



CHAPTER 10 – FLAPS

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10 FLAPS

Many of the assembly operations for the flaps are identical to those already described for the ailerons. Some reference may be made in this chapter to Chapter 9 – Ailerons, where the appropriate instructions will be found.

10.1 SETTING OUT BUILDING BOARD

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 68 7/8” apart and, using a square, mark perpendicular lines from these marks to the edge of the board.

STEP 3

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

STEP 4

Mark a line 14 1/4” from the initial left hand line. Using a rib place it with the right hand edge on the 14 1/4” mark and draw a line down the left hand side (position of rib 2).

STEP 5

Use the line just drawn and mark a line 14 1/4” 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 68 7/8” mark, position a rib and mark the inner edge (position of rib 6).

STEP 7

Mark a line 14 1/4” from the initial right hand line. Using a rib place it with the left hand edge on the 14 1/4” mark and draw a line down the right hand side (position of rib 5).

Step 8

Use the line just drawn and mark a line 14 1/4” 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 1/8” except the middle bay, which will be slightly smaller (approx 13”).

10.2 PREPARATION OF SPAR

STEP 1

Identify the remaining W-0300 spar tubes from which the aileron spars were previously cut. These tubes will be used at their existing length, but will be trimmed later (nominally 68 7/8” see 10.3)

10.3 FLAP, FIRST STAGE ASSEMBLY

STEP 1

The actual length of the flap can be slightly different from the documented 68 7/8" as the inboard edge of the flap should line up with the wing inboard capstrip edge (rib 1). This discrepancy is caused by the movement of the ribs, so they can hold the fuel tank in position. It is therefore advisable to verify the exact length required first, do this as follows.

With the aileron positioned, put the flap spar tube up to the wing with a 1/4" packing between it and the aileron. Make a mark on the other end of the spar tube in line with the inboard face of the root rib capstrip. At the same time, mark the spar tube with the centreline of rib 4 and 2 webs (approx 16 7/16" and 51 1/4" from the outboard edge)– this is where the hinge centrelines will be located.

The first mark should be approx 68 7/8 " from the end. If necessary, adjust the flap root rib line on the building board. When satisfied cut off the surplus tube with a tube cutter.

STEP 2

Lay the 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 3

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 4

Abrade the tube using 100 grit emery cloth at each of the marked rib positions (approx 1/2" wide bands). Clean each location with acetone or MEK and paper towels as previously described.

STEP 5

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 face of the end rib's capstrip. 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 flap and to bond both at the same time. Obviously if space/time does not permit then each flap can be processed separately, just remember to make a pair and not two the same!

STEP 6

Mix a sufficient quantity of epoxy adhesive (C-0010.1 and .2) and apply a generous fillet to each side of every rib, to bond the ribs to the spar tube. Verify position and squareness of assembly and leave undisturbed until the adhesive has cured (24 hrs).

10.4 INSTALLATION OF THE TRAILING EDGE

The trailing edges are pre-formed light alloy.

STEP 1

Refer to Drawing 9.4 on page 9-5.

The ribs are made to fit inside the trailing edge W-0440 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 will have to be cut to the correct length (approx 68-7/8"), you will have determined this in 10.3, Step 1.

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

Abrade the inside face of the trailing 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 30 (1/8") hole, ¼" back from the trailing edge leading edge and midway between the rib centreline and right hand outer edge of the capstrip. Turn the 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. Fit countersink rivets, W-0330; pull carefully so as not to split the wood of the ribs.

10.5 PREPARATION OF THE HINGES

STEP 1

Identify the 2 flap bellcranks, W-0450, together with the 2 hinges, W-0460, and bronze bushings, W-0470. 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 4 components. Mark out, centre punch and drill 1/16" pilot holes in the centre and at each corner of the W-0460 hinges, ensuring that there is a minimum edge distance of 1/4" for the corner holes. Do the same for the bellcranks (2 x5 holes). Open holes out to 1/8" (No 30).

10.6 INSTALLATION OF HINGE AND BELLCRANK

The hinges will be fitted to the flap spar to align with the centreline of wing rib 4. The bellcrank will similarly be fitted to align with rib 4 centreline (approx 16 7/16" and 51 1/4" from outboard edge of cap strip). All fittings are attached such that the hinge bushing is on the underside of the flap.

STEP 1

Extend the rib 2 and rib 4 alignment marks made at 10.3 Step 1 around the circumference of the spar tube.

STEP 2

Locate the bellcrank, W-0450, and hinge, W-0460, and temporarily attach to the spar tube using hose clamps. Align the centreline of each hinge and bellcrank with the marked lines- the bellcrank is aligned with the rib 2 mark and the plain hinge with the rib 4 mark. *Refer to Drawing 9.4 on page 9-5* and position the centre of the bushing 10" from the rear edge of the trailing edge. Remember the pivot points are on the underside of the flap.

STEP 3

Recheck that both hinge and bellcrank are correctly set by offering the flap up to the wing. Mark the perimeter of each fitting with a fine line felt marker.

STEP 4.

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

STEP 5

Remove hinge 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 6

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

10.7 INSTALLATION OF LEADING EDGE

STEP 1

Leading edge material is made of preformed fiberglass, W-0390. Each length provides one aileron or one flap leading edge. From a piece, square off one end. 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, (as there may be variation in length) 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 hinge 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.

STEP 4

For the false ribs, (W-0400) mark 5/16" either side of the bellcrank centreline (i.e. leaving a 5/8" gap), 5/16" either side of the hinge centreline (i.e. leaving a 5/8" gap) and at the midpoint of the other 3 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 hinge and bellcrank are located.

STEP 7

Apply a generous coating of epoxy to the noses of the main ribs, noting the guidance at 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.

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 fiberglass leading edge. Remove wood not fiberglass! Apply a little lightweight filler as necessary to help the transitions

STEP 9

Remove the fiberglass leading edge material between the rib noses at the hinge and bellcrank points and dress back to the inside faces of the ribs. These cuts extend from the bottom trailing edge of the leading edge to ½” from the trailing edge of the leading edge top surface.

10.8 FITTING FLAP TO WING

STEP 1

Fit the bronze bushings, W-0470, into the 4 pivot points of the flaps. 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-0480 hinge brackets and assemble 2 pairs for the Escapade and 3 pairs for the Highlander located at ribs 1, 3, and 5. One pilot drilled and one un-drilled. Number each plate of each pair eg. 1a/b, 2a/b etc, so they stay in their pairs.

Pass both hinges through slots in trailing edge and clamp (1 hinge drilled, 1 hinge un-drilled).Use deep clamps to clear rib web, when alignment is satisfied drill plates using drill plate as a guide. **Mark both plates as a pair.**

Ream out the bolt holes to 3/16”. Assemble one pair to each of the flap hinges with the bolts, W-0490, provided.

STEP 3

Offer up the flap to the wing and carefully pass the hinges through the slots cut in the wing trailing edge. Temporarily clamp the W-0480 brackets to the rib webs.

STEP 4

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

STEP 5

Further adjust the flap until it aligns correctly with the wing and the 1/8” packing is snug in the gap. Clamp the hinge brackets securely. When the flap articulates 40 degrees down you are ready to drill and rivet the hinge brackets.

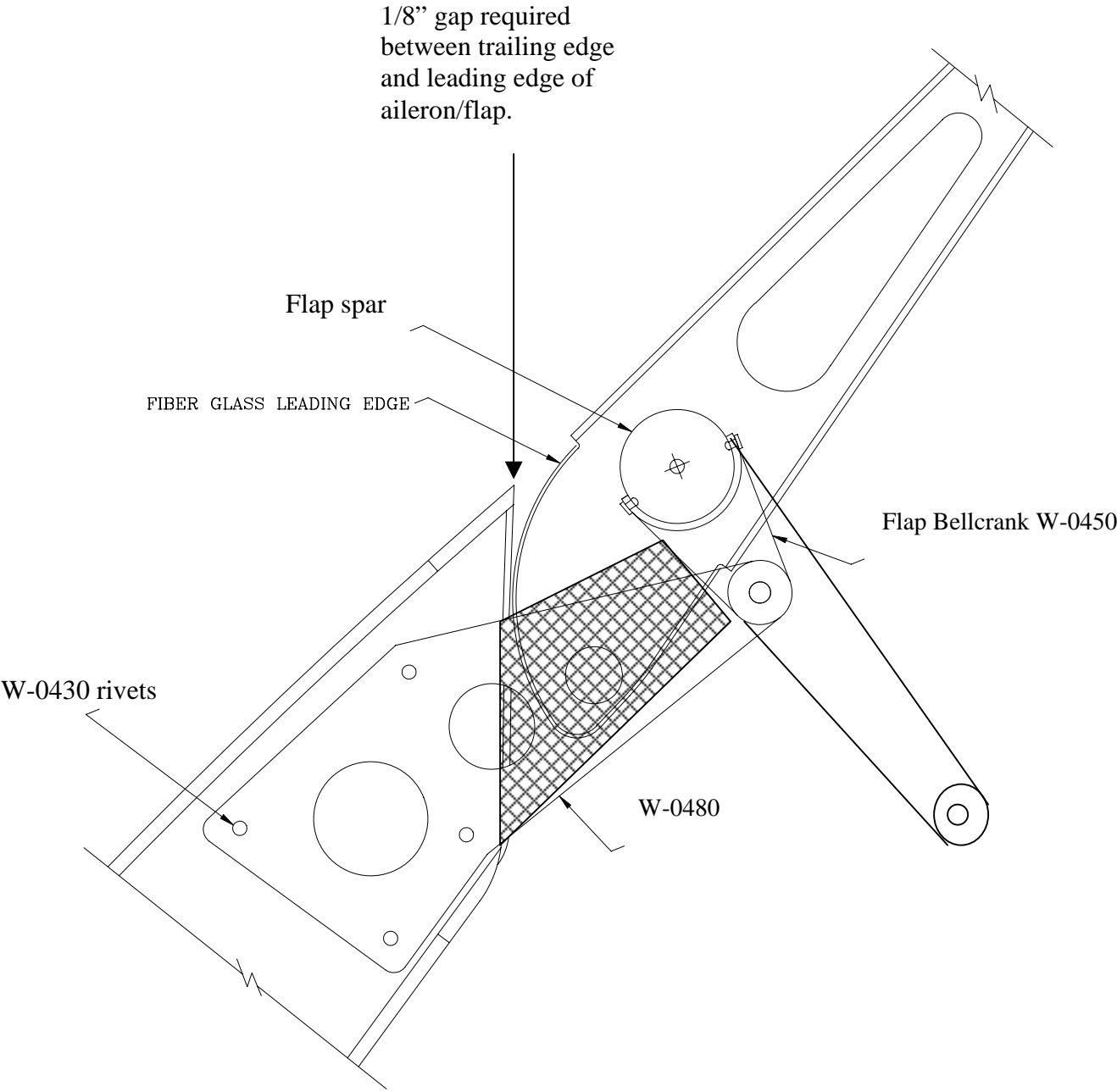
To get an accurate and pleasing alignment, it is better to align the flap and aileron at the same time.

STEP 6

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

STEP 7

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, re-locate and re-secure. Finally, rivet with the W-0430 rivets supplied.



Drawing 10.8: Flap bellcrank

STEP 8

Notice the flap bellcrank has only one horn, not two like the aileron. The neutral position (zero degree) is controlled by a ¼" plywood block which is inserted into the flap to wing attachment bracket of the bellcrank. The hatched area in *Drawing 10.8*. The up-travel of the flap is facilitated by a return spring. This spring, W-0680, attaches to the flap return tab, W-0510 and the W-0690 attach tab that is held in place by the flap pulley bolt. See *figure 10.8.9*

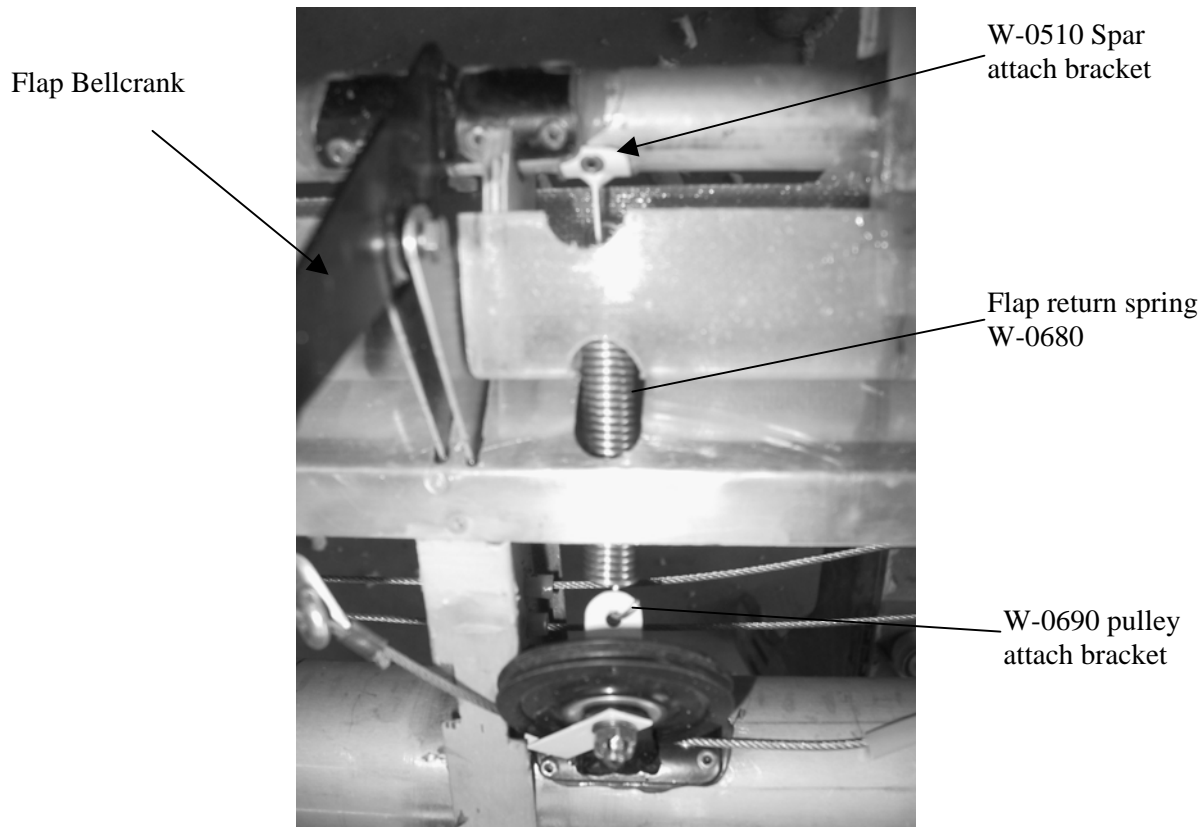


Figure 10.8.9

The bracket, W-0510, is mounted on the flap spar epoxy bonded and riveted in place with rivets, W-0510.1 The other end of the spring will hook onto the flap return tab, W-0690, which is mounted under the head of the flap pulley mounting bolt, AN4-10.

10.9 PREPARING FLAP FOR COVERING

STEP 1

As for other structures, lightweight body filler is used over 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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