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## **9 AILERONS**

**NOTE:** *Many of the operations described for the ailerons are common with the flap assembly. With careful planning, time and material can be saved by grouping together similar processes. However, if you do so, you need to be extremely careful to avoid inadvertent mistakes.*

### **9.1 SETTING OUT BUILDING BOARD**

A rigid, level and flat surface will be required to build both the ailerons and flaps (although the setting out will be different). It is suggested that you build both ailerons together and both flaps together to avoid any possibility of 2 left or 2 right assemblies.

#### **STEP 1**

Mark a straight line not less than 74" long on the baseboard 9" from the long edge. A thin line felt marker is recommended. The 9" dimension will later help you clamp the ribs in place during assembly.

#### **STEP 2**

Make 2 marks on the line 72 1/2" apart (these are the outside edges of the aileron) and, using a square, mark perpendicular lines from these marks to the edge of the board.

#### **STEP 3**

From the left hand mark (outer edge of rib 1) position a rib (W-0310) and mark along its inner edge (position of rib 1).

#### **STEP 4**

Mark a line 15" from the initial left hand line. Using a rib place it with the right hand edge on the 15" mark and draw a line down the left hand side (position of rib 2).

#### **STEP 5**

Use the line just drawn (left side of rib), mark a line 15" to the right. Again, use a rib and with the right hand edge on the new line, draw a line down the left hand side of the rib (position of rib 3).

#### **STEP 6**

From the right hand 72 1/2" mark, position a rib and mark the inner edge (position of rib 6).

#### **STEP 7**

Mark a line 15" from the initial right hand line. Using a rib, place it with the left hand edge on the 15" mark and draw a line down the right hand side (position of rib 5).

#### **STEP 8**

Use the line just drawn (right side of rib) and mark a line 15" to the left. Again, use a rib and with the left hand edge on the new line, draw a line down the right hand side of the rib (position of rib 4). You should now have the rib positions marked and they should all be approx 13 7/8" however the middle bay will be slightly different (13 5/8").

## **9.2 PREPARATION OF SPAR**

### STEP 1

Identify the W-0300 spar tubes. Each 12ft length will be used for one aileron and one flap spar. **From each** 12ft tube mark out a 72 ½” length to be used for the aileron spar; save the excess to be used later for the flap spar. Cut on the outside of the line and finish to the 72 ½” dimension. A tube cutter is recommended, as this will give a cut perpendicular to the tube axis and you can cut straight down the line.

## **9.3 AILERON - FIRST STAGE ASSEMBLY**

### STEP 1

Lay the 72 ½” spar tube in its correct position on the building board and mark onto it the position of all 6 ribs using a felt marker.

### STEP 2

Trial fit the 6 ribs onto the spar. If necessary, ease the fit by lightly sanding the inside of the rib hole. When complete, disassemble.

### STEP 3

Abrade the tube using 100 grit emery cloth at each of the marked rib positions (approximately ½” wide bands). Clean each location with acetone or MEK and paper towels as previously described.

### STEP 4

Locate the ribs in their approximate positions and then place the assembly on the building board. First, locate and lightly clamp the spar tube so that the rear face of the tube is vertically over the 9” marked line on the board and the tube is also correctly positioned at the ends. A square is required for this operation.

Next, position the end ribs so that the outer face of the cap strip is on the marked line, i.e. the ends of the spar tube aligns with the outer faces of the end rib’s cap strip. Ensure that each rib is perpendicular to the spar tube and then clamp the tail of the rib to the baseboard with a spring clamp. Position the remaining ribs as already marked.

### STEP 5

Recheck the location and squareness of the whole assembly and finally, make sure it is securely clamped.

At this point, if space permits, it is a good idea to prepare the other aileron, and to bond both at the same time. This can also apply to the flaps, i.e. prepare both flaps and bond at the same time as the ailerons. Obviously if space/time do not permit then each aileron/flap can be processed separately.

### STEP 6

Mix a sufficient quantity of epoxy adhesive (C-0010) and apply a generous fillet to each side of every rib **a little less generously on the inside faces of the end ribs of each aileron** (space required for

hinges) to bond the ribs to the spar tube. Leave the assembly undisturbed until the adhesive has cured (24 hours).

#### 9.4 INSTALLATION OF THE TRAILING EDGE

The trailing edges W-0320.0 are pre-formed light alloy.

##### STEP 1

*Refer to Drawing 9.4.*

The ribs are made to fit inside the trailing edge W-0320 and should not require any additional preparation. When fitted into the trailing edge the distance from the rear face of the spar tube to the trailing edge should be 8 ½” (this is also 9” from the spar centre).

##### STEP 2

The alloy trailing edge should already be cut to the correct length of 72 ½”, if not trim it to length. (If the trailing edge that you are looking at is too short then you have the **flap** trailing edge! Take care). Fit and securely tape the trailing edge to the ribs, ensuring the ends of the ribs are nested with the inside radius of the trailing edge. Mark the position of each rib capstrip on the top and bottom front edges of the trailing edge with a fine line felt marker, i.e. 2 marks at each point spaced by the width of the capstrip. Also, mark where the trailing edge front edge crosses the capstrip top and bottom (so you know where to apply epoxy glue).

##### STEP 3

Remove trailing edge and abrade the inside face at each rib position with 100-grit emery cloth and thoroughly clean as previously described.

##### STEP 4

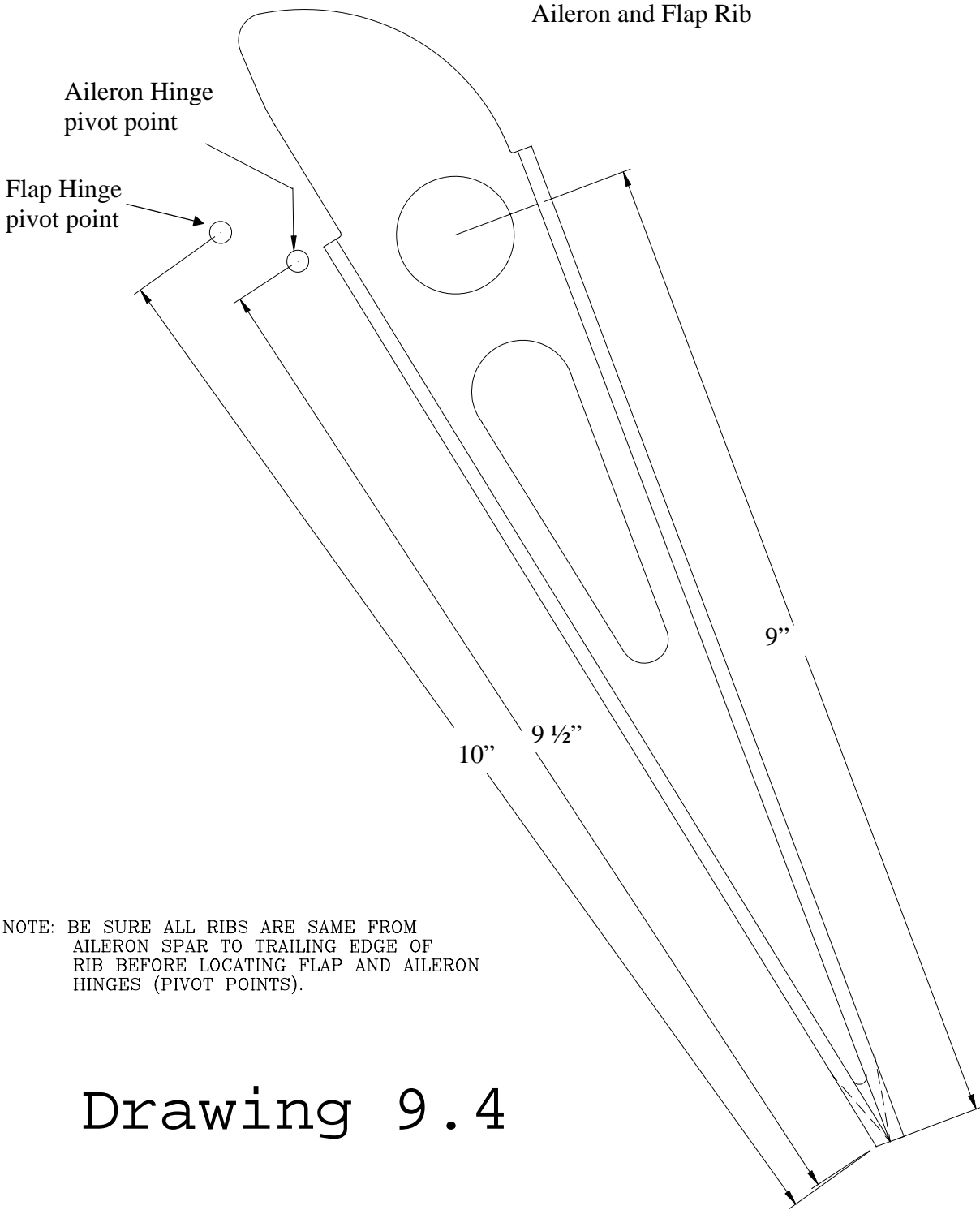
Replace trailing edge onto ribs and clamp in place making sure that trailing edge is at right angles to all ribs then centre punch and drill a No 40 (3/32") hole, ¼” back from the trailing edge leading edge and midway between the rib centreline and right hand outer edge of the capstrip. Turn aileron over and repeat, locating the rivet hole on the opposite side of the rib web. Countersink all holes in trailing edge material.

##### STEP 5

Remove trailing edge, mix and apply a generous coating of epoxy adhesive to each rib tail. Re-fit the trailing edge and secure in position with masking tape.

Ensure all joints are well coated with adhesive adding further fillets where necessary.

Ensure measurements are still correct then fit countersink rivets W-0330, pull carefully so as not to split the wood of the ribs.



NOTE: BE SURE ALL RIBS ARE SAME FROM AILERON SPAR TO TRAILING EDGE OF RIB BEFORE LOCATING FLAP AND AILERON HINGES (PIVOT POINTS).

Drawing 9.4

## 9.5 PREPARATION OF THE HINGES

### STEP 1

Identify the 2 aileron bell cranks W-0340 (left) and W-0350 (right) together with the 4 hinges, W-0360, and bronze bushings, W-0370. With each component secured in a vice, ream the bush housings with a 5/16" reamer. The bronze bushings should be an easy push fit.

### STEP 2

Completely remove the powder coating from the mating faces of all 6 components. Mark out, centre punch and drill 1/16" pilot holes in the centre and at each corner of the W-0360.0 hinges, ensuring that there is a minimum edge distance of 1/4" for the corner holes. Do the same for the bellcranks (2 x 5 holes). Open holes out to 3/32" (No 40).

## 9.6 INSTALLATION OF HINGES AND BELLCRANK

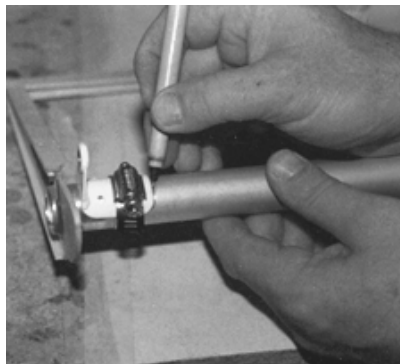
The hinges will be fitted to the aileron spar to align with the centrelines of rib 5 and 9. The bellcrank will similarly be fitted to align with rib 7's centreline. All fittings are attached such that the hinge bushing is on the underside of the aileron/flap.

### STEP 1 **NB. THIS STEP IS ESSENTIAL**

As a cross check, offer the aileron up to the wing and ensure that each mark aligns exactly with the centre of the respective rib web. Make minor adjustments as necessary. *Refer to Drawing 7.1: Wing structure, p7-4.*

### STEP 2

Temporarily attach the outer hinges, W-0360, to the aileron spar with hose clamps ensuring that the fore and aft centreline of the hinge bushing coincides with the marks made at 9.6, Step 1 (*see Figure 9.6.3*) and that the centre of the bushing itself is 9 1/2" from the rear edge of the trailing edge. *See Drawing 9.4(page 9-5) and figure 9.6.4.*



*Figure 9.6.3*

### STEP 3

Temporarily attach the bellcrank (W-0340.0 left aileron/W-0350.0 right aileron) following the instructions at Step 3, to align with the centre line of rib 7. *See figure 9.6.4.*



*Figure 9.6.4*

**STEP 4**

Recheck that all 3 hinges are correctly and accurately set. Mark the perimeter of each fitting with a fine line felt marker (*see Figure 9.6.3*).

**STEP 5**

Using the holes previously drilled in the hinges and bellcrank, drill the spar i.e. all holes not covered by the hose clamps. Fit Clecos. Remove the hose clamps and drill the remaining holes to the same procedure.

**STEP 6**

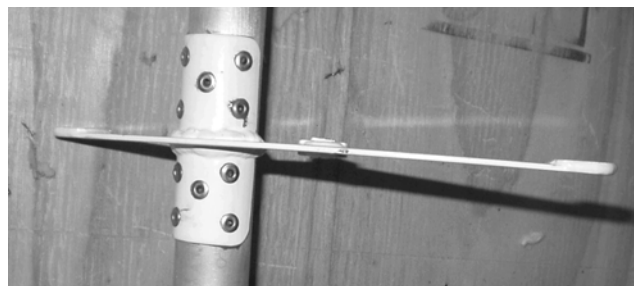
Remove hinges and bellcrank, deburr all holes and abrade the spar tube where marked with 100 grit emery cloth. Thoroughly clean all mating faces as previously described.

**STEP 7**

Mix sufficient epoxy adhesive and apply a generous coating to each mating face. Finally, rivet fittings in place with rivets supplied, W-0380, and remove surplus adhesive from around joints. *See figures 9.6.8a and 9.6.8b.*



*Figure 9.6.8a*



*Figure 9.6.8b*

## 9.7 INSTALLATION OF LEADING EDGE

### STEP 1

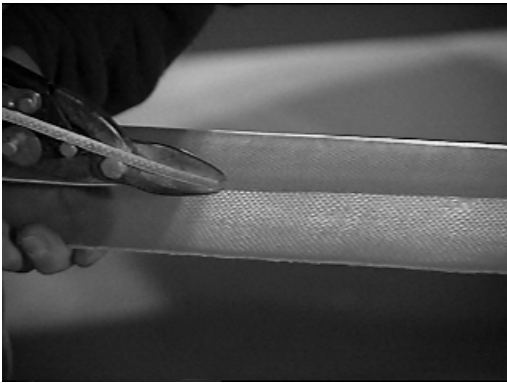
Leading edge material is of preformed fiberglass, W-0390. Each length provides one aileron or one flap leading edge. From a piece, first square off one end and then cut to length, again squaring off and finishing to the Rib Ends. Cutting thin fiberglass is best done with a very fine blade metalworking saw, and dressing to marked lines is best done using medium grade abrasive paper bonded to a suitable wood block or purpose made sanding block. You may want to leave the trimming to length until after it has been fitted, use the capstrip outer edge as a guide.

### STEP 2

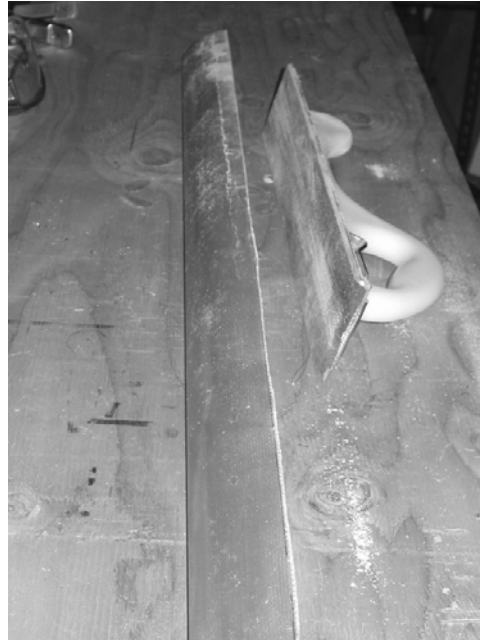
Fit the W-0390 leading edge onto the aileron and secure with masking tape. The leading edge should butt up to the rib capstrips. Remove a minimum of material to clear the hinges and bellcrank. Mark where any excess will need to be trimmed off and use a straight edge to draw a trim line on the upper and lower surfaces, you can see the capstrips through the fiberglass which you use as a guide. Remove the leading edge and cut off the waste. This can best be done with sharp metal shears as shown in *figure 9.7.5a* and the cut edge finally dressed as described in 9.7 Step 1, see *figure 9.7.5b*.

### STEP 3

Refit the leading edge and secure with masking tape. Mark the inside and outside position of each rib web, top and bottom, with a fine line felt marker.



*Figure 9.7.5a*



*Figure 9.7.5b*

### STEP 4

For the false ribs (W-0400) mark the following positions as centres for false ribs, 1 ¼" from inboard edge, 1 1/8" from the outboard edge and 5/16" either side of the bellcrank centreline (i.e. leaving a 5/8" gap) and at the midpoint of the other 4 rib bays.

STEP 5

Lightly abrade the inside of the leading edge at all the main and false rib locations using 240 grade emery cloth and thoroughly clean as previously described.

STEP 6

Mix sufficient epoxy adhesive and apply a generous coating all round the nose of each false rib and locate them at the correct positions inside the leading edge. Make sure that they are perpendicular and square and secure with masking tape. If necessary build up a small fillet either side of each false rib, but remove any extruding adhesive from around the inside faces of the ribs where the hinges are located. *See figure 9.7.6*

STEP 7

Apply a generous coating of epoxy to the noses of the main ribs, noting the guidance at 9.7, Step 6. Fit the leading edge and secure with masking tape. Ensure that the false ribs are epoxy bonded to the spar and check squareness and tape in place. Set aside to cure. *See figure 9.7.6*



*Figure 9.7.6*

STEP 8

When dry use a sanding block to reduce the height of the front edge of the upper and lower rib capstrips to provide a smooth transition from the fibreglass leading edge. **Remove wood not fiberglass!** Apply a little lightweight filler as necessary to help the transitions.

STEP 9

Remove the fibreglass leading edge material between the rib noses at each of the 3 hinge points and dress back to the inside faces of the ribs. *See figure 9.7.9.* These cuts extend from the bottom trailing edge of the leading edge to ½” from the trailing edge of the leading edge top surface.



*Figure 9.7.9*

## **9.8 FITTING AILERON TO WING**

### **STEP 1**

Fit the bronze bushings, W-0370, into the 6 pivot points of the ailerons. Lightly press them into place. On final assembly the hinge bracket will pinch the bearing, so that the hinge and bellcrank will rotate on the bearing, not the bearing rotating on the bolt.

### **STEP 2**

Identify the W-0410 hinge brackets and assemble 3 pairs, one pilot drilled and one un-drilled. Number each plate of each pair, e.g. 1a/b, 2a/b etc., so that they stay in their pairs.

Clamp each pair together and pilot drill the plain plates; open out the holes to 1/8". Round off the corners of all the brackets.

Ream out the bolt holes to 3/16". Assemble one pair to each of the aileron hinges with the bolts, W-0420, provided.

### **STEP 3**

Offer up the aileron to the wing and carefully pass the hinge brackets through the slots cut in the wing trailing edge. Temporarily clamp the W-0410 hinge brackets to the rib webs.

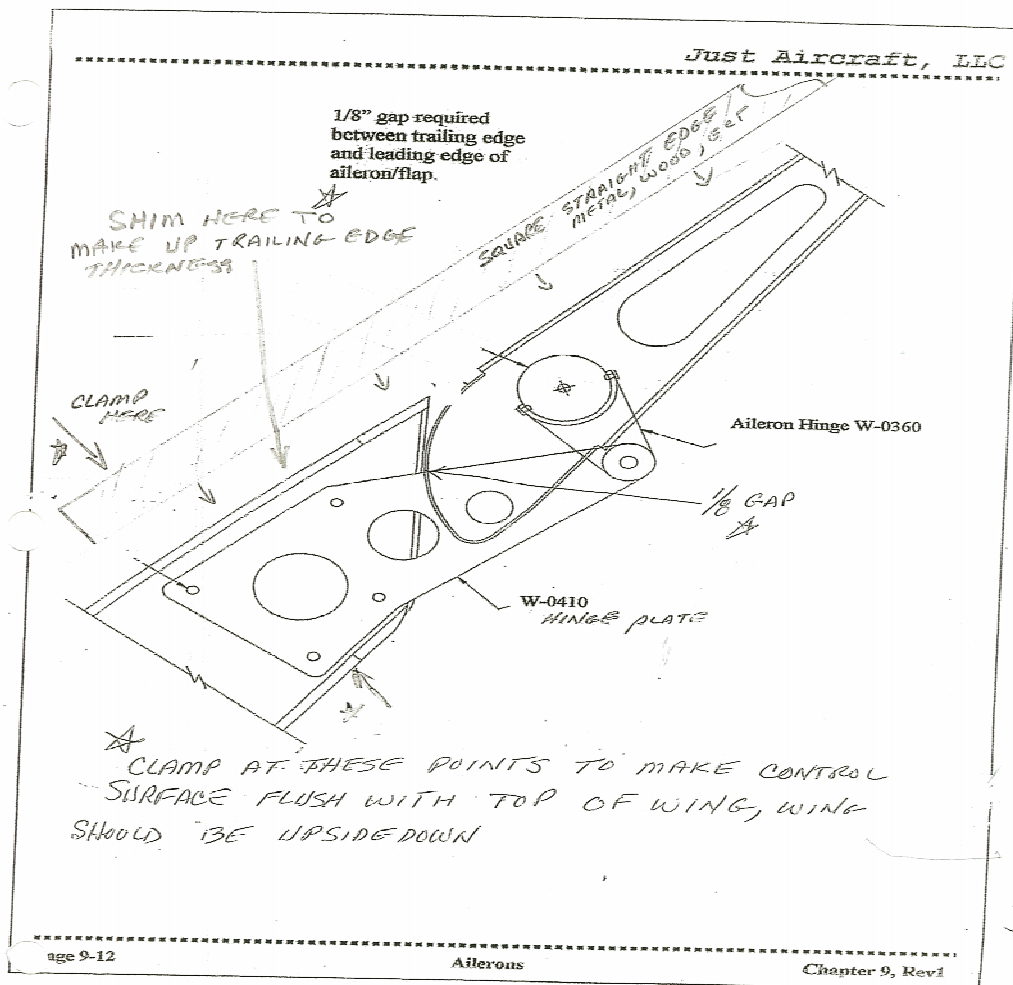
### **STEP 4**

Cut small scraps of 1/8" ply and insert them between the nose of the aileron and the wing trailing edge section. Attach to the aileron with masking tape to aid further adjustments.

Step 5

To set the proper gap and alignment of aileron and flaps, turn wing over. Install straight edge, (metal, wood, etc.) on top of the wing rib just extending far enough to get into rib contour. This aligns the top of the air foil with the ribs.

A slight difference at wing tips is normal (wash out). The length of the aileron and flap should match when in the neutral position



STEP 6

Further adjust the aileron until it aligns correctly with the wing and the 1/8" packing is snug in the gap. Clamp the hinge brackets securely. When the aileron articulates 30 degrees up and 30 degrees down you are ready to drill and rivet the hinge brackets.

**To get an accurate and pleasing alignment, it is better to align the flap and aileron at the same time**

**Step 7**

Carefully drill the rib webs for the hinge brackets. To start, drill one corner hole just into the web, rotate the other plate to one side and continue the drilling right through the web.

Use a Cleco to hold the 2 plates together on either side of the drilled hole re-align the 2 plates holes and re-clamp. With the plates now aligned proceed to drill the remaining 3 holes.

**STEP 8**

Remove the hinge brackets in pairs, abrade mating faces with 240 grit emery cloth and clean as previously described. Mix sufficient epoxy adhesive, apply a generous coat to the mating faces, relocate and re-secure. Finally, rivet with the rivets supplied.

**9.9 PREPARING AILERON FOR COVERING**

**STEP 1**

As for other structures, lightweight filler is used over and to hide the rivets and provide smooth transitions between surfaces, but beware that this adds weight and you will be surprised how easily your aeroplane gains pounds.

**STEP 2**

When all irregularities have been removed all surfaces of the spars and ribs should be covered with two or three coats of two-part polyurethane varnish, making sure that **NO** varnish gets on to any surface that is going to need glueing for fabric.

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