the peel ply from the fuselage mounting pads. Mix a quantity of Araldite 420 adding floc to stiffen it and apply it to the rear faces of the W26A ensuring none gets onto the lift pins.

Reposition the wings with the spar bolts in place and set them up so that the wing incidence is as accurate as you can achieve.

Orientate the leading edge sockets horizontally and push them inboard to touch the fuselage sides. There is not a great amount of room here but try to remove any excess adhesive that oozes out.

Ensure that the holes in the trailing edge sockets and wing rear pin are aligned by using the pip pins.

Check finally that the fuselage is still secure and level, the wings are not swept forwards or rearwards and, most importantly, that the angle of incidence of both wings is set at  $+ 2.5^\circ \pm 0.05^\circ$ .

Now walk away and don't allow anything to be disturbed until the adhesive has cured *properly*.

After full cure, check again that nothing has moved and that the wings' incidences have not altered.

Carefully remove the spar bolts and pip pins and slide the wings out of the fuselage, starboard wing first.

## Step 6

### Front sockets

Drill through the 1/4" holes in the front sockets right through the fuselage sides then insert the AN4-10A bolts from inside the fuselage with AN970-4 washers under the heads securing them with MS21042-4 nuts.

Clean up any rough lumps of excess Araldite from around the sockets and fill any gaps that may be present with fresh Araldite 420/floc as required. This may be left until you next make up a mix to save wastage.



## Step 7

### Rear sockets

As the trailing edge lift pin also acts to contain drag loads and the forward component of lift, a tie bar will be fitted across the fuselage to react these loads. A general arrangement of the tie bar assembly and associated parts is shown in figure 5.

**Note:** It is recommended, for ease of access, that at this stage you install the main gear legs, and then return to complete the rear socket installation. Go to chapter 29, and carry out the operations shown on pages 1 to 6 inclusive.

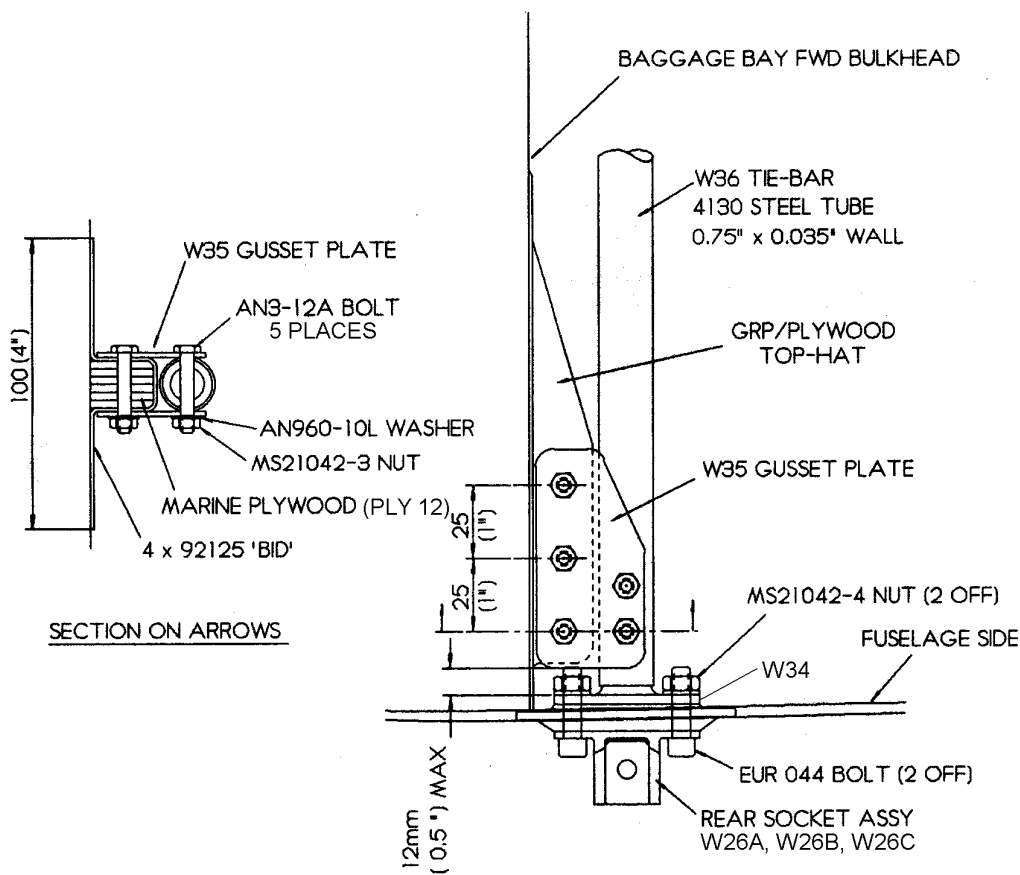


Fig 5. Top and sectional view of tie-bar and socket (port side).

Drill the two 1/4" and one 3/16" holes in the W26 assembly right through the fuselage. Drill as straight as possible otherwise the holes which will be made in the inner fitting W34 could end up too close to the edge of the disc or too close to the centre stem.

Temporarily locate the W34 fitting inside the fuselage using a EUR044 bolt and EUR046 plain nut for now. With W34 held correctly aligned, drill through the remaining 1/4" hole and the 3/16" hole. Install the other EUR044 bolt and EUR046 nut to hold W34 in position.

As the fuselage side is at a slight angle to the aircraft centre line where W34 sits, a shim of epoxy and flox will be required on assembly. Take this into account when positioning W34 at this stage. Mark a line across the top of the centre tunnel (and the ribs in Tri-gear aircraft) in the baggage bay to represent the 1" diameter steel tube tie-bar which will be fitted between the W34 fittings.

It will be seen that it is necessary to cut a slot in the centre tunnel. Cut this slot and adjust its size to leave a clearance around the tube of approximately 3mm (1/8"). Remember that the pitch push-rod is under the tunnel so don't cut into it by mistake.

Cut slots in the main gear ribs as required, but rather than a narrow slot as in the central tunnel, chamfer the slot sides at a 45° angle where possible. This affords better access for the tie-bar.

Again, temporarily install the W34 fittings, with the tie-bar, and insert the EUR044 bolts in each side. The thread on the EUR044 bolts should be cut off, but ensure that at least two threads protrude through the nut.

## Step 8

### Gusset Plates

In addition to reacting the tensile/compression loads it is necessary to provide sideways stiffness for asymmetric loads. This is done via two plywood blocks laminated onto the baggage bay front bulkhead, which are connected to the tie bar by means of a gusset plate, see figure 5.

At the outer 150 mm (6") of the baggage bay front bulkhead mark two horizontal lines showing the position of the top and bottom of the tie bar.

Make up the two plywood blocks from PLY 12 according to figure 6. As each aircraft is bound to be slightly different, the width of the blocks must be determined by measurement. Round off the corners to allow for glassfibre to be laid up over the blocks when installed.

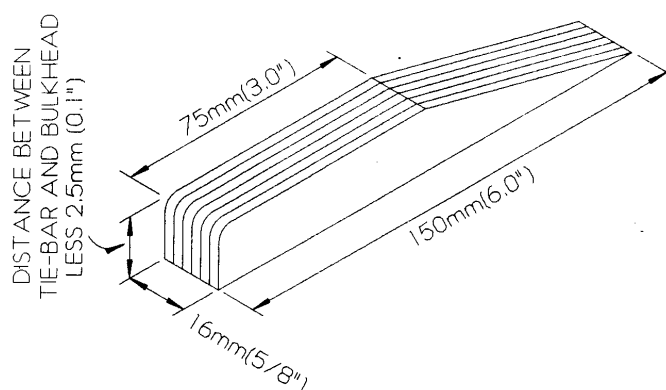


Fig 6. Plywood block for gusset plates.



## Step 9

Scuff sand the bulkhead where the plywood blocks fit and the surrounding 5 cm (2"). Using rapid epoxy spread over the entire bonding face, bond the plywood block on to the bulkhead, as far outboard as possible, but allowing space for the shortened EUR044 bolt and aligning it with the tie-bar. Remember to allow 2.5 mm (0.1") between the block and the tie-bar for the thickness of glass fibre which will go over the block.

Once secure, remove the tie-bar and W34 fittings and layup four plies of 'bid' at  $\pm 45^\circ$  over the plywood block, lapping onto the bulkhead all around as shown in figure 8. Make fillets with floc in the corners first to prevent the formation of air bubbles. Cover with peel ply and allow to cure.

After cure, remove the peel ply and reposition the tie-bar assembly. Position a W35 gusset plate on top of the plywood block and tie-bar and, using the two holes as a guide, drill right through the tie-bar centre-line with a 4.8 mm drill. Install an AN3-12A bolt in each hole after drilling to ensure alignment for the next hole.

Now mark a line on the upper gusset plates which is central to the plywood block, then mark the centres for three holes, each 25 mm (1") apart and 13 mm (1/2") from the edge of the plate. Drill right through with a 4.8 mm drill.

Next, install a W35 and W35A gusset plate to each end of the tie-bar, one above and one below, bolting them to the tie-bar with AN3-12A bolts, AN960-10L washer and MS21042-3 nuts. Drill through the lower gusset plate with the last 3 holes and install AN3-12A bolts in these also. Don't add the nuts to these bolts yet as you're just about to remove the assembly yet again. (The lower gusset plates W35A are undrilled to allow for drill alignment variations).

## Step 10

### Final assembly of tie-bar

Initially remove all components identifying where they were fitted for re-assembly. Clean away any burrs and swarf caused by drilling. At this stage it would be a good idea to paint the tie-bar to protect it against corrosion so that it's dry ready for final assembly.

Prepare each side of the slot in the central tunnel of the cockpit module for a glass fibre layup by removing the upper skin and foam to expose about 10 mm (3/8") of the lower skin. See sectional diagram in figure 7.

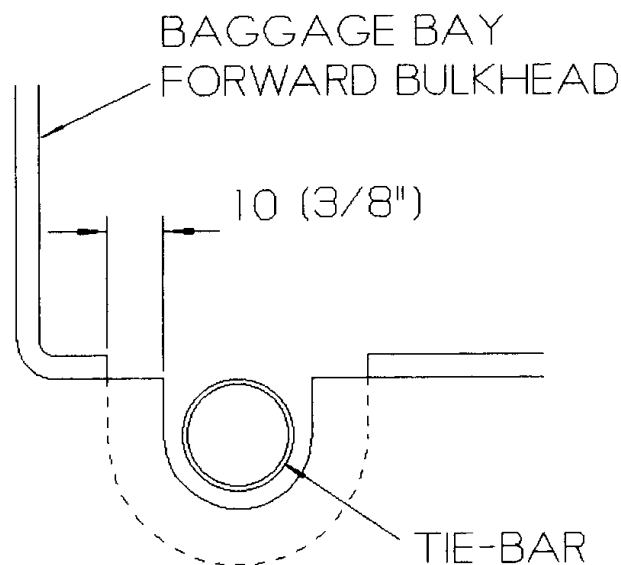


Fig 7. Section through baggage bay centre tunnel.

The tie-bar can now be installed for the last time. For the final installation of the tie-bar assembly make a stiff mix of floc and spread this on the flat face of the W34 fittings to form a shim to take up the uneven gap between them and the fuselage sides. With the tie-bar in place, fit the assembly into the fuselage and install the EUR044 bolts and MS21042-4 nuts and the EUR045 bolts (suitably shortened similar to the EUR044 bolts) and MS21042-3 nuts.

Do not fully tighten the bolts at this point just tighten them enough to prevent movement of the W34 fittings. Scrape away any excess floc from around the W34s.

Install the gusset plates with the AN3-12A bolts, AN960-10L washers and MS21042-3 nuts.

## Step 11

### Central tunnel slot closure

The final task to be done is to close the slot in the tunnel, tying the tie-bar into it in the process. Cut pieces of 3 mm foam to fit into the slot across the top and down the angled sides. The side pieces may be in two pieces each to take it around the tie-bar. Scuff sand the bonding areas each side of the slot.

### Layup

Layup 2 plies of 'bid' at  $\pm 45^\circ$  on plastic sheeting at least 30 cm x 20 cm (12" x 8"). Cut a strip to fit into the slot and lay it to join the inner skins together. Drape it over the tie-bar, cutting it to allow it to go around the tie-bar at the sides. See figure 8.

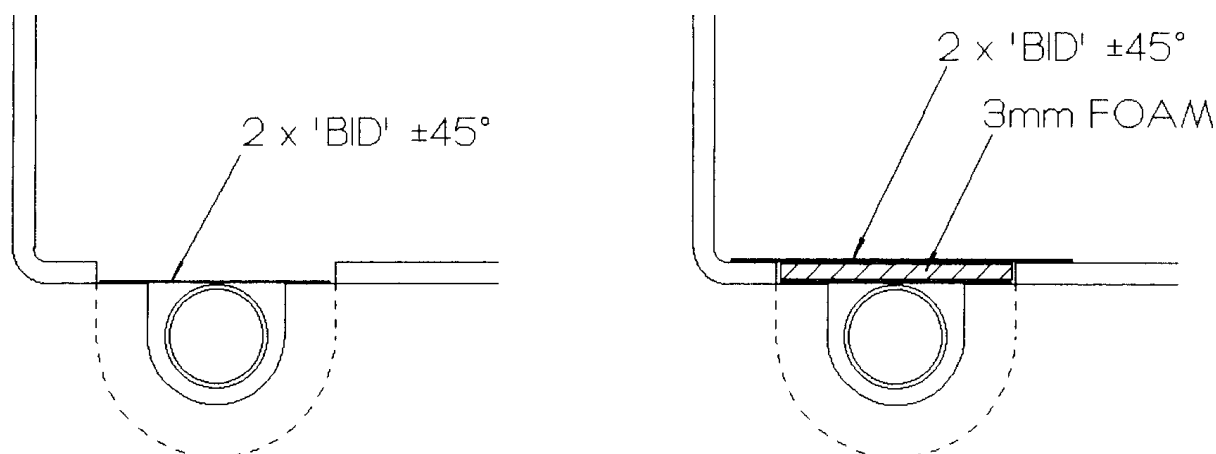


Fig 8. Section through tunnel detailing layup sequence.

Apply a layer of floc to the underside of the 3 mm foam pieces and lay them in place over the first layup.



Next, coat the upper portion of foam with floc and finally layup 2 plies of 'bid' at  $\pm 45^\circ$  over the foam lapping onto the surrounding glass fibre and the tie-bar by about 20 mm (0.75").

You may actually find it easier to lay the glass cloth onto both sides of the foam before installing it rather than in the stages as described above.

Cover with peel ply and allow to cure.

## Step 12

### Front stiffener

Extra stiffness of the fuselage skin behind the forward lift socket is achieved by the addition of a 75 mm (3") wide stiffener laid up on the inside. See figure 9

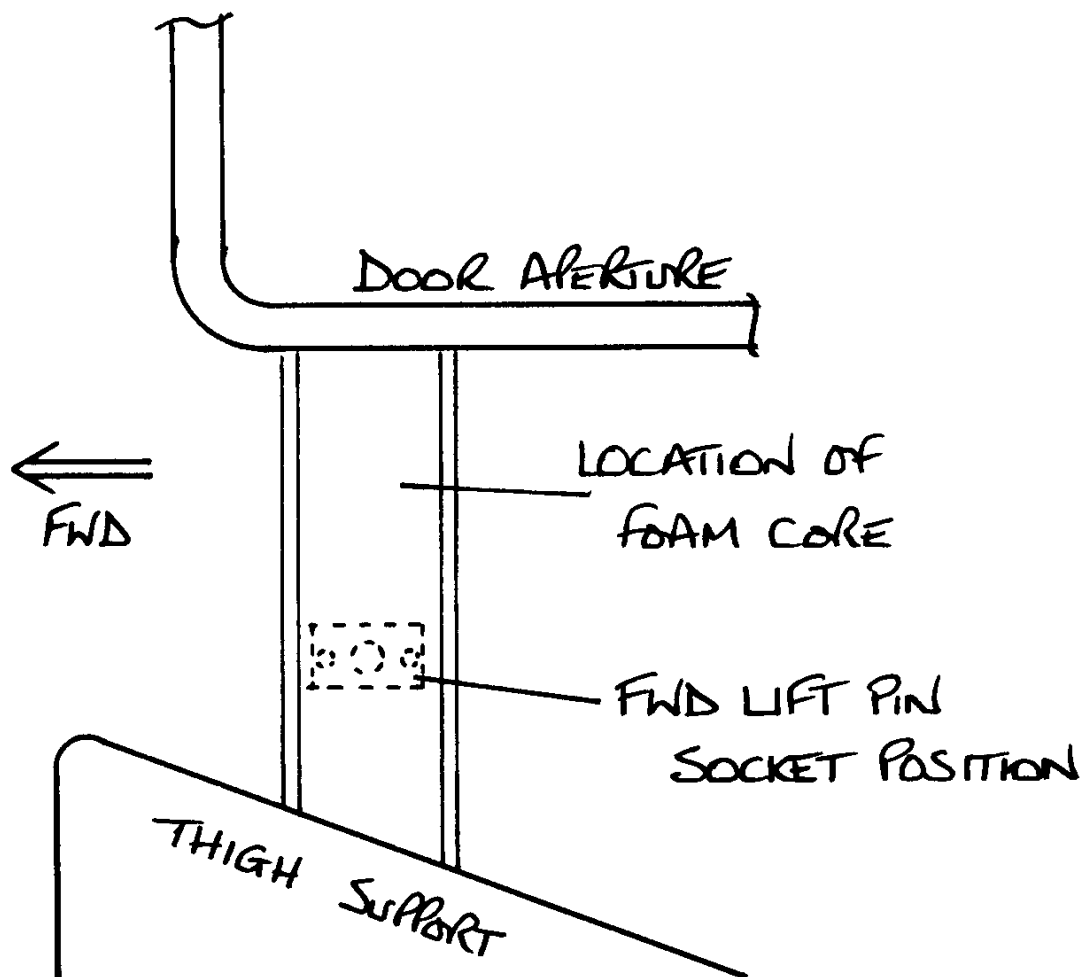


Fig 9. Partial view on inside cockpit wall (starboard side).



Using scraps of blue styrofoam, make two pieces to the dimensions 410 mm x 75 mm x 7 mm thick (16 $\frac{1}{4}$ " x 3" x  $\frac{1}{4}$ " thick).

To make the foam 7 mm ( $\frac{1}{4}$ " ) thick, cut it slightly thicker than, with 7 mm thick wooden battens nailed to a flat surface wide enough apart to fit the foam, sand across the foam until you contact the battens. The thickness of the foam is not super-critical.

Trim the foam to fit vertically between the seat thigh support and the underside of the door aperture, when central relative to the forward lift pin socket.

Chamfer off the vertical edges to allow transition of the glassfibre layup which will go over the foam and dig out cavities in the foam to allow the bolt heads holding the socket to fit.

Cut a total of 6 pieces of 'bid'  $\pm 45^{\circ}$  130 mm (5") wide x 475 mm (19") long.

Scuff sand the inside skin, top of the thigh support and underside of the door aperture flange.

Flox the foam cores in place on the fuselage side and, ensuring it is against the side wall, allow to cure.

Next, coat the exposed foam with micro slurry and layup 3 plies of 'bid' at  $\pm 45^{\circ}$  over each foam piece, lapping onto the fuselage all around by about 25 mm (1"). Cover the edges, at least, with peel-ply and allow to cure.

After cure, remove the peel-ply and carefully drill through the socket's hole, right through the fuselage side, with a 12 mm drill to allow the pin to penetrate.



## Spar pins

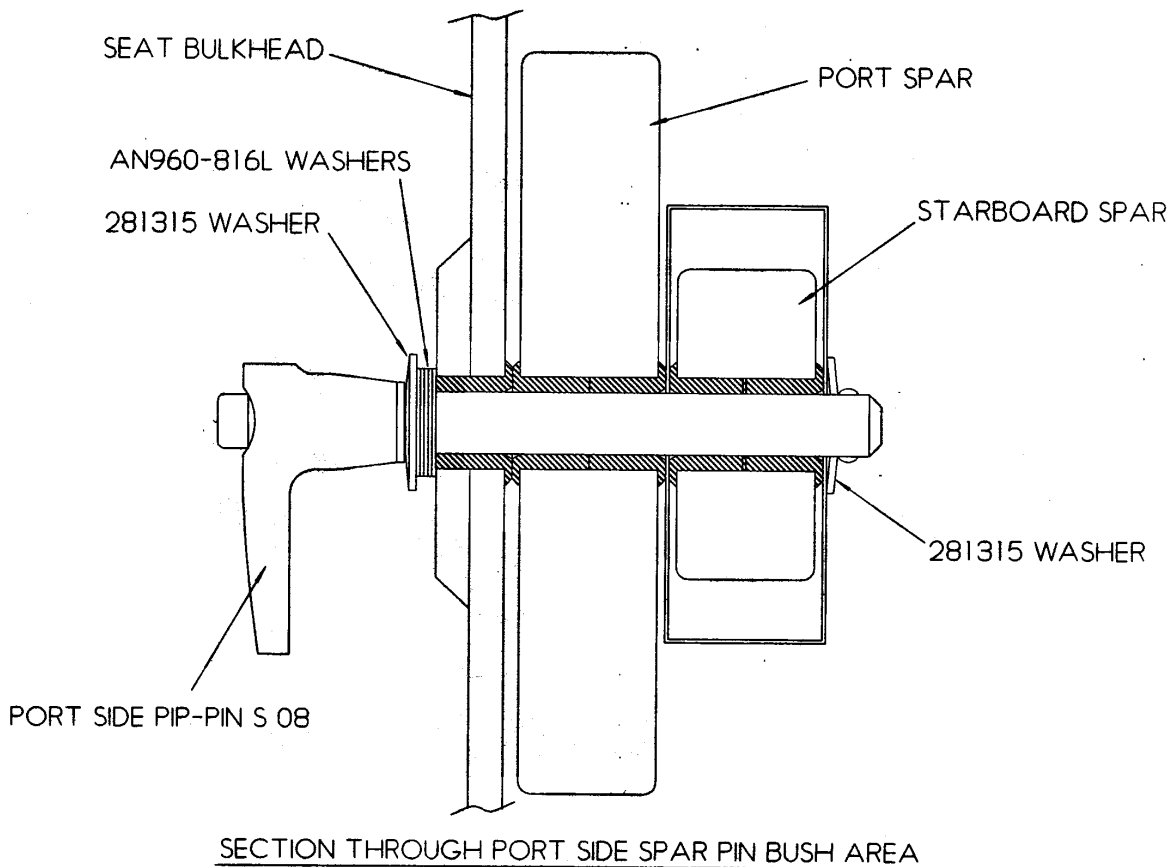
There are two different spar pins; one being a pip-pin the other a plain steel pin. The pip-pin is to be used on the port side of the aircraft to retain the tip end of the starboard wing spar in the event of an overload. The rigging socket is not regarded as a structural component. The tip end of the port spar is restrained by the starboard spar behind it.

### Step 13

#### Pip-pin

The pip-pin supplied is deliberately slightly too long which enables fine adjustment of its fit in each individual aircraft. To be effective, the pip-pin balls should be no further than 0.020" (0.5 mm) from the rear of the rigging socket.

To strengthen the rigging socket hole against which the pip-pin will react, a hardened steel washer is to be bonded in place. A sectional view through the spar at the pip-pin location is shown in figure 10.



*Fig 10. Section through port side spar pin bush area.*



Set the port wing on supports with the trailing edge uppermost. Scuff sand the rear face of the rigging socket, which is bonded to the port wing spar, in preparation for bonding. Scuff sand also the hardened washer both sides. You will bond the washer to the rigging socket then retain it with a ply of 'bid'.

Prepare a piece of 'bid' about 50 mm x 50 mm (2" x 2") and mix up a small quantity of epoxy (approx 50 g). Keeping enough epoxy to wet out the 'bid', mix a small quantity of flox into the rest to make a wettish consistency. Apply the flox to the concave side of the slightly conical washer and then position it over the hole of the rigging socket. Use one of the 1" bolts to centre the washer then, with flox added around the outer edge of the washer to make a fillet, apply the single ply of 'bid' which will retain it. Although the 'bid' covers the hole, it is best to leave it now and clear it out after cure to avoid disturbing it.

It would be a good precaution to apply a thin layer of grease to the bore of the bush to avoid any epoxy drips sticking.

After cure, cut open the hole through the 'bid' and sand away the glass fibre within 2 - 3 mm (&") of the hole to ensure that the pip-pin balls contact the washer when installed rather than the glass fibre.

## Step 14

### Pip-pin length adjustment

Rig the wings into the fuselage and install the pip-pin in the port side seat back bush. The pip-pin's button needs to be depressed until the pin is fully in. Check that the button springs out after insertion. If it doesn't, there is something preventing the balls from emerging.

Without pressing the button in, pull on the pin until the balls contact the hardened washer. Measure the gap between the underside of the pin's head and the seat back. This gap should be taken up with a spacer which is between 0.1 and 0.5 mm (0.004" and 0.020") less than that measured.

To make up the spacer, select a number of the AN960-816L washers, which are approximately 0.8 mm (0.032") thick each and include one slightly conical hard steel washer over them which adds another 2 mm (0.080"). Refer to figure 10. Slide the calculated combination onto the pip-pin and assemble the wings. Check that the pin's button pops out, so engaging the balls and that the free play is less than 0.5 mm (0.020").

Position the washer assembly in place with a greased 1" bolt and nut around them with a mix of rapid epoxy with flox to make a fairly stiff mix. The idea is only to retain the washers when the aircraft is derigged. To make the washer assembly more secure add a couple of plies of 'bid', lapping 10 - 20 mm (\* - ") onto the seat back. Do this after removal of the bolt and ensure that no glass fibre is left between the washer and the pin head, otherwise the pin length adjustment will be affected.



## Step 15

### Starboard spar pin

The starboard spar pin SO7 will require the threaded end cutting off so that it measures 85mm

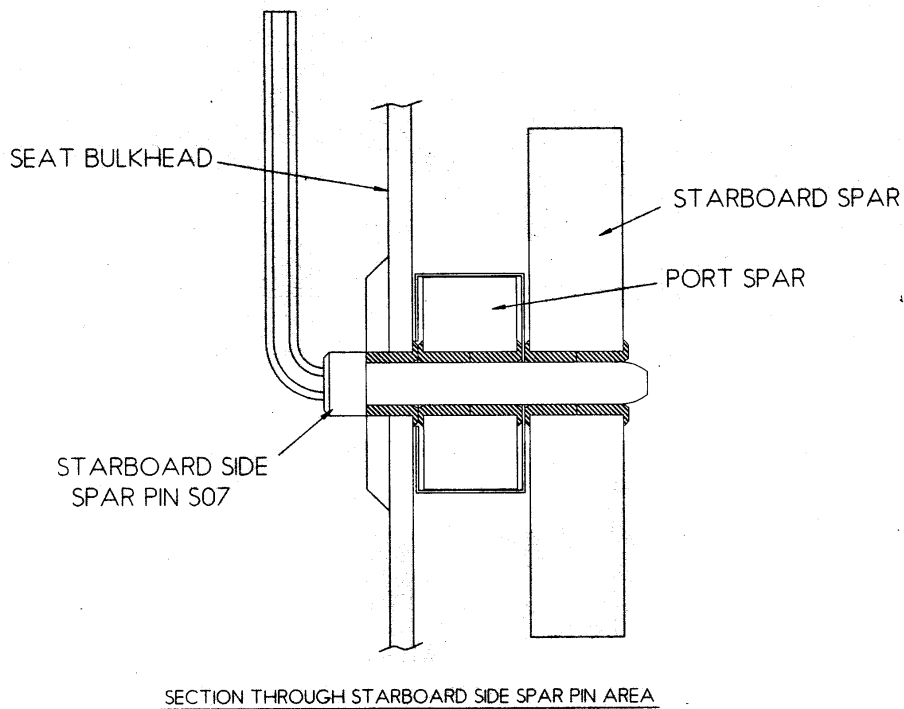


Fig 11. Section through starboard side spar pin area.

(3-3/8") from under the head. Round off the end to enable easy location. A sectional view through the spar at the starboard pin location is shown in figure 11.

## Step 16

### Starboard Spar pin latch

After inserting the two spar pins during rigging, the starboard pin handle is to be secured in a simple receptacle mounted in the corner of the fuselage side and seat back. As a further safety consideration, a latch prevents the pin handle from swinging out of the receptacle making it impossible to come out of the spars. See figure 12.

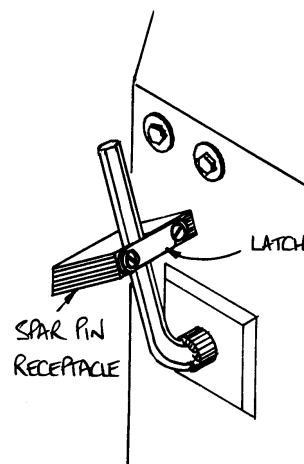


Fig 12. Spar pin in and latched in safety receptacle

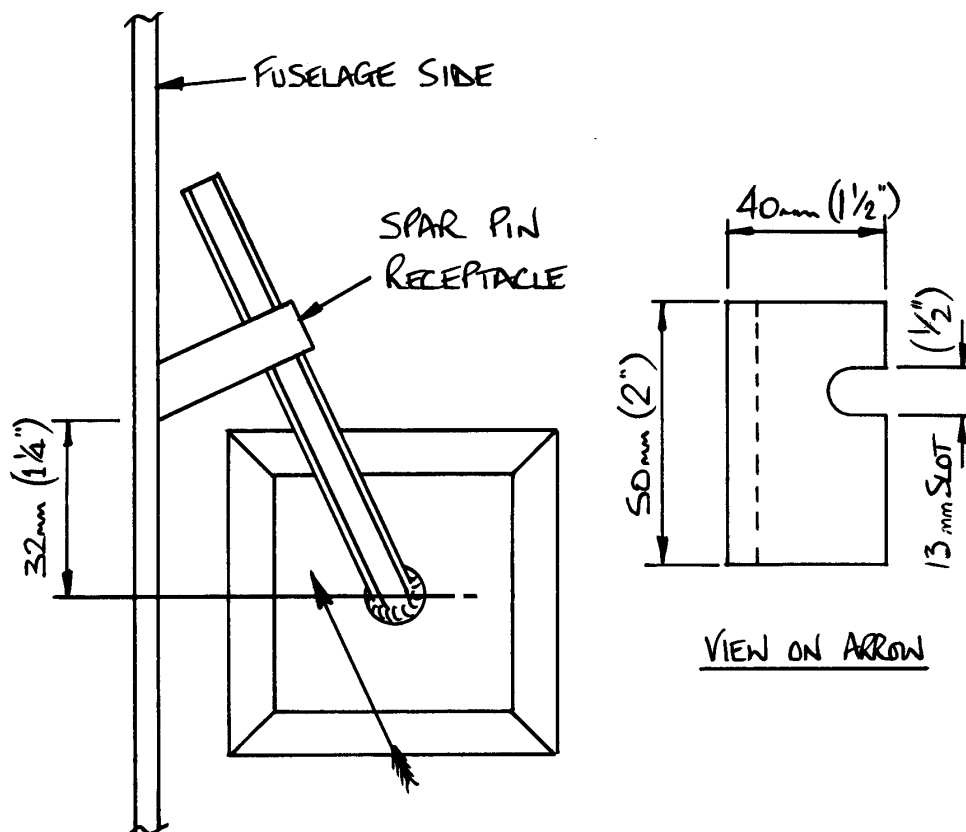


Fig 13. Dimensions and position of pin receptacle.

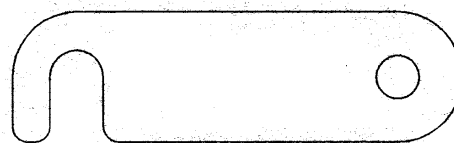
The receptacle is made from 12 mm plywood, part number PLY-5. See figure 13.

The slot should be positioned by holding the receptacle in place as indicated in figure 13 and marking where the pin handle contacts it. Drill a 13 mm ( $\frac{1}{2}$ " hole for the end of the slot, centred 10 mm ( $\frac{3}{8}$ " from the edge and cut the remaining piece away to make the slot.

Trim the total length of the receptacle to be no more than 13 mm ( $\frac{1}{2}$ " forward of the slot to minimise intruding into occupant space.

### Latch

The latch -part number S09 - is shown in figure 14.



Hold the latch in place on the edge of the receptacle with the slot in it and drill two 3 mm ( $\frac{1}{8}$ " holes for the latch pivot and catch.

Screw the latch to the receptacle, using EUR 024 screws, the forward screw, with an AN960-10L washer under its head, acting as the pivot to minimise possible inadvertent operation by the seat back cushion.



## Installation

Remove the latch and screws for final installation.

Scuff sand the fuselage side and seat back where the receptacle will go then, using rapid epoxy mixed with flox, bond the receptacle in place.

Next, layup 2 plies of bid at  $\pm 45^{\circ}$  over the top and bottom of the receptacle, lapping onto the fuselage and seat back 20-25 mm ( $\frac{3}{4}$ "-1"). Cover with peel ply and allow to cure before reinstalling the latch.

### Step 17

#### Pin identification

Although the safety latch should act as a reminder, it is possible to rig the aircraft and put the spar pins in the incorrect locations so it is important to identify the pins and the holes in the seat back in some manner. For example, paint the handle end of the port side pip-pin red, the starboard pin green and paint a matching colour around the holes. Alternatively, attach the pip-pin to a strap which is secured to the fuselage, via the seat belt attachment bolt for example, to avoid it being used on the starboard side.

### Step 18

#### Aileron quick connect bellcrank pivot position repositioning

The important thing with the aileron quick-connect system is that the pivots of both W16 and CS15 bellcranks are properly aligned. Having set them up initially in the cockpit module you may find that they no longer align properly when the fuselage is assembled. First, visually check the pivot bolts alignment with the wings rigged. Note the amount and direction of misalignment. You will need to move the bolt in the spar.

Remove both W16 and CS15 bellcranks from their pivot bolts. Remove the bolt in the spar by heating it carefully to soften the Flox, then tap it out with a hammer. File a slot for the pivot bolt and its head to allow the bolt to align with the pivot bolt of CS15.

Find a piece of rigid tube which fits onto the 1/4" diameter pivot bolts, and is the same length as the CS15 pivot bolt. Slide the tube onto the CS15 pivot bolt. Install the W16 bolt through the spar with Flox, making sure it is not on the thread. Apply tape over the back of the Flox filled hole to prevent it being pushed out.

Rig the wings then, gaining access from under the wing and using long nosed pliers, slide the tube which is on CS15's pivot bolt so that it is half on both bolts- be careful not to push the W16 pivot bolt back into the spar. Leave to cure.

Remember to slide the tube over the pivot bolts back before attempting to derig the wings. Now refer back to the aileron quick connect section and re-install the bellcranks.

## Step 19

### Aileron quick connect bellcrank pads

Rig the wings to the fuselage again; you'll notice that there is a gap between the pairs of quick-connect bellcrank faces. Insert temporary shims into the gaps to make them parallel then measure the gap.

Make a pad for each wing from the piece of 1 mm thick Tufnol (EUR 008) to fit into the gaps with a minimum of 0.25 mm (0.010") clearance to allow for the thickness of Araldite 420 adhesive. Sand the Tufnol to obtain the thickness desired, and scuff sand the outboard faces of the CS15P and CS15S bellcranks.

Separate the wings enough to give access to the bellcranks, then bond the pads in place using Araldite 420 adhesive. Making absolutely sure that there is no adhesive on the front of the pad, put the wings back on to ensure that the gap between the bellcranks is completely filled, and the pad is not too thick. Wipe away any adhesive that oozes out and leave to cure.

Re-rig the aircraft and operate the aileron controls to check for any lost motion, and for any stiffness in operation, particularly if the stiffness increases with aileron deflection.

## Step 20

### Aileron quick connect bellcrank

At full aileron deflection (roll to starboard) there is the possibility that a corner of the aileron quick connect bellcrank CS15P, which is mounted in the fuselage, may contact the spar pip-pin. With the aircraft rigged and the aileron controls correctly adjusted, the W16P bellcrank will not contact the pin. See figure 15 and confirm this on the aircraft.

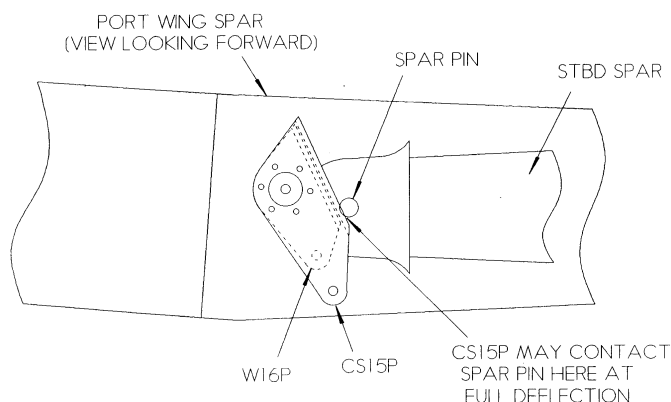


Fig 15. Detail of port side aileron quick connect bellcrank.



To avoid contact with the pin, the corner of CS15P should be removed as shown in figure 16. Ensure that the inner corner is radiused as shown.

On installation, check that there is clearance between the spar pin and CS15P, making any small adjustment as necessary.

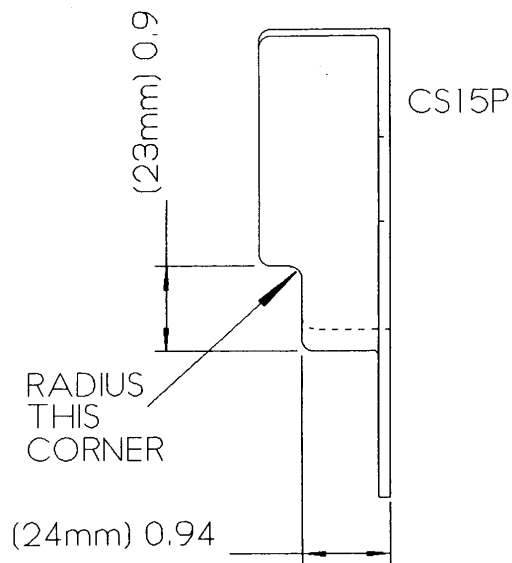


Fig 16. Cut-out as required in CS15P.

### Step 21 Spar guides

Although not an essential addition, spar guides attached to the aileron quick connect bellcrank mounting bracket make wing rigging easier. Using Tufnol allows the spar to slide easily into the fuselage and not damage the layup on the flange of CS14. Forming the guide as an “L” shape prevents the spar from sliding aft. See figure 17.

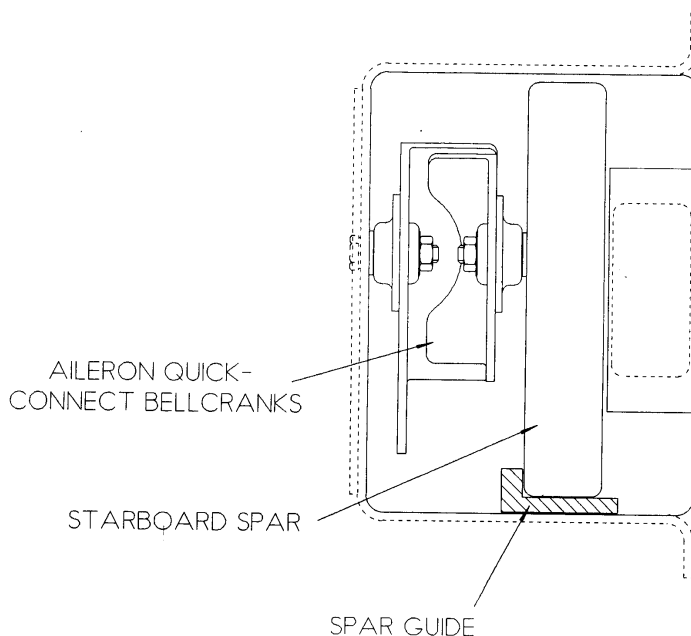


Fig 17. Location of spar guide - starboard shown.

## Spar strap

When the wings become loaded in flight, the spars within the fuselage bend, as well as the wings themselves. Due to the spar pins being supported by the seat back bulkhead only, the spars try to twist as well as bend.

To limit the twisting effect, a 75 mm (3") wide glass fibre strap is to be attached to the port wing spar at the aircraft centre-line. The strap is to be laid up directly around the starboard spar, which will be suitably treated with release tape, to ensure a perfect fit.

## Preparation

### Step 22

#### Starboard spar

To accommodate spar bending, the strap needs to be made with some clearance at each end over the spar's upper edge. Without this, the starboard spar would tend to shear the strap from the port spar as it bends. To form this clearance, cut a piece of thin card to the width of the spar and at least 90 mm (3/1/2") long and cover it with release tape.

Using two 3 mm thick spacers placed on the spar as shown in figure 18, position the card former between them so that it curves and, using the release tape, attach it to the spar. Wrap the release tape, all around the spar trying not to distort the curved shape of the card. It might be wise to support the card in various places underneath so you don't lose the curve.

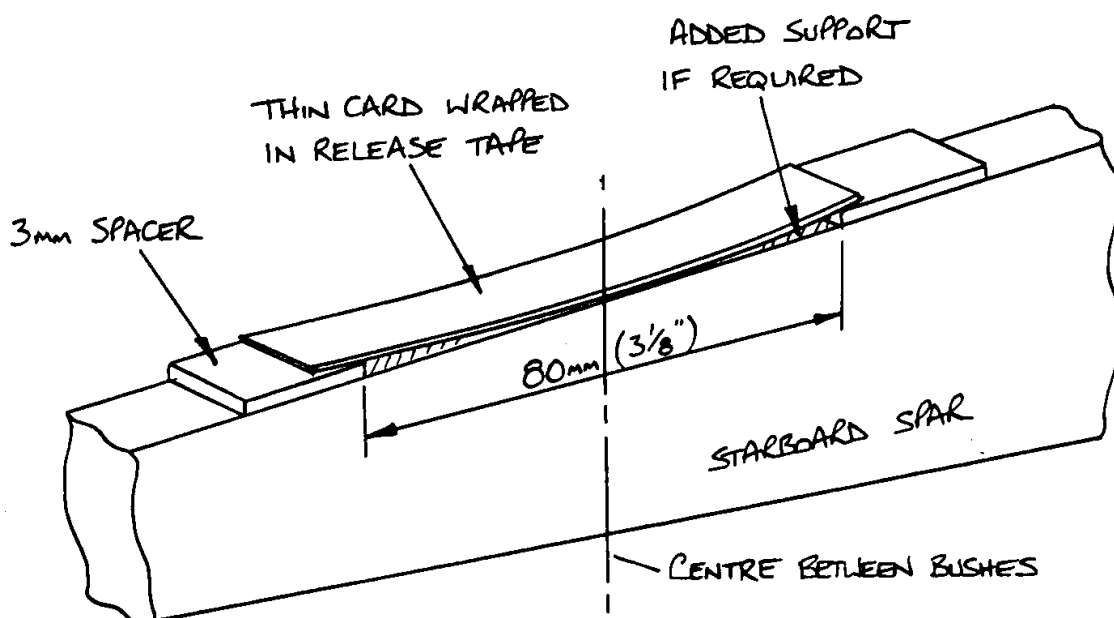


Fig 18. Former position on spar.



## Step 23

### Port spar

Scuff sand the central 15 cm (6") all around the port wing spar in readiness for bonding the strap to it. Support the port wing, leading edge down and arrange it such that the starboard wing can be rigging in position with it, but don't put them together at this stage.

### Layup

Cover an area of your work bench with plastic sheeting, then directly onto it make two different layups. One will be the strap, the other will form two brackets.

- **Brackets** - Layup 2 plies of 'bid' at  $\pm 45^\circ$  large enough to cut two 90 mm x 90 mm (3" x 3") squares.
- **Strap** - Layup a strip large enough to cut a piece 350 mm x 90 mm (14" x 3") to the following schedule.

2 x 'bid' at  $\pm 45^\circ$ .  
2 x 'uni' (fibres running lengthwise).  
2 x 'bid' at  $\pm 45^\circ$ .

Position the bracket layups onto the centre of the port spar, lapping just 25 mm (1") onto the spars rear face, one at the upper edge, the other at the lower edge. See figure 19. For now, leave the bracket's pieces hanging down.

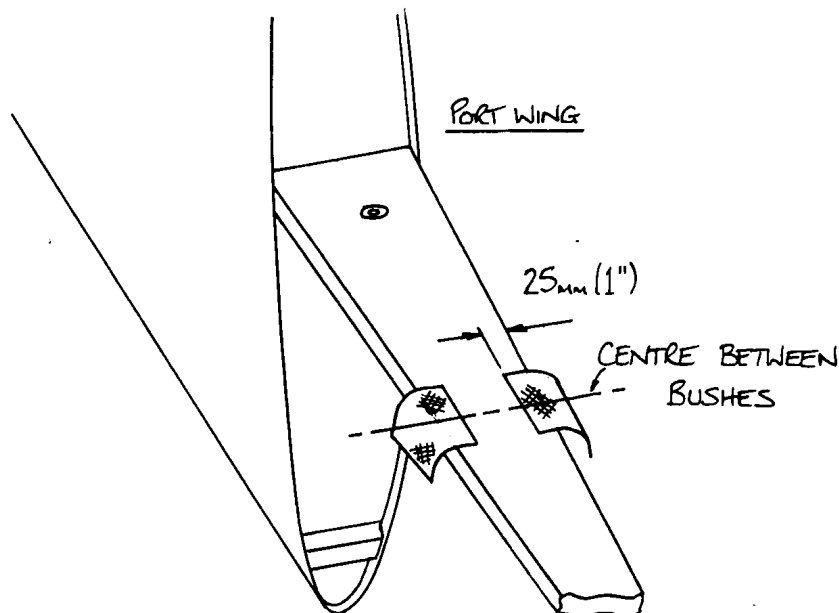


Fig 19. Bracket plies in position on port spar.

Now position the starboard spar onto the port spar and insert the spar pins or two ½” bolts through the spar bushes. Ensure that the spars are properly together, use clamps if necessary but don't squeeze the centres of the spars together.

With the spars together, wrap the bracket layups around the starboard spar. See figure 20.

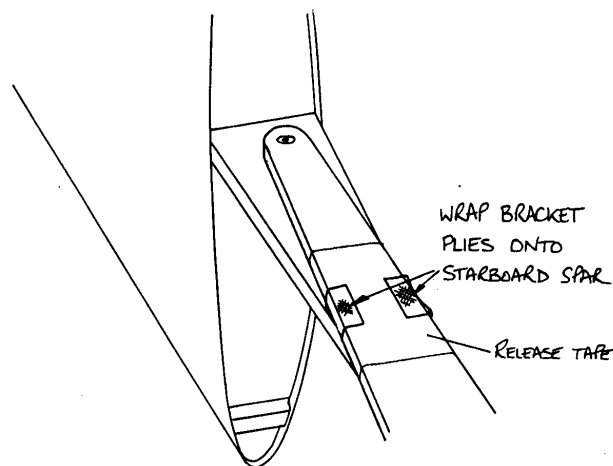


Fig 20. Brackets wrapped around starboard spar.

Apply floc to make a fillet between the bracket layups and the port spar then lay on the strap layup, over the brackets wrapping around onto the forward face of the port spar.

The strap is not meant to overlap here, so trim the ends if necessary. Having made sure that the layups are properly in place, leave to cure.

After cure, remove the spar pins and separate the spars. Trim the edges of the strap to remove sharp edges, adjusting the strap's width to no less than 75 mm (3"). See figure 21.

**Note:** It may be necessary to separate the spars with a scissor jack, but be careful not to apply any impact load.

Finally remove the release tape and card former from the starboard spar.

### Wing root fairings

The gap between the wing root and the fuselage skin will be filled with the moulded fairing. The fairing becomes part of the wing which further adds to the wing root stiffness and can assist in passing forward and aft wing loads into the fuselage.

### Step 24

With the wings properly rigged apply layers of tape or a piece of card to the fuselage sides, where the root fairing will

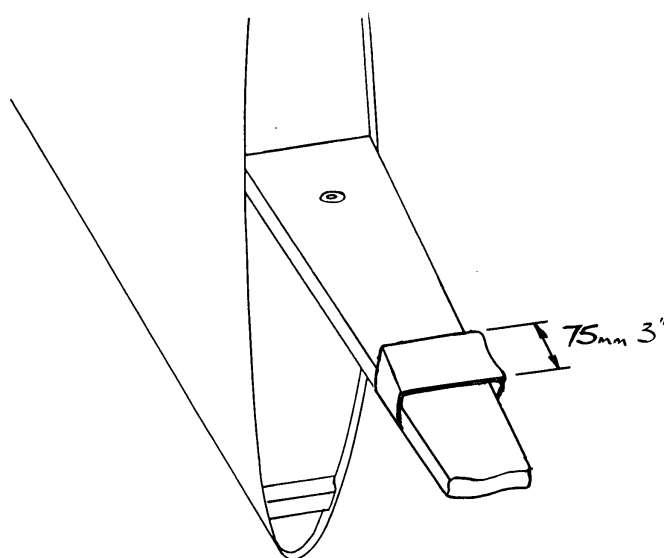


Fig 21. Spar strap trimmed to size.

be, to a thickness of about 2 mm. Lay the fairing onto the wing so that it touches the 2mm spacer you have just made. Mark the fuselage sides to indicate the pip pin positions as they will become hidden by the fairings. Mark the position of the fairing on the wing.



Scuff sand the area of contact and then bond the fairing to the wing with Araldite 420/flox, being careful to keep the adhesive clear of the fuselage sides. Leave to cure.

## Step 25

After cure, cut a hole through the fairing to extract the pip pins and remove the wings. This hole should be as small as possible to avoid reducing the strength and stiffness of the root rib.

With the wings rigged, any gap between the fuselage and wing fairing should be sealed by applying silicone to the fairing having applied a sheet of thin plastic to act as a release agent to the fuselage side first. Leave the wings rigged until the silicone has set.

**Note:** *Do this after painting otherwise areas that have been in contact with the silicone will not allow paint to adhere.*

## Aileron setting up procedure

### Initial set-up

1. Check that the short aileron link-rod is adjusted such that when the bellcrank W13 is against its stop, the aileron has moved 23.5° up.
2. With the aileron at neutral, adjust the length of the lateral push-rod so that the quick-connect bellcrank W16 is at 90° to a line between both spar bushes.
3. Adjust the tie-rod between both cranks CS08 so that both control columns are parallel.
4. Adjust the short outer push-rods between the CS08's and the CS15 bellcranks so that the latter are vertical when the control columns are vertical.

When the wings are rigged the aileron movement should be 23.5° up and 20° down with full lateral control column movement and both ailerons should be in their neutral positions together when the control columns are vertical.

### Adjustments

If more than 20° down aileron is achieved, shorten the aileron link rod. This will, of course, increase the upward movement of that particular aileron, so check that the aileron stop in the opposite wing prevents the mass balance weights from contacting the wing skin.

If both ailerons are slightly up instead of being in their neutral positions when the control columns are vertical, shorten the two outer push-rods linking CS08 to CS15. Lengthen these push-rods if the ailerons are slightly down together.

### Pitot/static tube

Drill two 1/4" diameter holes through the port fuselage side midway between the forward wing socket and the spar opening, making sure to keep them away from the seat belt mounting. These holes are for the pitot/static tubes.

When rigging the aircraft the tubes will be led over the top of the spar tang