

Flaperon Assembly Manual

for
PegaStol Aftermarket Wings



A Senior Project

presented to

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of the Requirements for the Degree

Bachelor of Science

by

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3 EQUIPMENT

In addition to the all of the parts given as part of the kit for the PegaStol wings, several tools will be needed to assemble the flaperons. This equipment includes a drill, #40 and #30 drill bits, a drill stop, de-burring tools, primer, ruler and marker, size A4 pull rivets, a rivet gun, #40 and #30 sized cleco clamps and pliers, and a grinder. Additional equipment used include: wood scraps, screws, and additional clamps. This additional equipment is used primarily for means of creating fixtures to hold the flaperons during the assembly process. The main tools and equipment necessary for the assembly of the flaperons can be seen in Fig. 1.



Figure 1: Tools and Equipment Required

4 FLAP ASSEMBLY

Once all the equipment is gathered, the assembly process can begin. The first step in the assembly of the flaps is to assemble the ribs and brackets with the spar. Then the rear skin and nose skin can be fitted and then the flap can be completed when the end plates are put on. The parts and layout of the flaps can be seen in Table 1 and Fig. 2 respectively.

P/N	Name	Qty.
C-102	Flap Nose Rib	7R
C-105	Flap Rear Rib	7R
C-108	Flap Nose End Rib	1R/1L
C-106	Flap Rear End rib	1R/1L
C-301	Flap Spar	1
C-202	Hinge Pivot Bracket	2
C-501	Control Horn	1
C-502	Flaperon Splice Plate	1
C-601	Flap Nose Skin	1
C-602	Flap Rear Skin	1

Table 1: Flap Parts

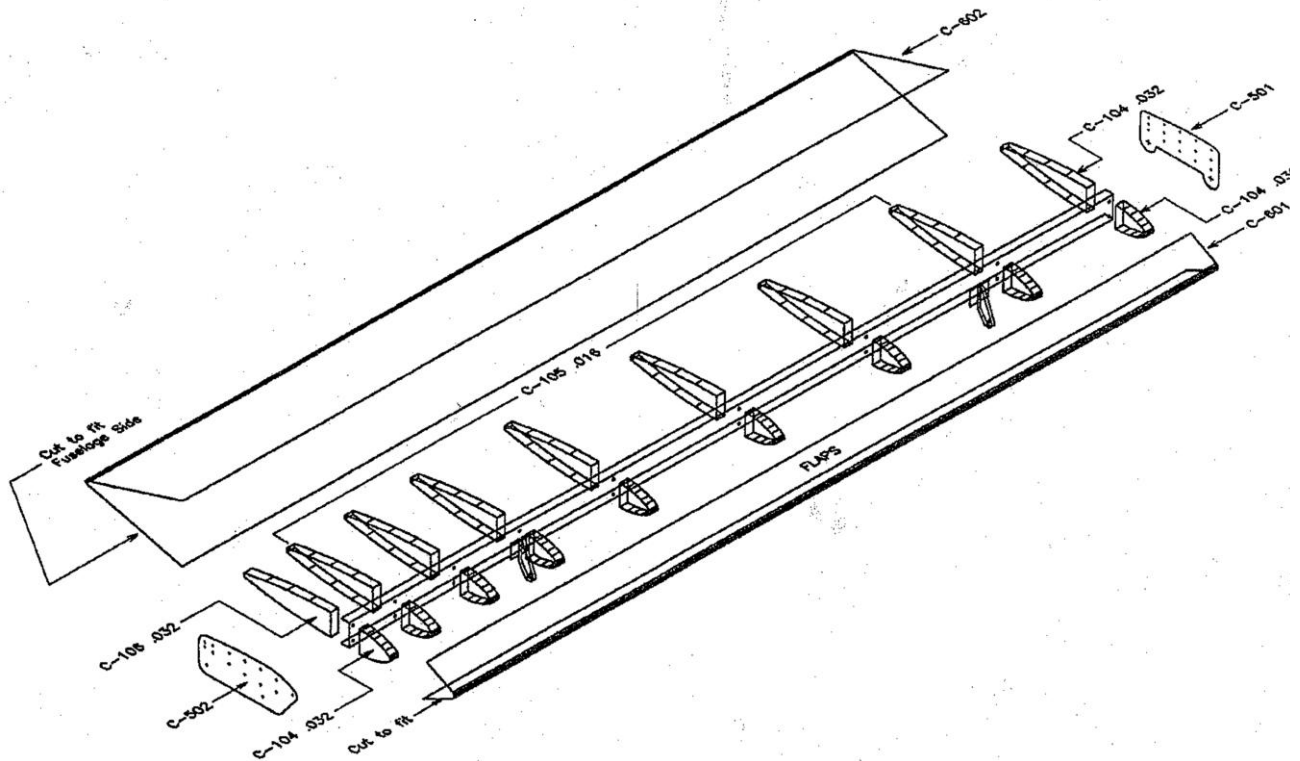


Figure 2: Flap Parts Layout

4.1 RIB ASSEMBLY

In beginning the rib assembly, there are several key things to keep straight. First thing to note is that the rear ribs go into the channel of the spar while the nose ribs are placed on the flat side of the spar; this can be seen in Fig. 3. It is also important to note that there are two ribs

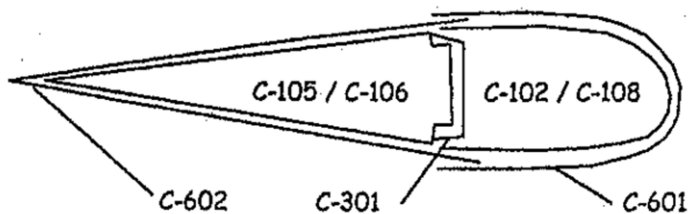


Figure 3: Flap Rib Attachments to Spar

that are twice as thick as the normal rib (0.032" rather than 0.016"). These thicker ribs are the end ribs. Finally, all ribs face in the same direction except for the final inboard rib which faces inward as seen in Fig. 2.

To assemble the ribs, draw a centerline along the end of all the ribs. Line up the centerline on the end of the rear ribs with the holes on the spar. Drill through the rear rib and spar using the #40 drill bit. Be sure to cleco clamp after each hole is drilled. This will ensure that the holes will remain aligned. After all rear ribs are drilled out we will drill out the nose ribs. In order to do so the cleco clamps will need to be removed. Then align the centerline of the nose ribs with the holes in the spar and rear ribs and again drill through using the #40 drill bit. Again, remember to cleco clamp after each hole is drilled. While attaching the ribs, it is also good to drill out the brackets. Align the bracket holes with the holes in the spar and drill out to size #40. Make sure that the bracket is going up and not down. These steps completed can be seen in Fig. 4.



Figure 4: Ribs and Brackets Drilled Out to #40 Attached to Flap Spar

The next steps in the process to assemble the flaps are to drill all of these holes out to the next size up, using the #30 drill bit. One by one remove the cleco clamps, drill out to the next size, and then replace the cleco clamp with the correctly sized cleco. Next, remove all of the cleco clamps and begin de-burring. Every hole is to be de-burred on both sides to allow for a

clean rivet. After de-burring, spray primer at every hole where the ribs and spar or bracket and spar come into contact. Leave the primer to dry for a few minutes. When the primer has dried enough re-cleco clamp all of the ribs and brackets to the spar. Finally the ribs are ready to rivet to the spar. Set up the rivet gun and

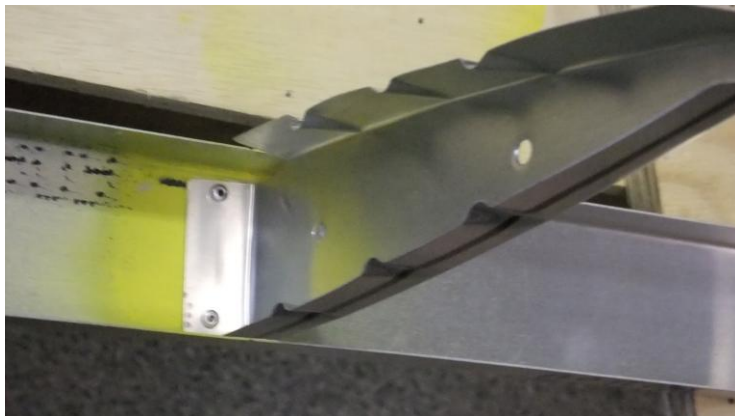


Figure 5: Riveted Flap Ribs

one by one take out the cleco clamp and rivet the ribs to the spar. Make sure that prior to pulling the rivet it is pushed all the way through the rear rib, spar, and nose rib. Fig. 5 shows the pulled rivet going through the rear rib to the spar and out the nose rib. At this point, the internal structure of the flap is completed and the skins can now be applied to the structure.

4.2 SKIN ASSEMBLY

Before starting any drilling on the skins, use the ruler and marker to draw centerlines on the top and bottom along the rear ribs and nose ribs. The centerline can be seen on the bottom of the rear rib in Fig. 5. It is also important at this point to create some sort of fixture on your work table to ensure that the flap remains flat and does not bend while you work on it.

Starting with the rear skin, place the skin over the rear ribs. Starting on the outboard side, line up the holes in the rear skin with the centerline on each rib, drill to #40, and cleco clamp each hole. The centerline is vital to ensure that none of the rivets done later will puncture through the edge of one of the ribs. It is rather difficult to line up the centerline with the holes in the skin and it will require adjustments to be made by reaching underneath the skin to bend the rib into the correct position. Remember to start from one side and finish at the other, starting at the outboard side and working towards the inboard side. This ensures that the skin is tight to the ribs and bubbling of the skin doesn't occur. It is helpful to not drill into the inboard end rib yet as the skin needs to be trimmed to fit the fuselage shape. After one side of the skin has been clamped to the ribs, flip the flap over and repeat the process again starting from the

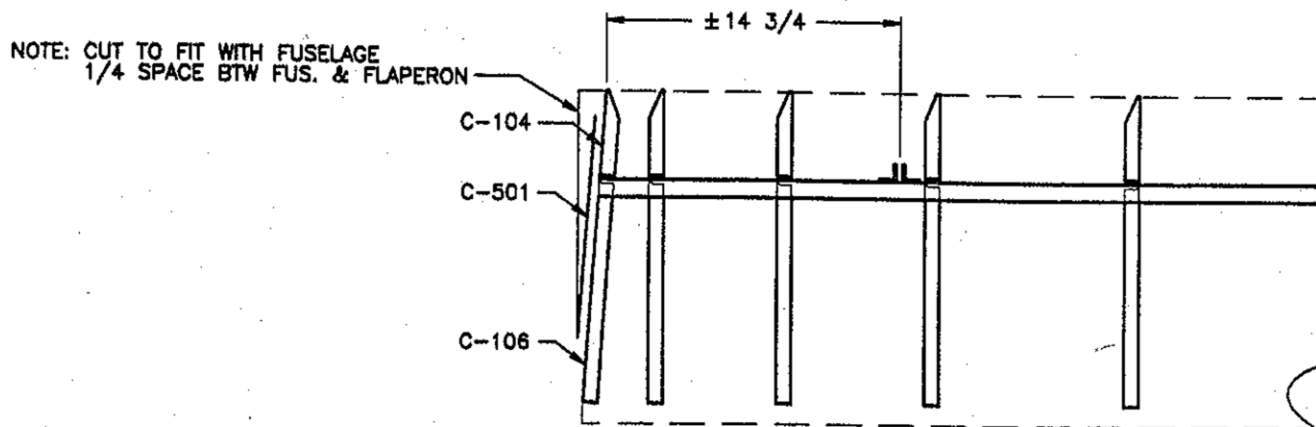


Figure 6: Inboard Side Flap Layout

outboard side and working towards the inboard side. As shown in Fig. 6, the inboard profile of

the flap needs to be trimmed to an angle where the edge of the nose rib is $14\frac{3}{4}$ " from the center of the closest bracket. This ensures a $\frac{1}{4}$ " space between the fuselage and the flaperon.

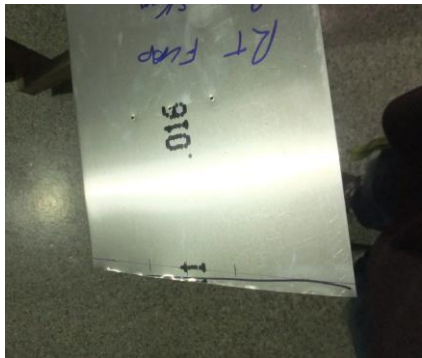


Figure 7: Rear Skin Inboard Angle

In order to do the trimming, after the skin has been fitted to all the ribs except the end rib, draw a line along this angle on the skin. It is easiest to use a trimmer to then cut the end of the skin off but leave room to use a bench grinder to make the actual angle. After the skin has been

trimmed with the trimmers, remove all the cleco clamps and use the grinder to trim the skin to the line. The final angle cut on the skin can be seen in Fig. 7. After the angle has been cut, re-clamp the skin to the ribs and now can drill out the end rib, bending it to ensure a flush end between the skin and the end rib.

Now that the skin has been clamped to the ribs and the inboard side has been trimmed, the holes can now be drilled up to the next size, #30. One by one and working from outboard to inboard, remove the cleco clamps, drill out to the next size, and replace the cleco clamps. This completes the drilling and now the rear skin can be removed from the ribs and de-burred. Using the de-burring tools, de-burr each hole on the skins and the rear ribs as seen in Fig. 8. After each hole has been de-burred,



Figure 8: De-burring Rear Skin

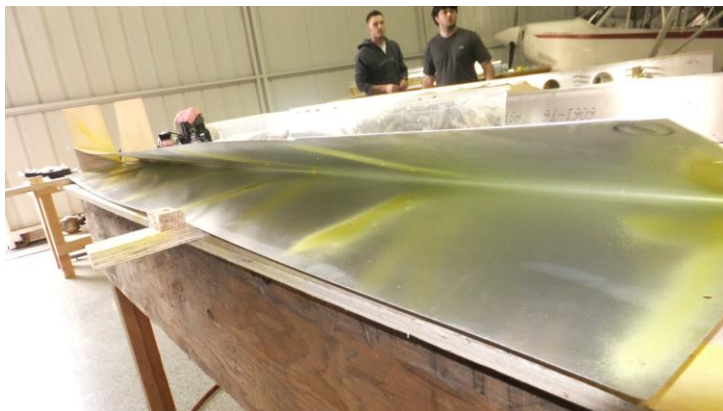


Figure 9: Inside of Rear Skin Primed

spray each rib with primer as well as the inside of the skin as seen in Fig. 9.

After all holes have been primed, refit the rear skin to the rear ribs on the flap using the cleco clamps. Again, this may be difficult as it will require reaching underneath the skin to bend the ribs to align the holes. After being refit, go from the outboard side to the inboard side, once again removing the cleco clamps and riveting the skin to the ribs using A4 rivets. The riveted rear skin, as well as the fixture used to ensure no bending in the flap, can be seen in Fig. 10.

The next step is to attach the nose skin. The assembly of the nose skin is very similar to the rear skin. Again working from outboard to inboard, line up the centerline on the nose rib

with the hole in the skin, drill out to #40, and cleco clamp. Also make sure that the bracket fits through the bracket holes. If it does not fit, the hole may need to be widened using a file. Again before drilling out the end rib on the inboard side, draw a line to finish the angle as seen above in



Figure 10: Riveted Rear Skin

Fig. 7. Fig. 11 shows how much of the nose skin needs to be trimmed. After drawing the angled line, cut most of the material off using trimmers and again use the grinder to cut the rest of the skin off until the skin is flush with the rib at the correct angle. After the angle is trimmed go ahead and drill out the end rib. After all these holes are drilled out to #40, go through and drill out to #30 the same way the rear skin was done. After it is drilled out to the correct size, remove all cleco clamps and de-burr. Prime all areas of contact between the nose skin and the ribs and then rivet the skin to the ribs using A4 pull rivets.



Figure 11: Nose Skin Untrimmed

The most important part in the skin assembly is to ensure that while working on it, the structure isn't bending. This means it is important to create a fixture that will secure the flap to the table so that adequate pressure can be applied while it is being assembled. In addition, working from outboard to inboard is vital to ensure the skin doesn't bubble between riveting points. Repeat this process for the second flap. With both flaps being complete, the ailerons can now be assembled.

5 AILERON ASSEMBLY

The aileron assembly is very similar to the flaps and in some areas easier. First the internal structures, the ribs and spars, will be assembled, and then the skins will be fitted. The parts required for the ailerons are listed in Table 2 and the layout of the ailerons can be seen in Fig. 12.

P/N	Name	Qty.
C-101	Aileron Nose Rib	6R
C-104	Aileron Nose End Rib	1L
C-201	Aileron Spar	1
C-202	Hinge Pivot Bracket	2
C-502	Flaperon Splice Plate	2
C-611	Aileron Nose Skin	1R
C-612	Aileron Rear Skin	1
C-103	Aileron Rear End Rib	1L
C-107	Aileron Rear Rib	6R

Table 2: Aileron Parts

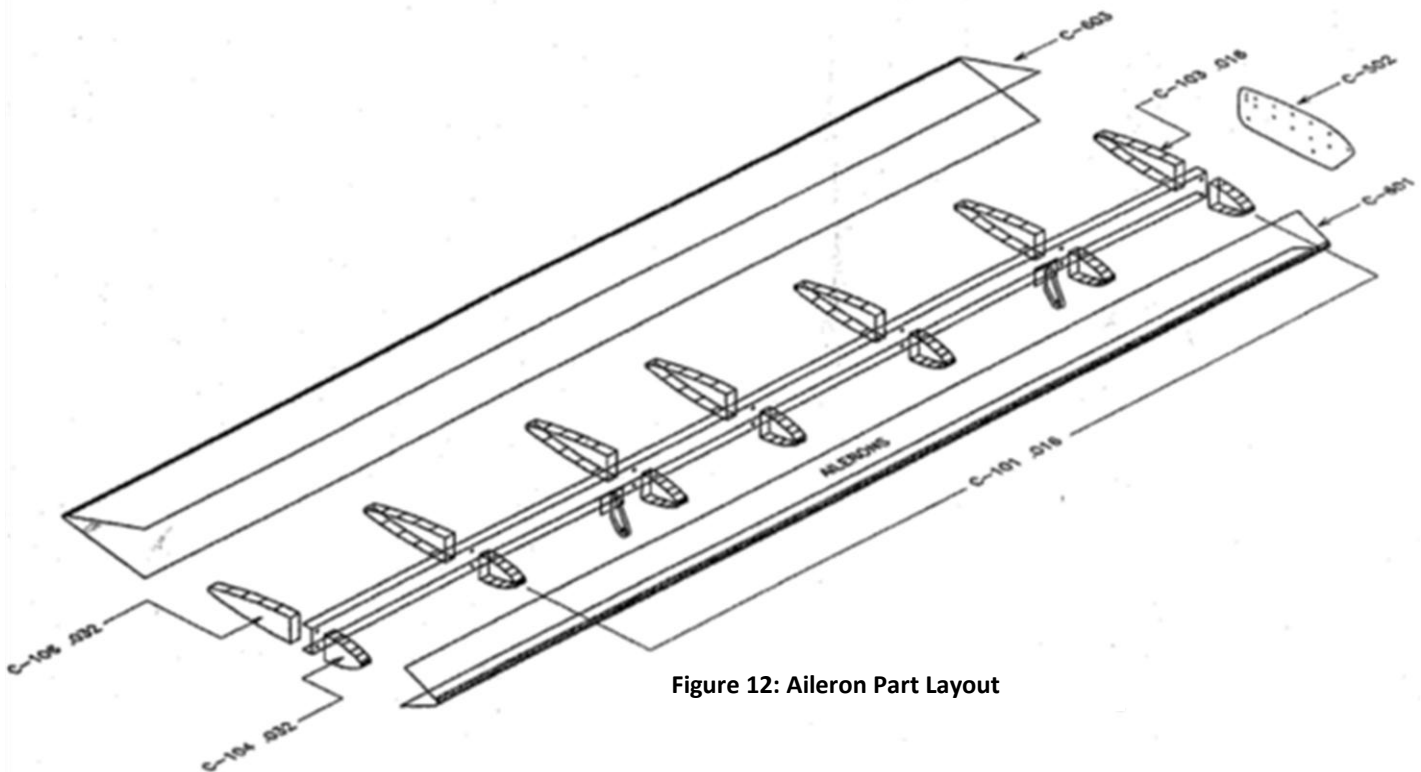


Figure 12: Aileron Part Layout

5.1 RIB ASSEMBLY

The rib assembly for the ailerons is essentially the same as the assembly for the flaps. The rear ribs will fit into the channel of the spar while the nose ribs will fit against the flat side of the spar as seen in Fig. 13.

Before beginning to drill, measure and draw a line down the center of the ends of the rear ribs and nose ribs. Starting with the rear ribs, align the centerline with the holes in the spar, drill out to size #40, and cleco clamp the rear rib into place. Do this for all rear

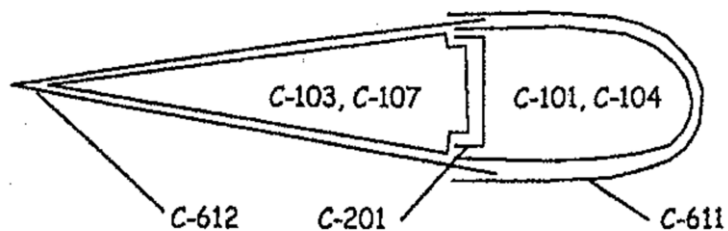


Figure 13: Aileron Rib Attachments to Spar

ribs but be sure that the end ribs are located on the ends of the ailerons. Like the flaps, all ribs should be facing the same direction except the inboard end should be facing inward. After all the rear ribs have been drilled out to size #40, remove all cleco clamps and do the same for the

nose ribs. After the nose ribs have been drilled out cleco clamp both ribs into place as seen in Fig. 14. Then one by one drill through the nose rib, spar, and rear rib with the #30 drill bit and re-clamp.



Figure 14: Ribs Clamped to Spar

At this point, remove all cleco clamps from the ribs and de-burr all holes. Next, spray primer on all holes and points of contact between the spar and the ribs.

After the primer has dried, rivet the ribs to the spar using A4 rivets. Be sure that in this step, the rivet passes through the rear rib, the spar, and the nose rib. With the internal structure of the aileron complete, the skin assembly can now be started.

5.2 SKIN ASSEMBLY

The skins of the ailerons are assembled the same way as the flap skins were with the exception of one step. The skins do not need to be trimmed on the ailerons. To start out, draw the centerlines on the top and bottom of all the ribs. Again, start from one side of the aileron and work towards the other end. Starting with the rear skin, line up the holes with the centerlines on the ribs; drill out to #40, and cleco clamp to ensure that the skin is flat. The clamped rear skin can be seen in Fig. 15. Try to get the ends skin to be flush with the end ribs on the aileron.



Figure 15: Clamped Aileron Rear Skin

After the initial skin fitting, one by one drill out the holes up to the next size, #30 and re clamp using the clecos. Remember that during this skin fitting it is important to have a fixture to keep the aileron flat to prevent any bend. After the drilling is complete remove all the clamps and de-burr all the holes. After de-burring, prime all the holes and re-clamp. Rivet using A4 pull rivets.

Repeat this same process for the nose skin; drill out to #40 and clamp, drill up to #30 and clamp, de-burr, prime, and then rivet. At this point, one aileron is complete, repeat the process for the other aileron. With both ailerons completed, the flaps and ailerons can be assembled together to become flaperons.

6 FLAPERON ASSEMBLY

Now with flaps and ailerons assembled, the control horns and the splice plates can be added in order to assemble the flaperons. In addition to the equipment listed above a countersinking drill is also used to assemble these parts

6.1 SPLICE PLATE ASSEMBLY

The splice plates are what join the flaps to the ailerons so there will be one plate on the inboard side of the aileron and one on the outboard side of the flap for each flaperon. The layout of the splice plate on both the flaps (left) and the ailerons (right) can be seen in Fig. 16.

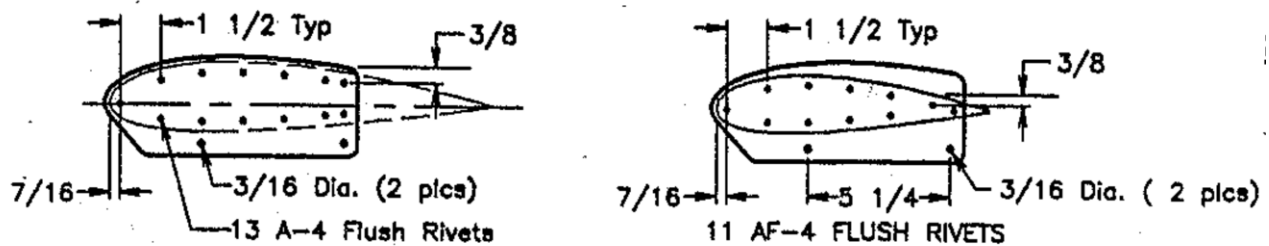


Figure 16: Splice Plate Assembly

Line the splice plates up as shown in the figure. Then drill the holes out to size #40 and cleco clamp. Then drill out to the next size, #30. After the holes have been drilled, use a counter sink drill to slightly countersink each hole on the splice plate. Switch the head on the rivet gun to a flat tip and rivet to the flap or aileron with A4 rivets. When both splice plates have been assembled, drill out the two holes on the bottom of each splice plate to the required 3/16" diameter and then bolt together using the AN-3-4A Bolt, AN960-10 Washer, and AN465-1032A Stop Nut. Now the flaperon is complete but the control horn must be added to the inboard side of the flaperons.

6.2 CONTROL HORN ASSEMBLY

Before adding the control horn to the flaperons the hinge pivot point must be drilled out to 5/16" as seen in Fig. 17. The alignment of the control horn and the flaperon can be seen in Fig. 18. After aligning the control horn it is attached to the flaperon using SS5 rivets.

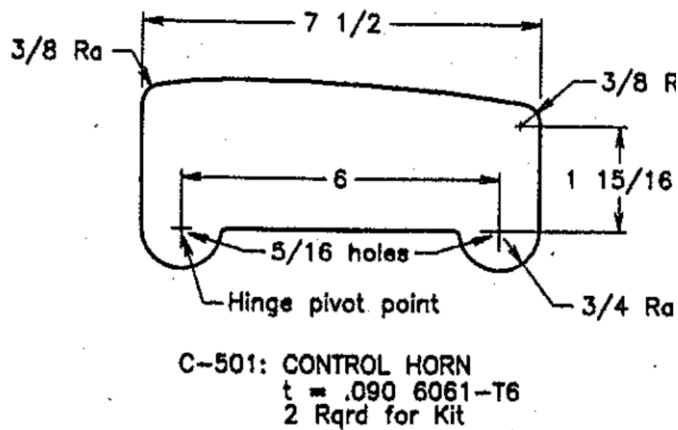


Figure 17: Flaperon Control Horn

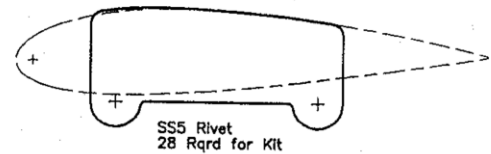


Figure 18: Control Horn Alignment

7 WING INTEGRATION

At this point the flaperons are complete and they are ready to be integrated onto the aircraft. Each flaperon has five connection points to the aircraft. Four of the connection points are connecting bracket to bracket as seen in Fig. 19 and the fifth is connecting the control horn. The bracket to bracket connection is a simple pin, but the control horn is a bit more complicated. The control horn setup can be seen in Fig. 20.

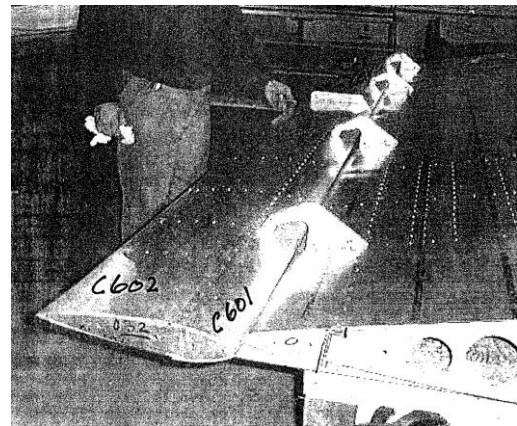


Figure 19: Bracket Connections

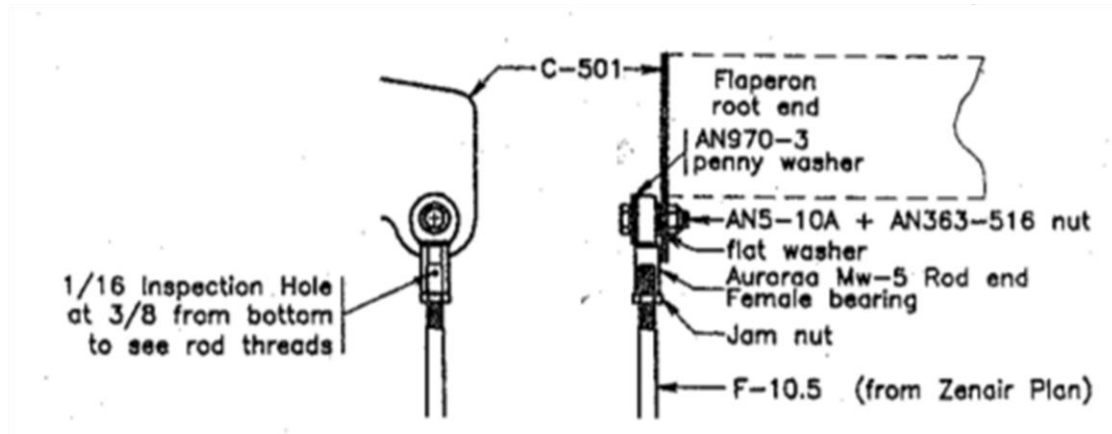


Figure 20: Control Horn Connection

The flaperons are now built and integrated into the wing. At this point it would be a good idea to check the connections of the flaperons to ensure it has the proper movement it would need in flight. The deflections the flaperons should be capable of can be seen in Fig. 21. If the flaperons are working correctly then they are complete.

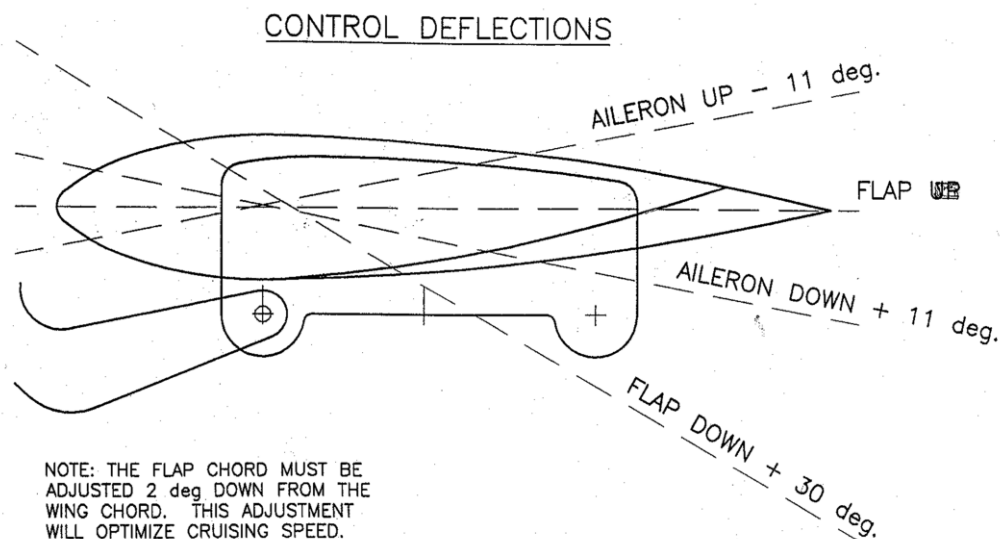


Figure 21: Flaperon Deflections

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