

## Wing Assembly

To assemble the wings you will require the following tools:

- 1) Variable Speed Hand Drill
- 2) a) Standard Drills - "F", #40, #30, #11, 5/32", 7/32", 1/4", 9/32", 5/16", 11/32", 3/8", and 1/2" b) 12" Long Drills - #40, #30, #11
- 3) Reamers - 1/4", 5/16", 3/8"
- 4) Quantity of 3/32", 1/8" and 3/16" clecos
- 5) Cleco Pliers
- 6) Deburring tools
- 7) Felt Marker
- 8) Riveter
- 9) Aviation Snips
- 10) Tape Measure
- 11) 36" or 48" Level
- 12) Hacksaw, 2 1/4" and 2 1/2" Hole Saws or Jigsaw
- 13) Flat and 1/4" Round Files
- 14) Two of each - 3/8", 7/16", 1/2", 9/16" Wrenches

Assembly of the wings is very similar for both the left and right side. This procedure is written for the right side. For the left side simply turn over your parts. However, it is noted where some right and left procedures differ.

**8.1 Spar Caps**

- 1) From the four Main Spar Caps (W-138) supplied, cut two Spar Caps 43" long (W-138), two Spar Caps 24" long (W-137), and two Spar Caps 13" long (W-163). One of each will be used on each wing.
- 2) On one of the 24" Spar Caps (W-137) drill #30 holes 9/32" from each end. Figure 8.1.1.
- 3) Between these holes drill 10 equally spaced #30 holes for a total of 12 holes. Figure 8.1.1.

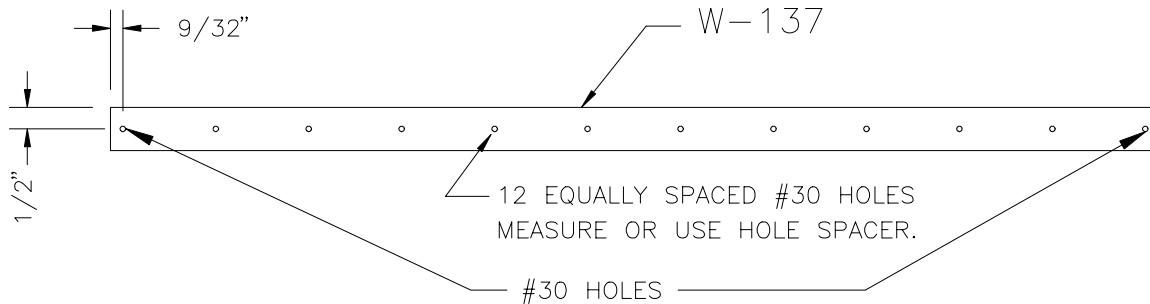


Figure 8.1.1

- 4) Clamp a drilled 24" Spar Cap (W-137) to the center of a 43" long Spar Cap (W-138). Figure 8.1.2.

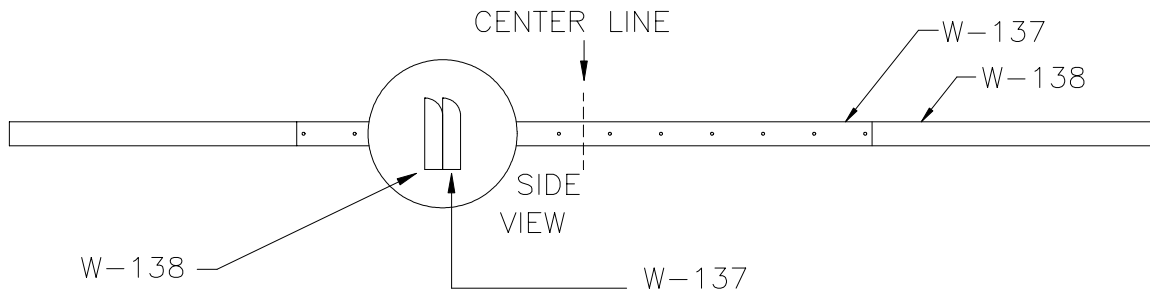


Figure 8.1.2

- 5) Using the holes in the W-137 as a drill guide, center and drill twelve #30 holes in W-138.
- 6) Drill #30 holes 9/32" from each end of W-138. Figure 8.1.3.
- 7) Drill five equally spaced holes in the remaining undrilled portion of each end of W-138. Figure 8.1.3.

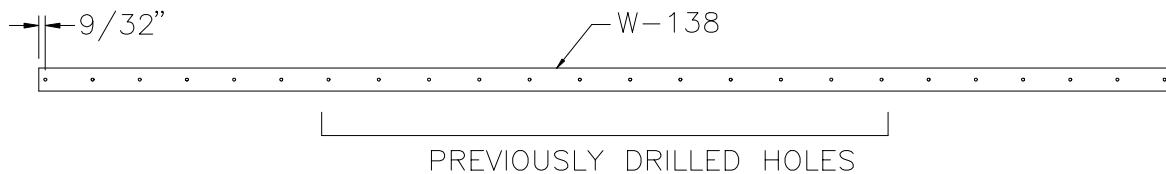


Figure 8.1.3

- 8) The ends of both Spar Caps (W-137 and W-138) may be sanded to reduce weight if desired. Figure 8.1.4.  
 (weight saving/aircraft = .18 lbs.)

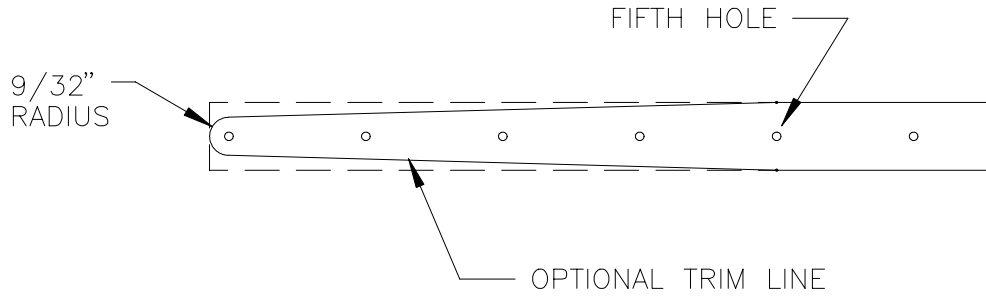


Figure 8.1.4

- 9) Clamp a Spar Cap, (W-138) securely to the Main Spar (W-112) as in Figure 8.1.5.

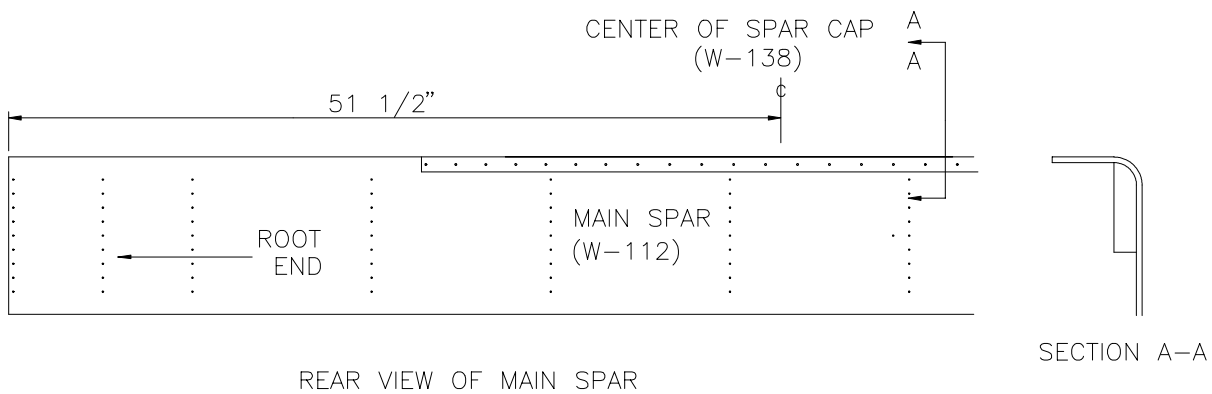


Figure 8.1.5

- 10) Using the holes in the spar cap as a guide, drill #30 holes in the spar.

- 11) Cleco W-137 and W-138 to the Main Spar. Figure 8.1.6.

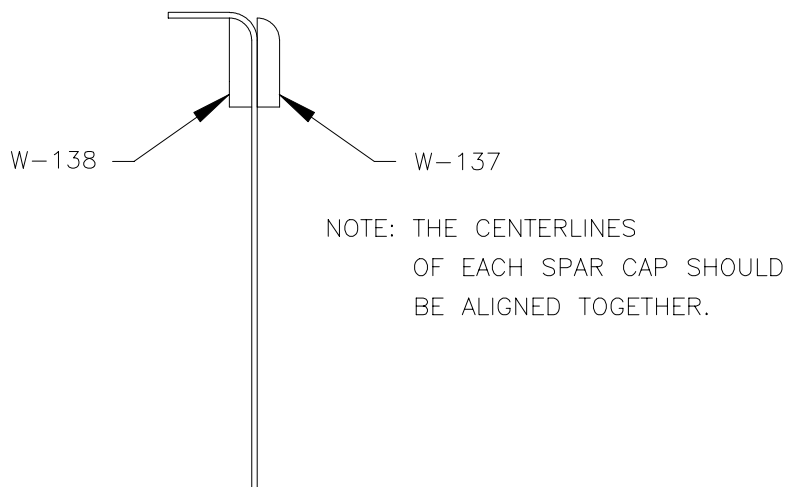


Figure 8.1.6

- 12) Drill out all #30 spar cap holes to 3/16" (#11).

- 13) Disassemble and debur.

14) Proseal, (see note below) mating surfaces and bolt together with twelve AN3-10A bolts and twelve AN3-6A bolts plus appropriate AN960-10 washers and AN365-1032 nuts.

**IMPORTANT:** Prepare the mating surfaces and apply Proseal between the (W-138) spar cap and Main Spar web to past the fourth rib location at the inboard end. Insert bolts “wet”. Mix just enough Proseal for the application you are doing now. If you are installing Extended Fuel tanks apply proseal to past the fifth rib location.

## 8.2 Main Spar Doubler

1) Clamp the Main Spar to the table edge. Figure 8.2.1.

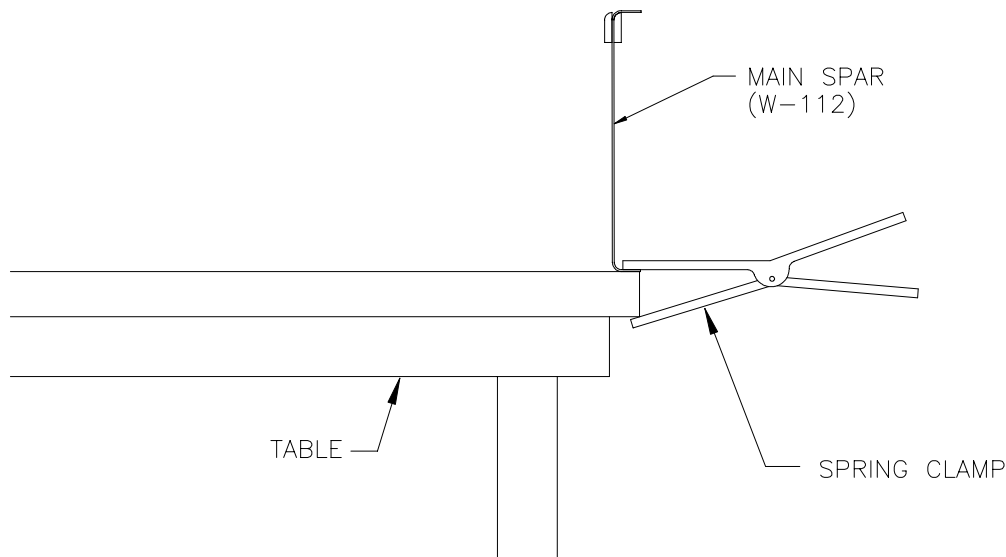


Figure 8.2.1

2) Position and cleco the Main Spar Doubler (W-603) on the front side of the Spar using the pre-punched hole in the Main Spar Doubler and the hole in the spar. Making sure the bottom edge of the Main Spar Doubler is parallel to the bottom web of the Main Spar. Drill the bottom hole to #11, cleco and drill the other two holes to #11. See Figure 8.2.2.

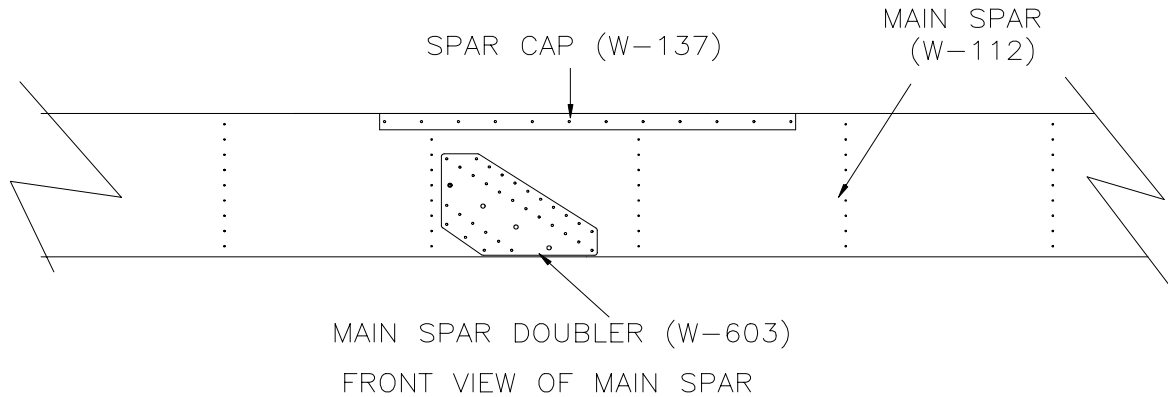


Figure 8.2.2

3) Using the Main Spar Doubler as a drill guide, drill out the holes in the Main Spar to #40.

4) Drill all the holes in the Main Spar and Main Spar Doubler to #30, cleco as you drill.

5) Cleco the Main Spar (W-112), Main Spar Doubler (W-603), Long Wing Strut Fitting (W-616) and Short Wing Strut Fitting (W-617) together. Figure 8.2.3.

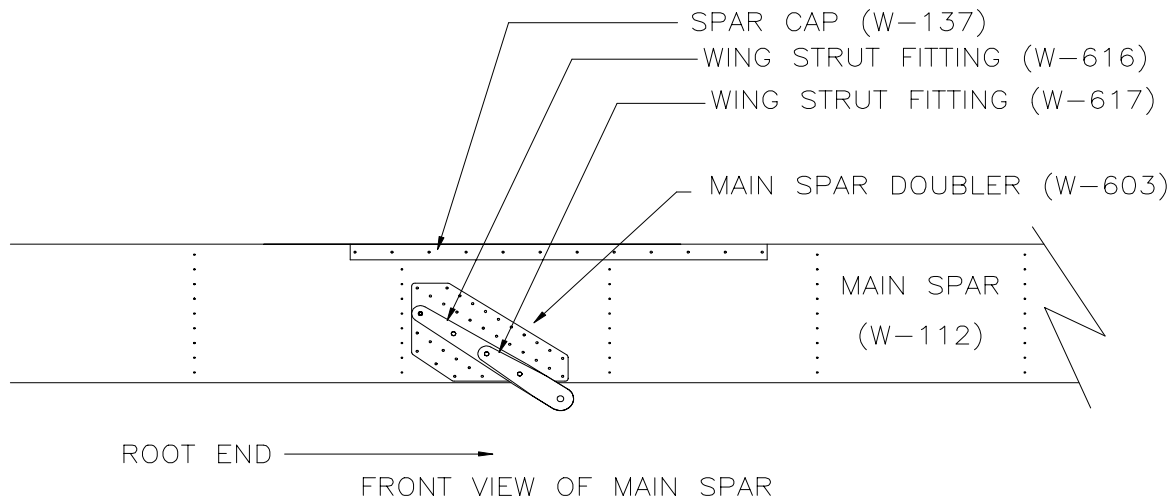


Figure 8.2.3

6) Drill out the four wing-strut fitting attach holes to 7/32" and then ream out to 1/4". Disassemble and debur.

7) Countersink and debur the bottom five holes in the rear face of the Main Spar web. This is done in order to accommodate the bottom Spar Cap which will be installed over these rivet heads later. You will use 1/8" CS rivets (RV-4412) in these five holes. These are inserted from the backside of the Spar. Chromate the mating surfaces of the Main Spar (W-112) and Main Spar Doubler (W-603) and rivet in place with 1/8" avex rivets (RV-1410). Do not bolt the Wing Strut Fittings in place at this time. Figure 8.2.4.

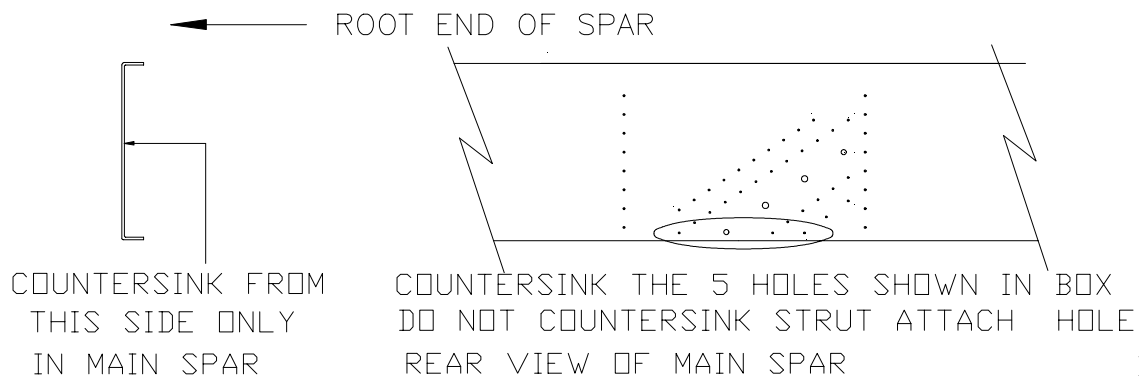


Figure 8.2.4

### 8.3 Rib Install

- 1) Lay out the thirteen Leading Edge Ribs (W-120) and one Leading Edge Root Rib (W-172) in front of the spar. Ensure the Root Rib is at the #1 position.
- 2) With a felt pen, label the ribs and their locations on the Spar from 1 to 13, (# 1 being the root rib). **NOTE:** There is a #1 and #1A Leading Edge Rib. For rib locations see Figure 8.3.3.
- 3) On each rib draw a line down the center of all the rivet flanges.
- 4) Cut out the rear top corner of the #5 and #6 ribs that come in contact with the 24" Spar Cap (W-137). Figure 8.3.1.

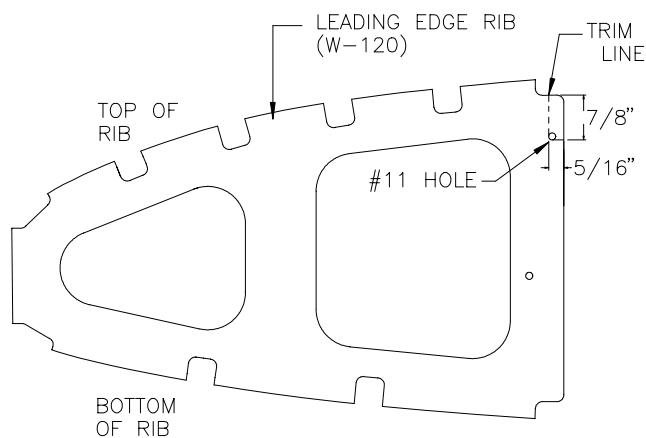


Figure 8.3.1

- 5) Place the Leading Edge Root Rib (W-172) in front of the Spar. Figure 8.3.2.

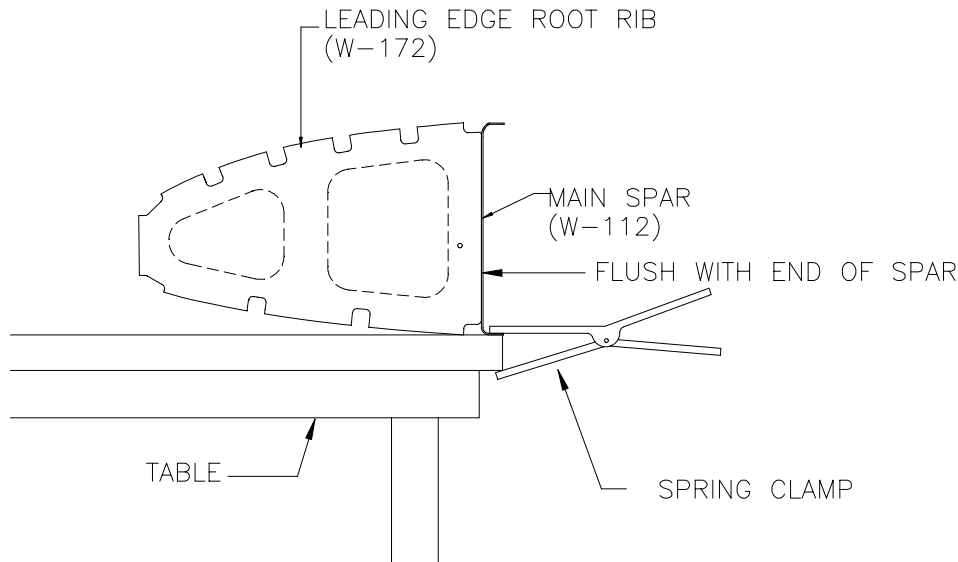


Figure 8.3.2

6) When you can see the line on the rib flange through the center of the prepunched holes in the spar, drill through the top hole with a #40 drill. Cleco, then drill the bottom hole and again cleco. Drill remaining holes in the rib. Do not drill out to #30 at this time. **NOTE:** Be sure that the Spar and Leading Edge Root Rib are both flush at the top and bottom. You can do this by clamping a small strip of .020 along the rib flange and on the top of the spar. You can do this for the other ribs as well.

7) Repeat steps until all Leading Edge Ribs are drilled.

**NOTE:** All Leading Edge and Main Ribs for both Wings are the same. There are no right and left ribs. Therefore, the rib flanges will point inboard in the LH wing and outboard in the RH wing.

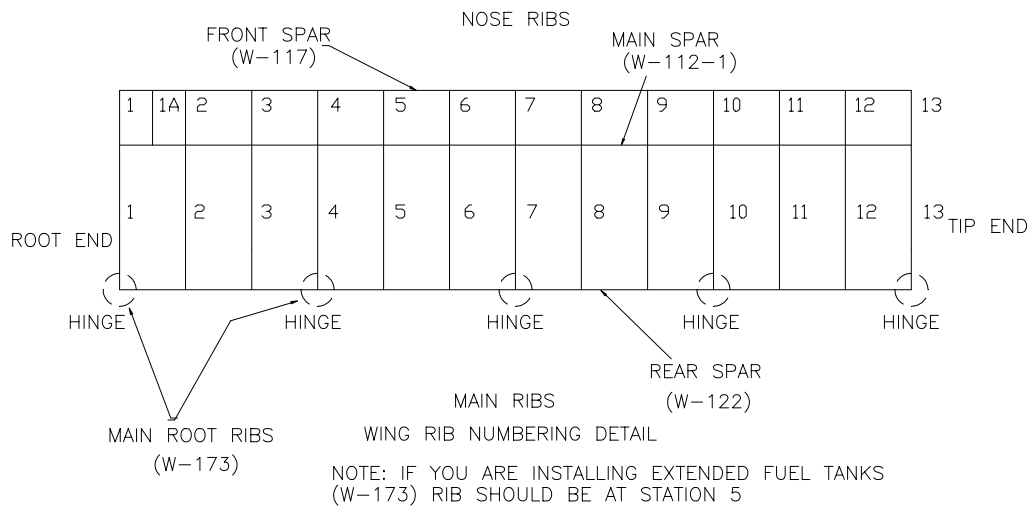


Figure 8.3.3

8) Remove the Leading Edge Ribs and unclamp the Spar from the table.

- 9) Turn the Spar around and lay out the eleven Main Ribs (W-121) and two Main Root Ribs (W-173). **NOTE:** Both wings require the fitting of a Main Root Rib (W-173) in the “#4” location. (If the Extended Fuel Tanks are to be installed, the solid rib will be put into the #5 location.)
- 10) Label and mark the Main Ribs as you did for the Leading Edge Ribs.
- 11) Position a rib on the spar and when the line is visible through the center of the prepunched holes in the spar drill and cleco as you did with the Leading Edge Ribs, starting at the #1 rib location.
- 12) Repeat for all thirteen ribs. Ribs #4,5,6 and 7 will interfere with the 43” Spar Cap (W-138) and will have to be trimmed as in Figure 8.3.4.

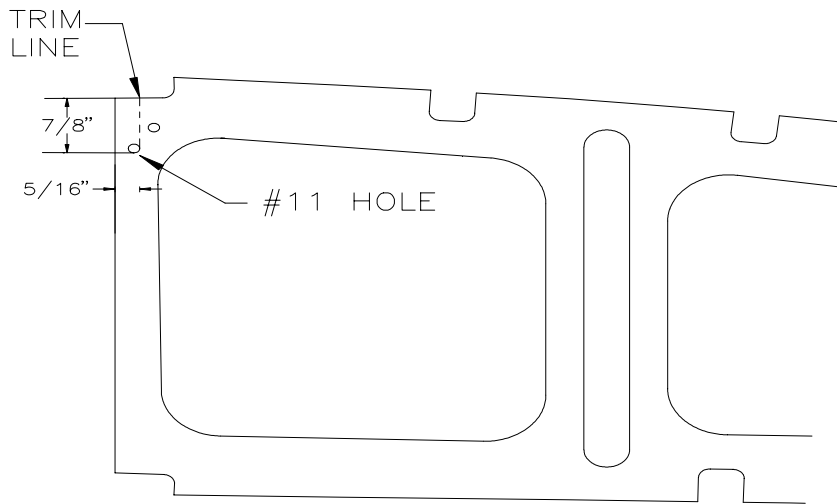


Figure 8.3.4

- 13) Cleco the Leading Edge Ribs, Main Spar and Main Ribs together and drill out all #40 holes to #30 holes. It helps to use an extra long #30 drill bit. Disassemble and debur.
- 14) Clamp a 13” Spar Cap (W-163) to the Main Spar lower web so it is centered between the #5 and #6 rib rivet holes. Ensure the radius on the Spar Cap nests into the spar flange radius. Figure 8.3.5.

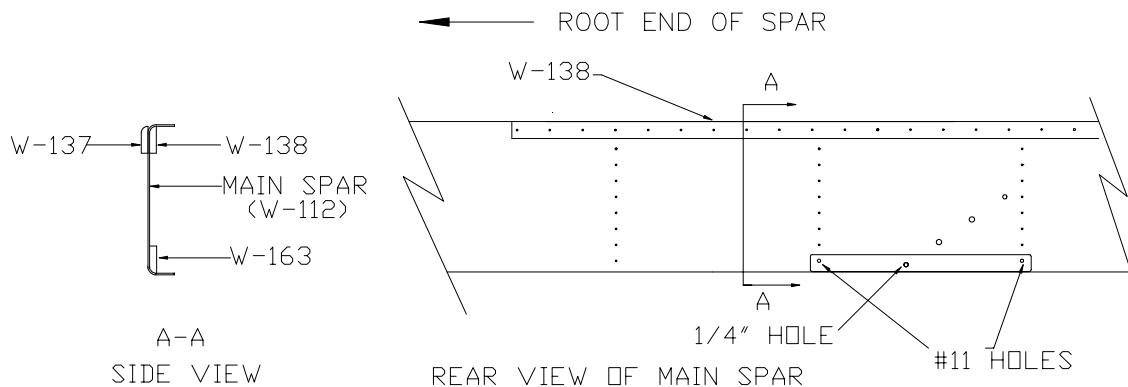


Figure 8.3.5

- 15) Using the existing rib rivet holes in the spar as a guide, drill through each end of the Spar Cap with a #30 drill, then enlarge to #11. Drill through the bottom Strut Fitting attach hole using a 1/4” drill. Figure 8.3.5.
- 16) Disassemble and debur all holes and edges in the Leading Edge Ribs, the Main Spar and the Spar Cap . **NOTE:** The ends of the Spar Cap should be rounded to a 1/2” radius about the #11 holes.

- 17) Chromate and attach the Spar Cap, Main Spar and #5 and #6 Leading Edge Ribs with two AN3-6A bolts, AN960-10 washers and AN365-1032 fibernuts. Use Proseal at Station 5 if installing Extended Fuel Tanks.
- 18) Measure and cut a relief, (similar to that of figure 8.3.4, but on the bottom of the rib) into Main Ribs #5 and #6 to clear the new spar cap. Debur.
- 19) Put the spar and ribs aside for the time being.
- 20) Label the rib locations on the Rear Spar (W-122) as in Figure 8.3.3.

#### 8.4 Rear Spar Extension

- 1) Position the (W-604) Rear Spar Extension Top at the tip end of the Rear Spar as in Figure 8.4.1.

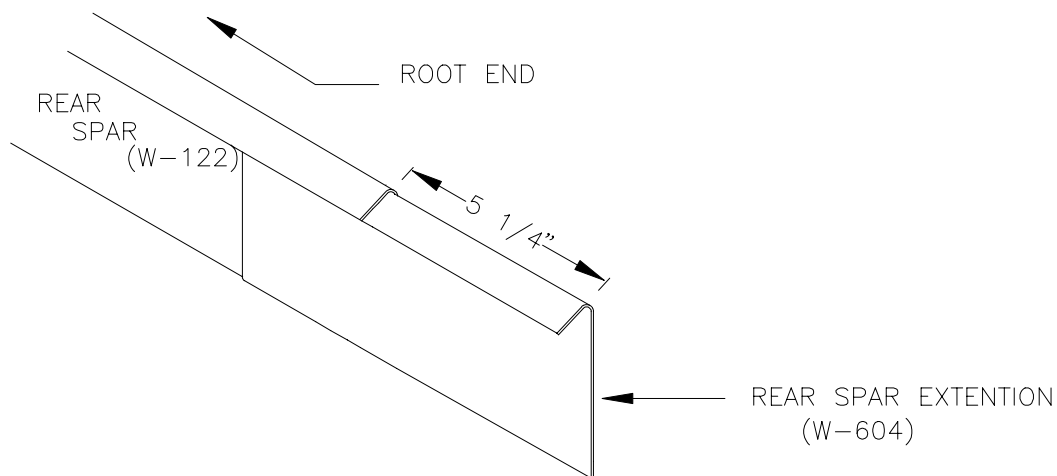


Figure 8.4.1

- 2) Back drill through the Rear Spar into the Rear Spar Extension Top (W-604) with a #40 drill.
- 3) Remove the Rear Spar Extension, mark out the rivet pattern and drill all the holes to #40 as in Figure 8.4.2.

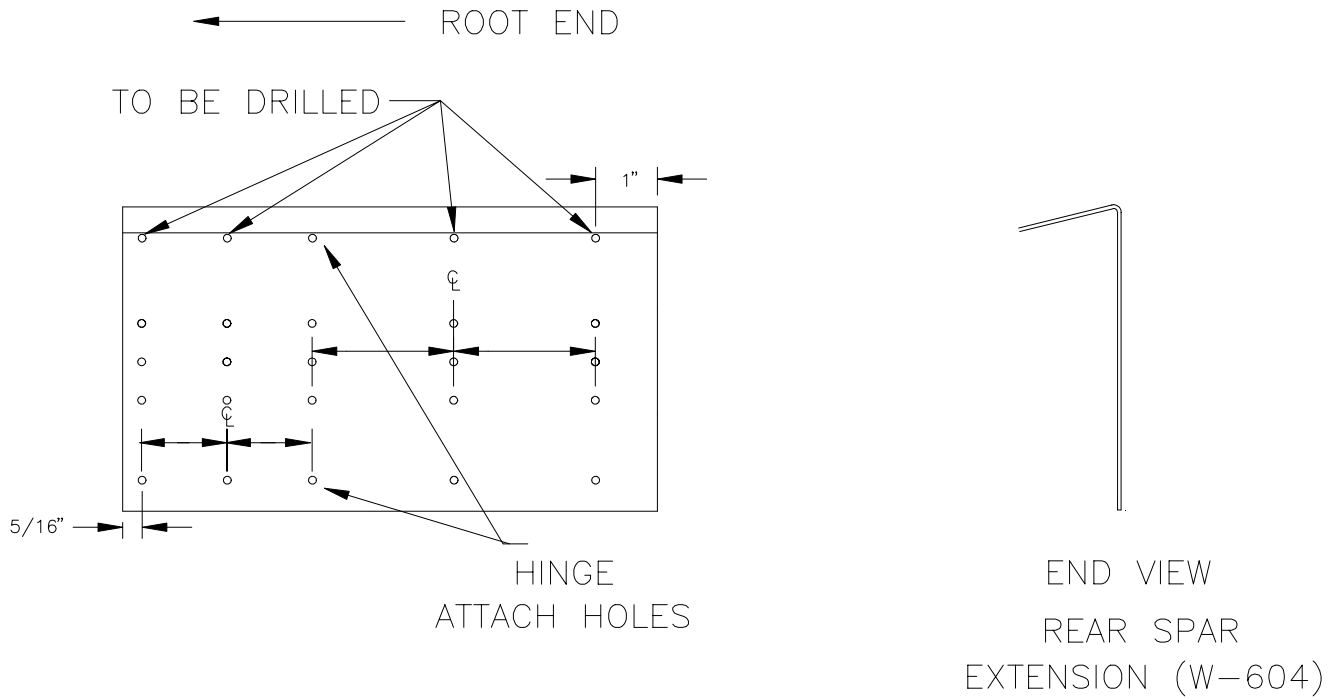


Figure 8.4.2

4) Position the W-620 Rear Spar Extension Bottom as in Figure 8.4.3.

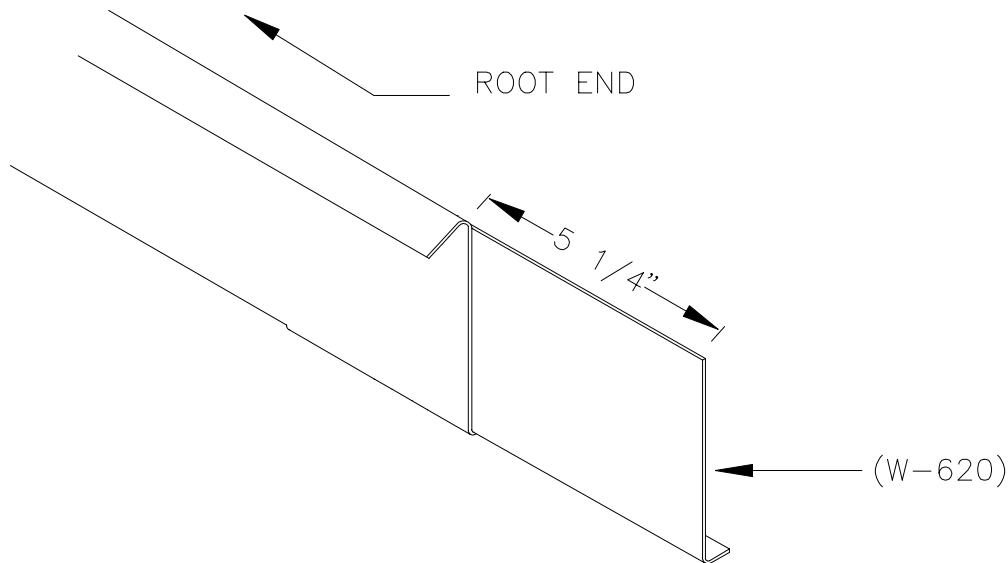


Figure 8.4.3

5) Back drill through the Rear Spar into the W-620 Extension Bottom.

6) Cleco the W-604 Extension Top back into place. Drill through the Rear Spar and W-620 Extension Bottom using W-604 as a drill guide. Drill #40 holes in reference to Figure 8.4.4.

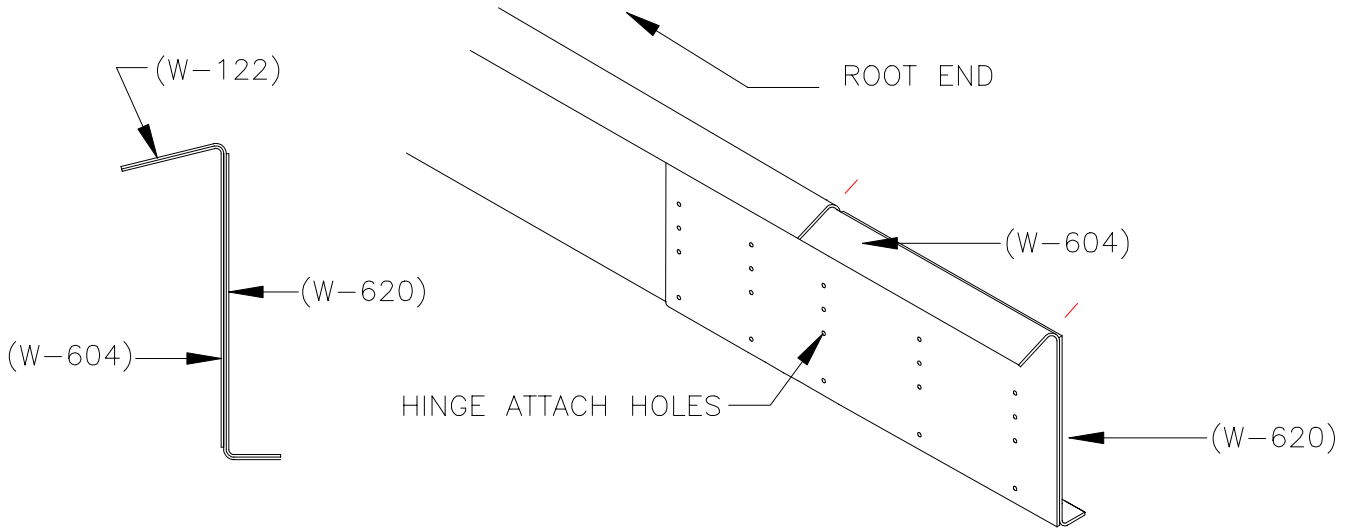


Figure 8.4.4

**8.5 Hinge Backing Plates**

- 1) From the .040 Raw Stock(W-602), cut out eight Hinge Backing Plates (W-133). Four for each wing. Figure 8.5.1.

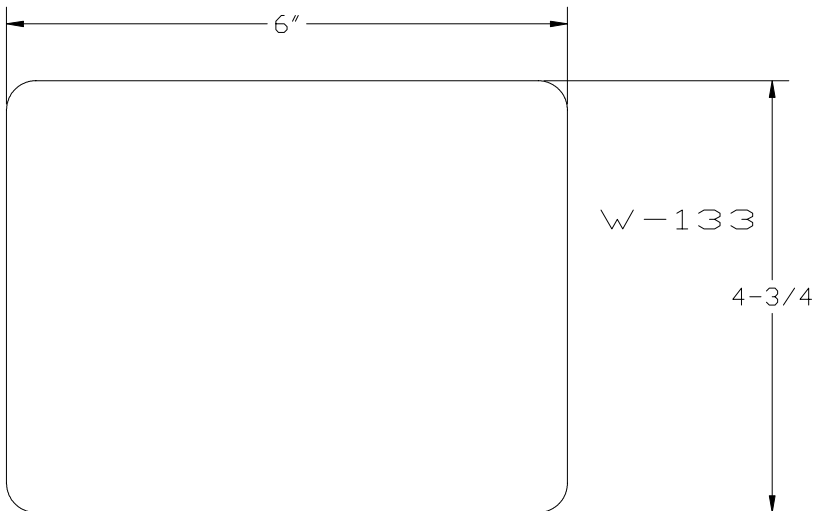


Figure 8.5.1

- 2) At the #10 rib location position a Hinge Backing Plate (W-133) as in Figure 8.5.2.

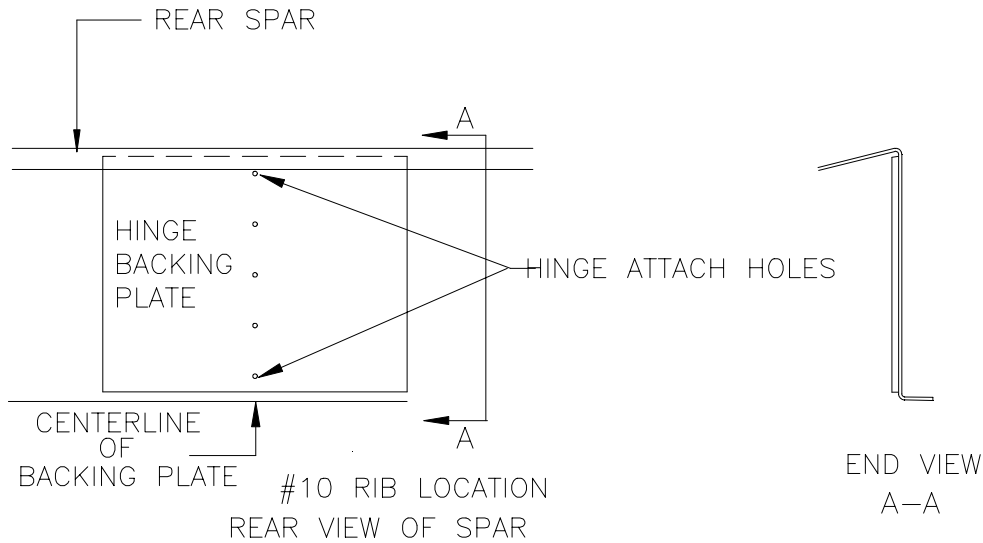


Figure 8.5.2

- 3) Drill back through the Rear Spar into the Hinge Backing Plate the five rib attach holes to #40. **NOTE:** Make sure the Hinge Backing Plate is not touching the radius of the Rear Spar.
- 4) Drill 20 more #40 holes into the Backing Plate and Rear Spar as in Figure 8.5.3.

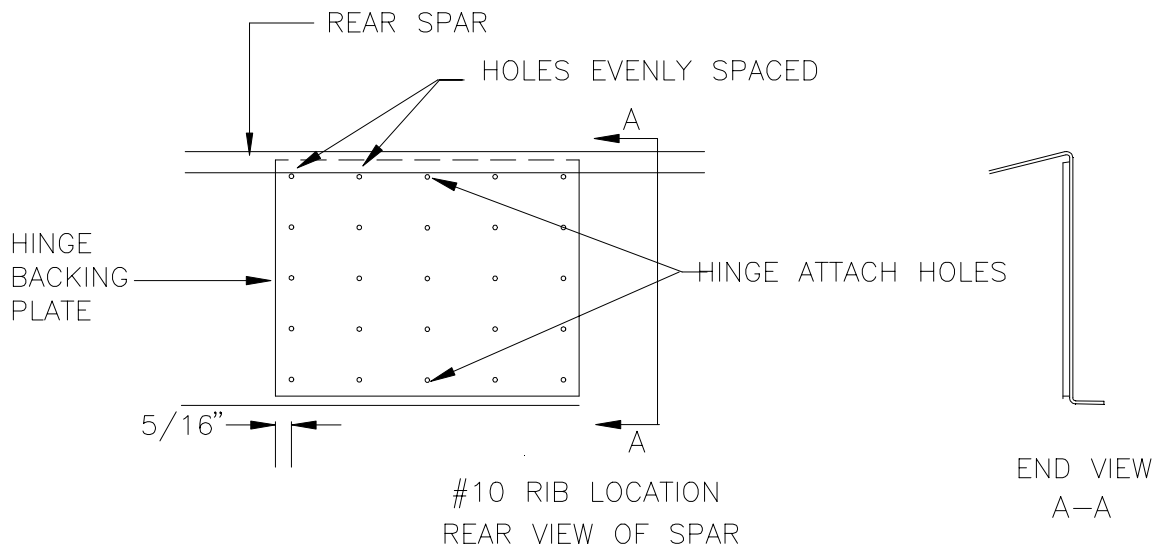


Figure 8.5.3

- 5) Repeat steps at the #4 rib location.
- 6) At the #7 rib location position a Hinge Backing Plate. Back drill through the Rear Spar into the Hinge Backing Plate the rib attach holes to #40 as in Figure 8.5.4.

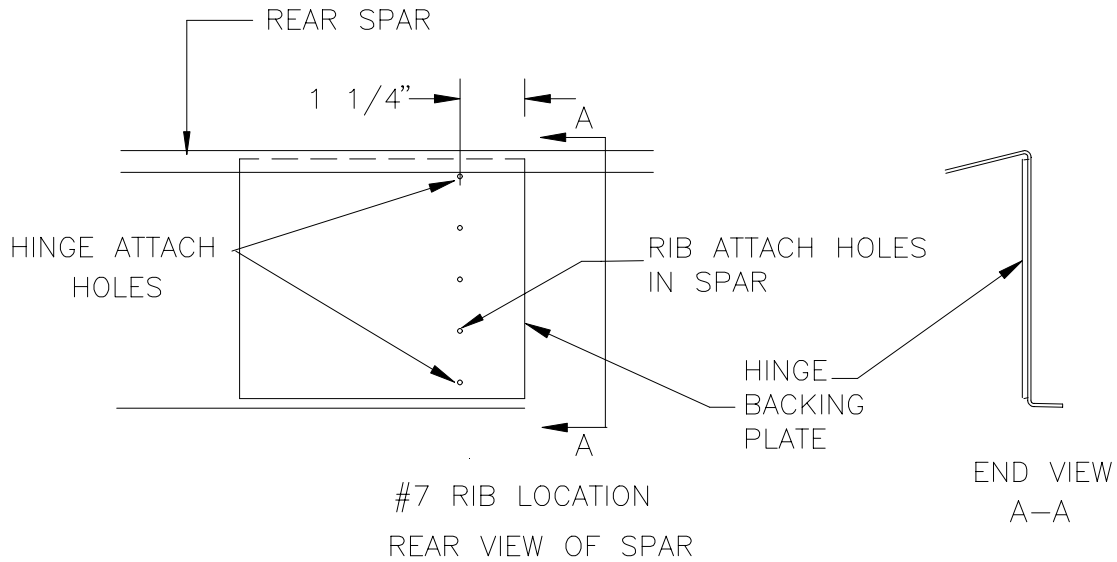


Figure 8.5.4

7) Drill five more #40 holes in Backing Plate and Spar, as in Figure 8.5.5.

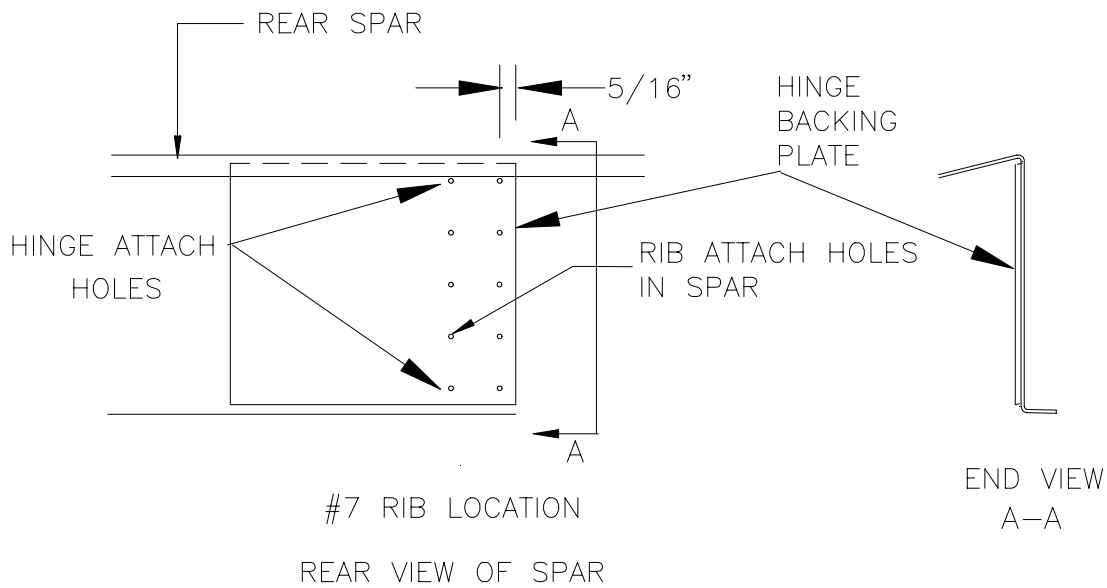


Figure 8.5.5

8) At the root position of the Rear Spar, position the fourth Hinge Backing Plate. Back drill through the Rear Spar into the Backing Plate #40 holes. Cleco as you go. Figure 8.5.6.

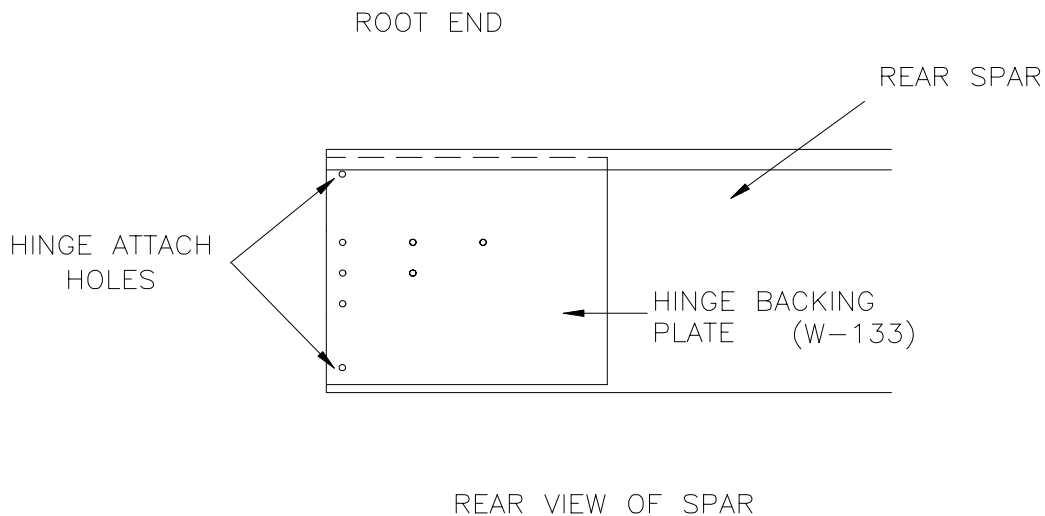


Figure 8.5.6

- 9) Remove the Hinge backing Plate and mark out and drill to #40. Cleco the Hinge Backing Plate to the Rear Spar and back drill the holes into the spar as in Figure 8.5.7.

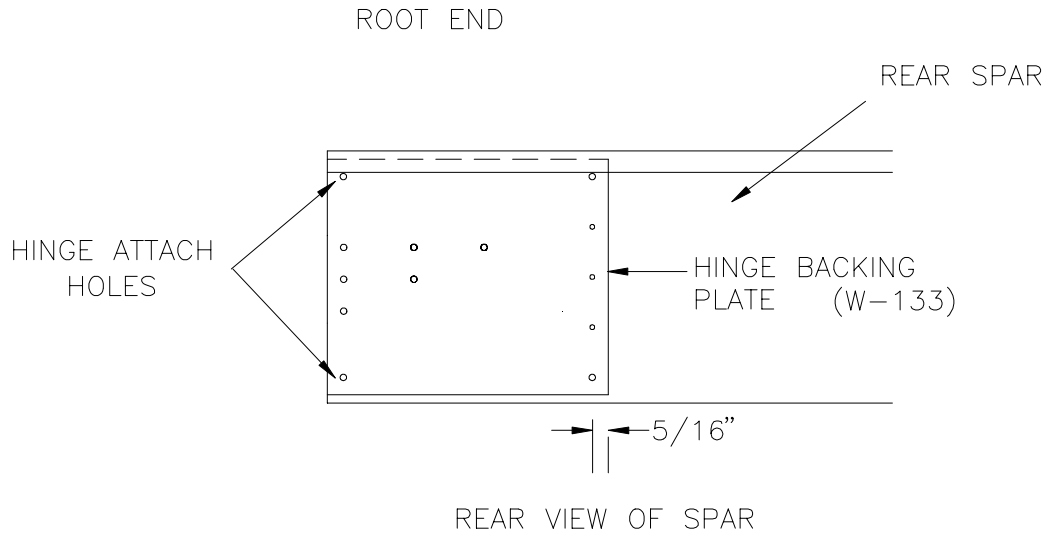


Figure 8.5.7

## 8.6 Wing Assembly

- 1) Cleco the Main Spar, Main Ribs and Leading Edge Ribs together.
- 2) Place a spacer or a wedge under the Main Spar to make the rear bottom portion of the Main Ribs lay flat against the table. Figure 8.6.1.

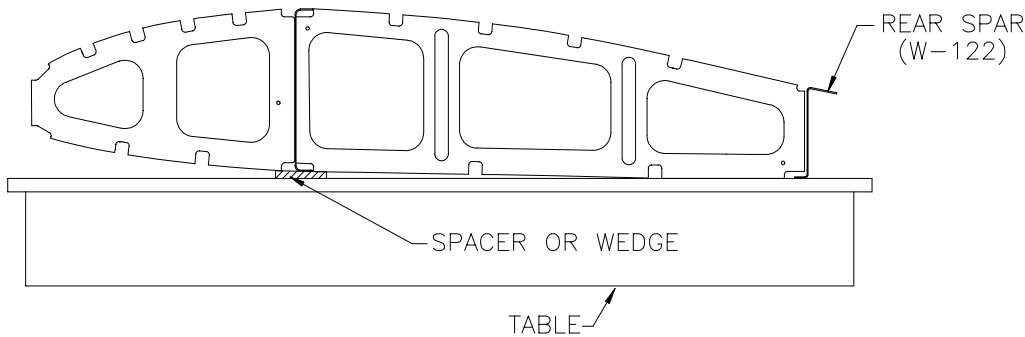


Figure 8.6.1

- 3) Position the Rear Spar and Hinge Backing Plates against the Main Ribs as in Figure 26.
- 4) When you can see the previously drawn line on the Root Rib flange through the prepunched holes in the Rear Spar, drill to #40 and cleco as you did on the Main Spar.
- 5) Repeat step for each rib using lots of clecos as you go. Then drill out all holes in the Rear Spar and Main Ribs to #30.

**8.7 Rear Spar Fittings**

- 1) Drill out the two Hinge Attach holes at ribs #1,#4,#7,#10 and #13 with a #11 drill. See Figure 8.5.7.
- 2) Cleco the two Rear Spar Fittings (W-124) to the root end of the Rear Spar and Hinge Backing Plate. Bolt the two fittings together with a 1/4" bolt to ensure alignment. See Figure 8.7.1.

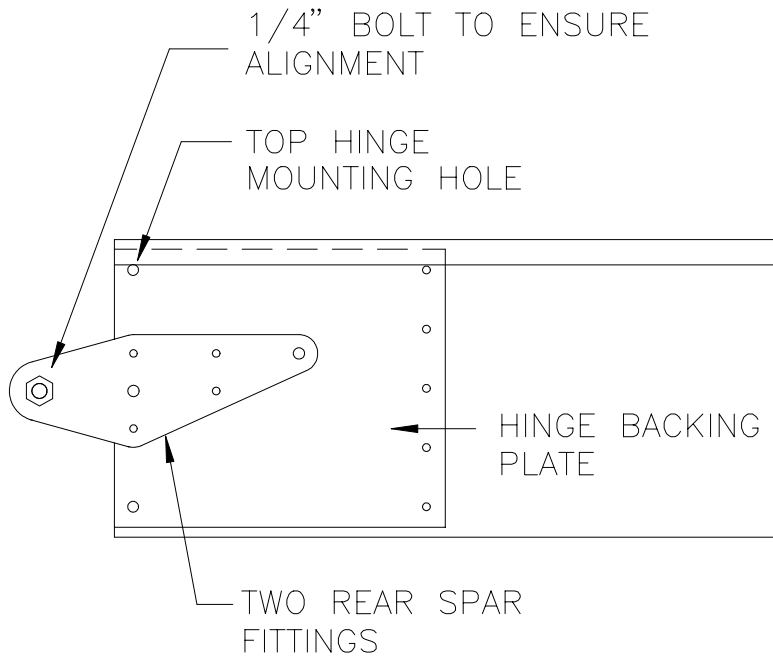


Figure 8.7.1

- 3) Drill out the six holes in the Rear Spar Fittings and Rear Spar to 5/32" and then ream out to 3/16". Cleco as you go.

**8.8 Bearing Bases**

- 1) On the two Bearing Bases (CC-38) mark and drill out nine #40 holes in the flanges as in Figure 8.8.1. after you have test fitted the CC-38 to the rear spar to ensure you pick up the backing plate with your holes.

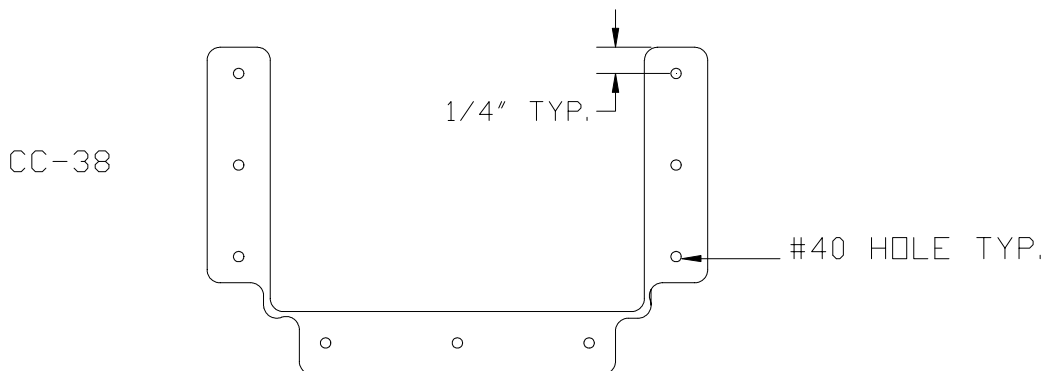


Figure 8.8.1

- 2) Attach two Delrin Bearings (CC-37) to the two Bearing Bases (CC-38) with eight flush AN 509-1032 R10 Machine Screws, eight AN960-10 Washers and eight AN365-1032 Nuts. Figure 8.8.2.

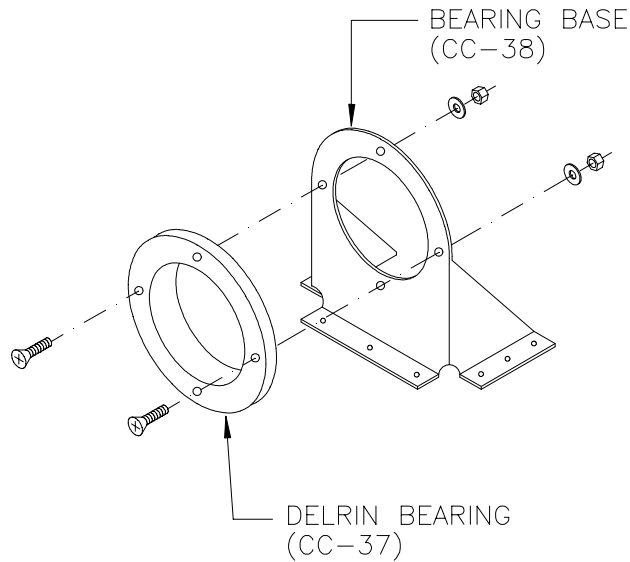


Figure 8.8.2

- 3) Remove the solid #4 Main Rib or if you have the extended fuel tank the solid #5 Main Rib.
- 4) Cut the 12 foot long (2" x .035) Tube into two equal lengths. Deburr the ends. These will become the Torque Tubes.
- 5) Position the inboard Bearing Base between ribs #1 and #2 with the flat side towards the root. Position the outboard Bearing Base between the #6 and #7 ribs with the flat side to the tip. Figures 8.9.1 and 8.9.3.

### 8.9 Torque Tube Install

- 1) From the outboard end of the Wing slide a Torque Tube (cut earlier) through the Main Ribs and the two Delrin Bearings. **NOTE:** It may be necessary to lightly sand the Delrin Bearings to get a good fit, so that the Torque Tube turns smoothly and easily, but has no excess play.
- 2) Center the Bearing Bases on the Rear Spar as per figure 8.9.2.

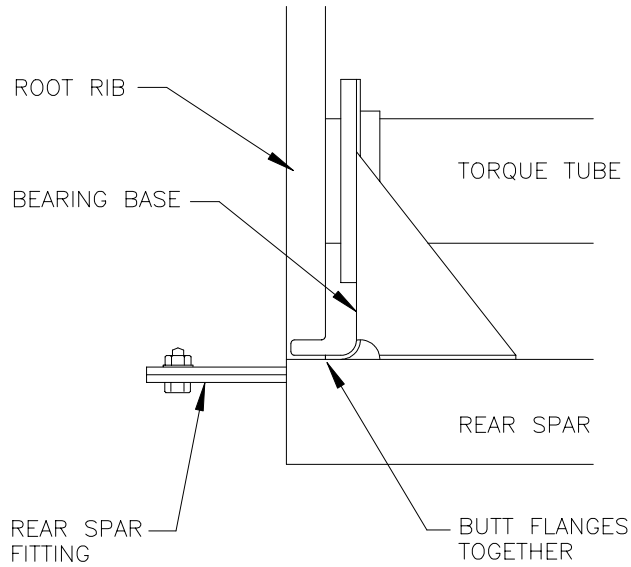


Figure 8.9.1

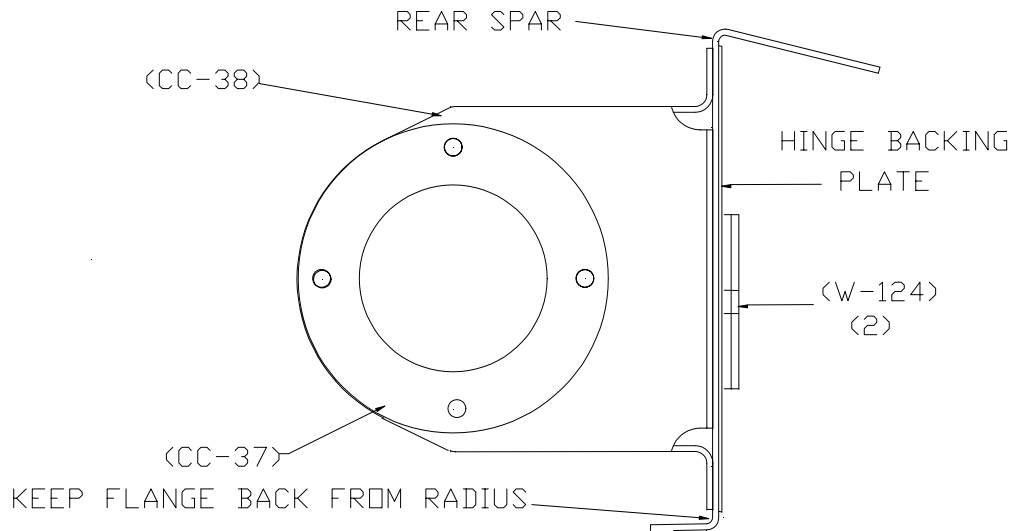


Figure 8.9.2

- 3) Hold the Torque Tube level with the top of the spar and drill two #40 holes back through the inboard Bearing Base into the Rear Spar. Cleco.

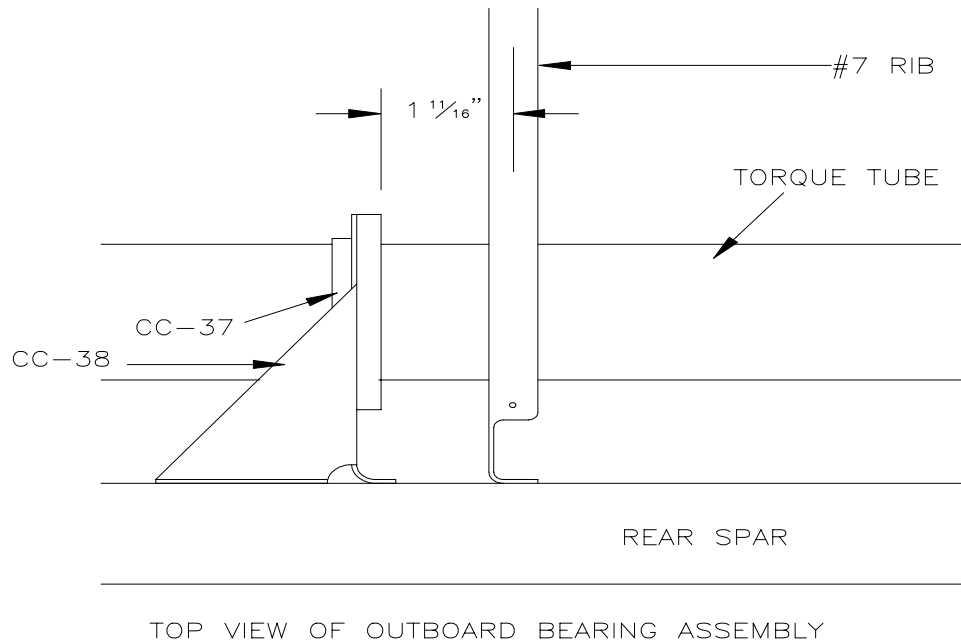
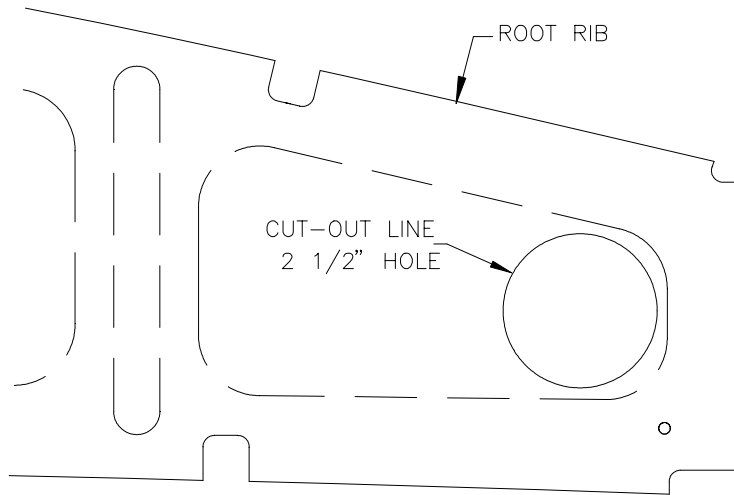


Figure 8.9.2

- 4) Drill two #40 holes back through the outboard Bearing Base into the spar and cleco.
- 5) Ensure that the Torque Tube turns freely.
- 6) Back drill the remaining holes into the Rear Spar. **NOTE:** The center hole of the vertical flange on the inboard Bearing Base will go through the Rear Spar Attach Fittings.
- 7) Drill out to #30. Cleco securely. Rivet the CC-38's to the Rear Spar using RV-1410 rivets. Leave the hole where the Spar Attach Bracket mates with the inboard CC-38 open at this time.
- 8) Next, remove the remaining Hinge Backing Plates, debur, chromate and re-assemble. Rivet them to the Spar with RV-1410 rivets. **NOTE:** Leave the rib location holes open for now.
- 9) Push the Torque Tube up against the Root Rib. Draw a line around the tube on the rib.
- 10) Remove the Root Rib and cut out a 2 1/2" hole where the Torque Tube will exit. Press the Root Rib into the #4 rib and transfer the hole location for the Torque Tube. Cut out the 2 1/2" hole. Figure 8.9.3.



ROOT RIB AS SEEN FROM INBOARD

Figure 8.9.3

11) Remove the Torque Tube and debur the outboard end.

**8.10 Control Horn**

1) In a 1" Sleeve (CC-100) drill eight #30 holes as in Figure 8.10.1.

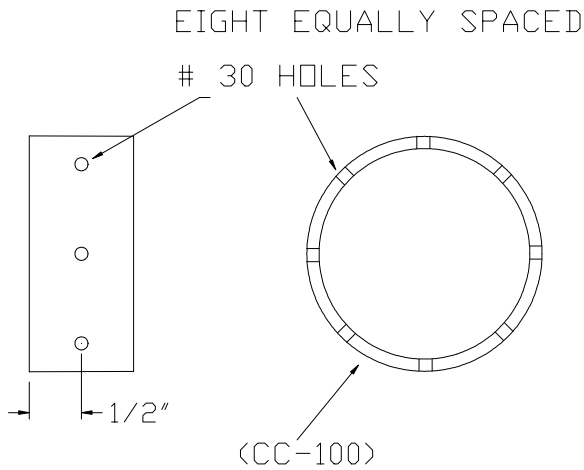


Figure 8.10.1

2) Align a Control Horn (CC-43) to an End Plug (EL-31) with a 1/4" bolt (no nut) and using the Control Horn as a drill template drill out the eight #11 holes into the End Plug. Cleco as you go. Ensure that the Control Horn is facing the direction for the wing that you are doing. Remove the bolt. Figure 8.10.2.

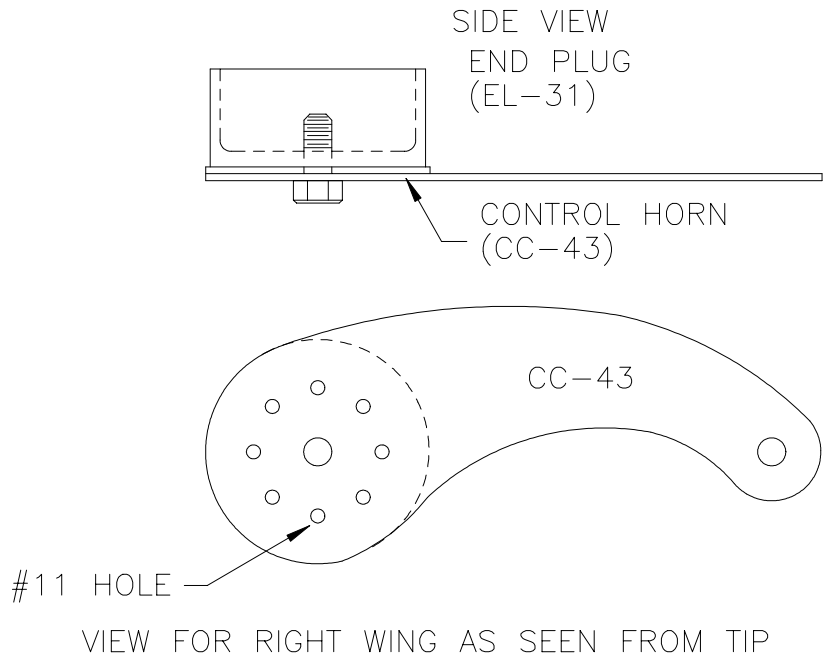


Figure 8.10.2

- 3) Slide the Sleeve (CC-100) over the outboard end of the Torque Tube.
- 4) Slip the Control Horn (CC-43) and the End Plug (EL-31) assembly into the end of the Torque Tube.
- 5) Stagger the holes in the Sleeve with the holes in the End Plug and drill to #30 and then to #11. Figure 8.10.3.

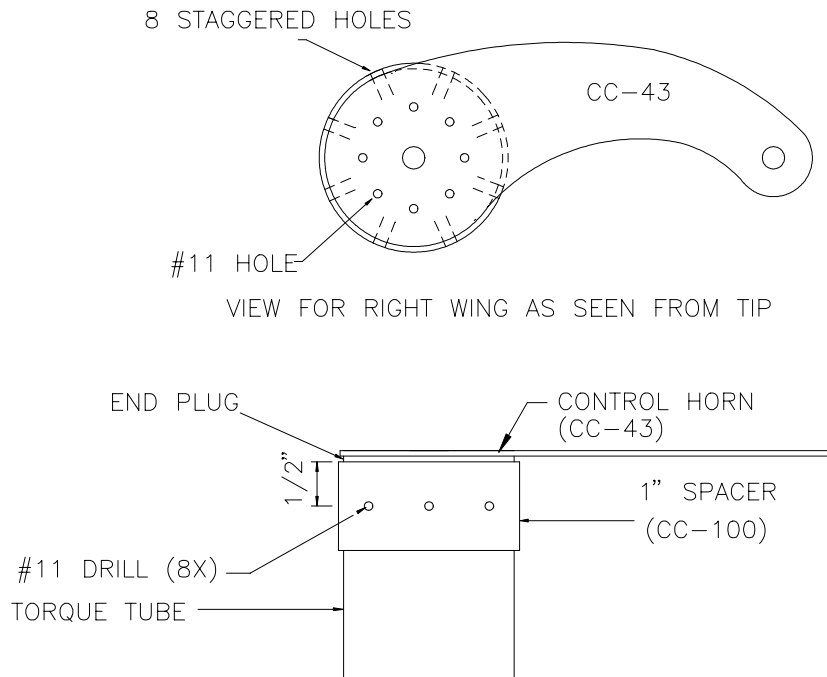


Figure 8.10.3

- 6) Disassemble and debur Torque Tube. Chromate mating surfaces and assemble as follows:
    - 1) Control Horn to End Plug with eight 3/16" SS rivets (RR-5606)
    - 2) Sleeve, Torque Tube and Plug assembly with eight 3/16" SS rivets (RR-5606)
  - 7) Replace Root and #4 ribs.
  - 8) Slide a 2" Washer (M2W) onto the Torque Tube and replace Torque Tube into the Bearings.
- NOTE:** To finish Torque Tube install go to step 5 section 8.25.

**8.11 Front Spar**

- 1) Cut a Front Spar Cap (W139) into two equal lengths. These parts then become Short Spar Caps (W-140).
- 2) Lay out a Front Spar (W-117) as in Figure 8.11.1.

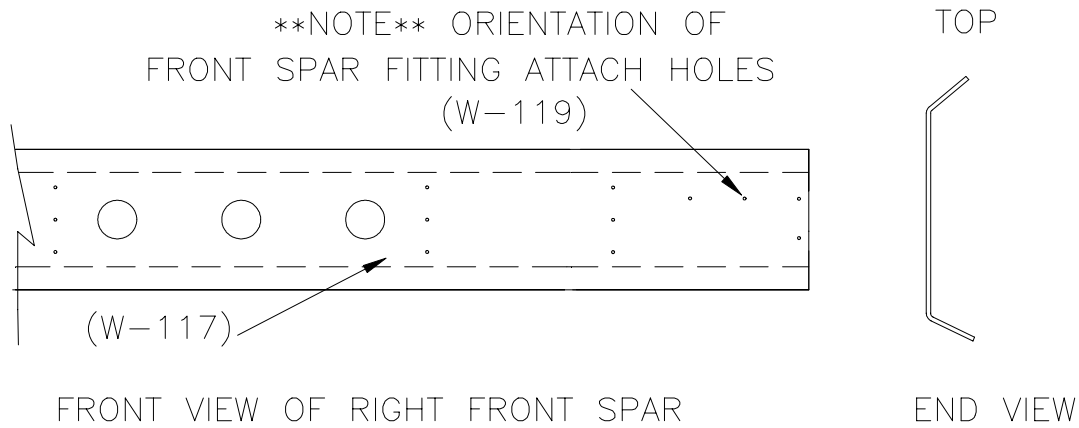


Figure 8.11.1

- 3) On the table lay out the right Front Spar (W-117), Front Spar Doubler (W-116), two long Front Spar Caps (W-139) and one short Front Spar Cap (W-140). Figure 8.11.2.

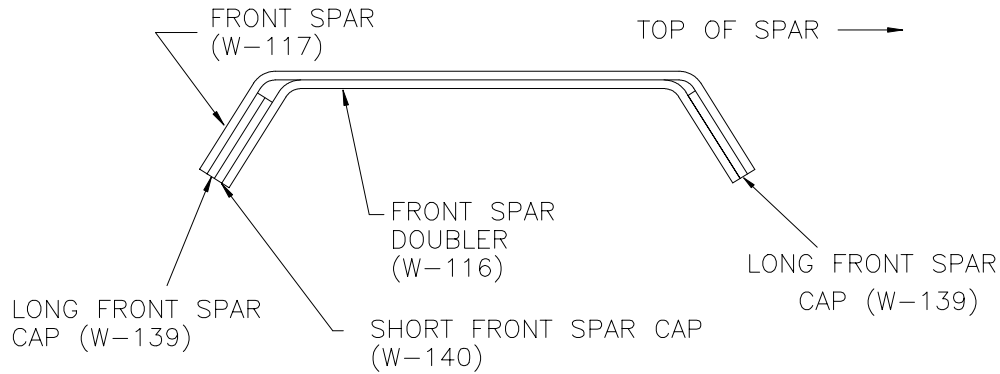


Figure 8.11.2

- 4) Ensure all parts are flush with the Root end. Then back drill the Front Spar Attach Fitting holes into the Front Spar Doubler (W-116) with a # 40 drill.
- 5) Remove Front Spar Doubler (W-116) and Spar Caps (W-139,W-140)
- 6) Place a Front Spar (W-117) face down and centered over the Front Spar Tripler (W-118) and flush with the root end. Back drill all the rivet holes into the Front Spar Tripler to #40. **DO NOT** drill lightening holes in the Front Spar Tripler. Cleco as you go. Figure 8.11.3

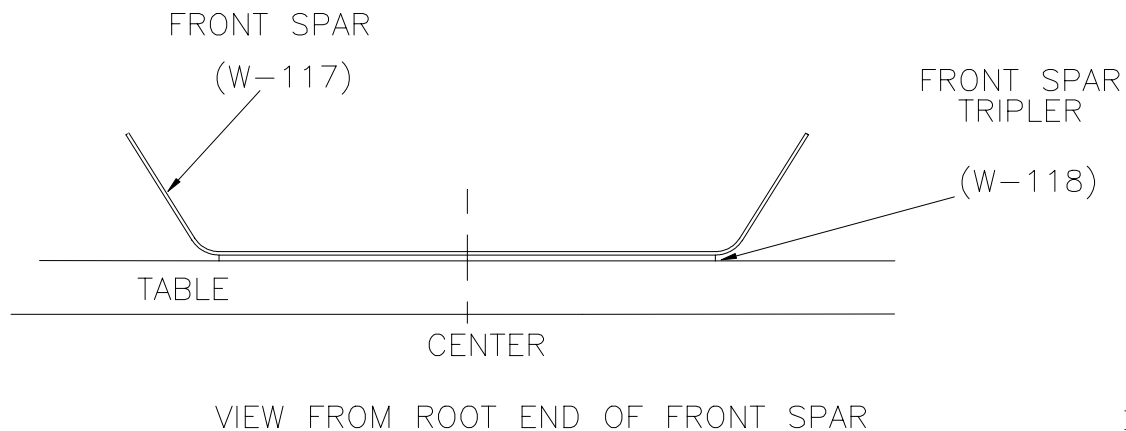


Figure 8.11.3

- 7) Remove the Front Spar Tripler, mark out and drill to # 40 as in Figure 8.11.4.

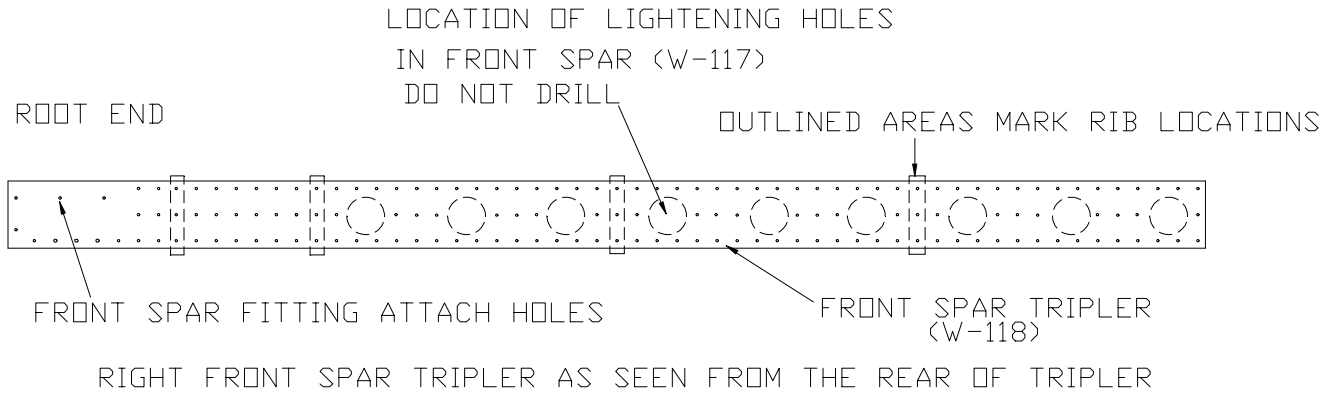


Figure 8.11.4

- 8) Cleco the Front Spar Tripler to the front of the Front Spar and back drill the Front Spar to #40 .
- 9) Cleco the Front Spar(W-117), Front Spar Tripler (W-118) and Front Spar Doubler (W-116) together and back drill the Front Spar Doubler to #40 through the Tripler and Front Spar.
- 10) Drill out the four Front Spar Fitting attach holes in the Front Spar, Front Spar Doubler and Front Spar Tripler to #11. Figure 8.11.4. **NOTE:** These holes will be drilled to ¼” later.
- 11) On each Leading Edge Rib drill a #40 hole in the center of the Front Spar Attach flange. **NOTE:** Do not drill the Leading Edge Root Rib. Figure 8.11.5.

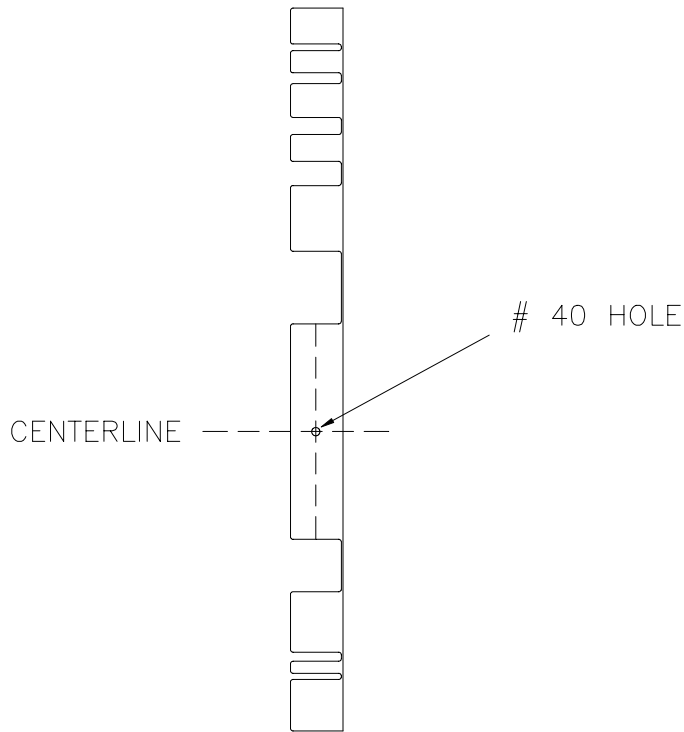


Figure 8.11.5

- 12) Cleco the Front Spar onto the Leading Edge Ribs using the holes just drilled in the flanges. Position the ribs so the lines on the flanges are visible through the center of the pre-punched holes in the Spar. Drill the remaining two holes to #40. Reassemble the Front Spar Tripler, Doubler and Front Spar to the Leading Edge Ribs and then drill all the #40 to #30 in the ribs and securely cleco in place. Figure 8.11.6.

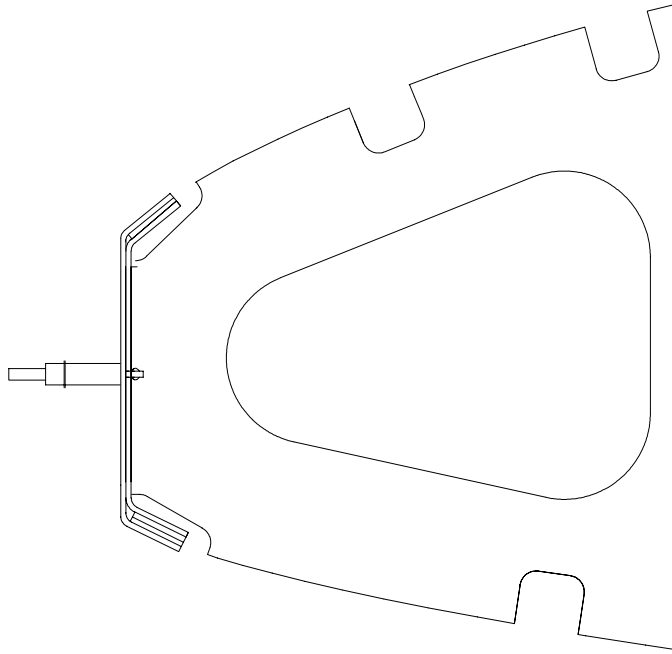


Figure 8.11.6

13) Remove the Leading Edge Root Rib from the assembly.

14) Cut the flanges off a second Leading Edge Root Rib (W-172) as in Figure 8.11.7. This will become a doubler for the Leading Edge Root Rib.

TRIM 3/16" ON ALL OTHER FLANGES

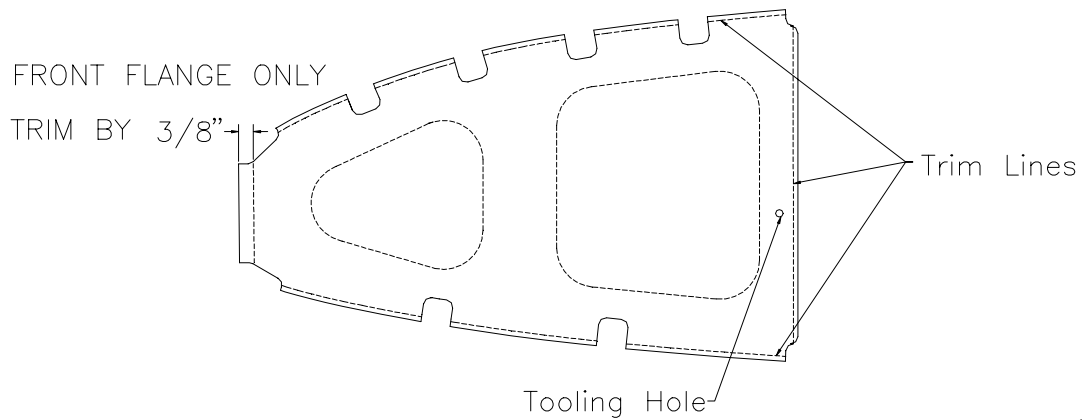


Figure 8.11.7

15) On the Root Rib trim the front flange only as in Figure 8.11.7.

- 16) Insert the Doubler into the Leading Edge Root Rib. Cleco together through the rear #11 tooling hole. Cleco the Leading Edge Root Rib back onto the Main Spar.

**8.12 Root Rib Attach Bracket**

- 1) On the Root Rib Attach Bracket (W-161). Drill a #30 hole as in Figure 8.12.1.

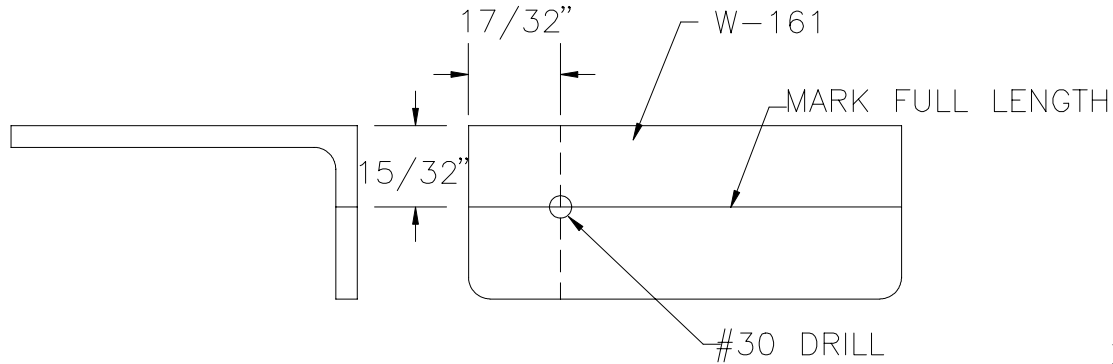


Figure 8.12.1

- 2) Clamp a Packer ( cut 2 1/2" long from the W-138 raw material) to the inside of the Angle Bracket and drill a hole through the Angle Bracket and the Packer first to #30 and then out to #11. Figure 8.12.2.

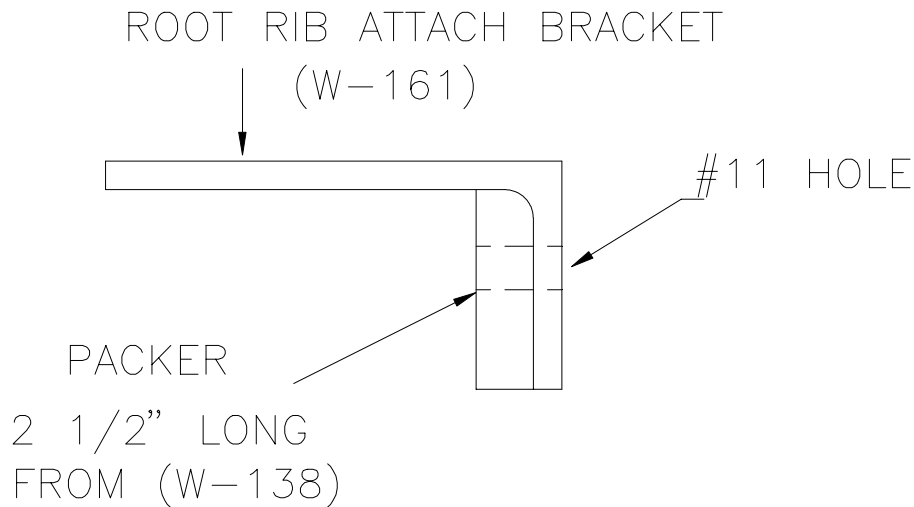
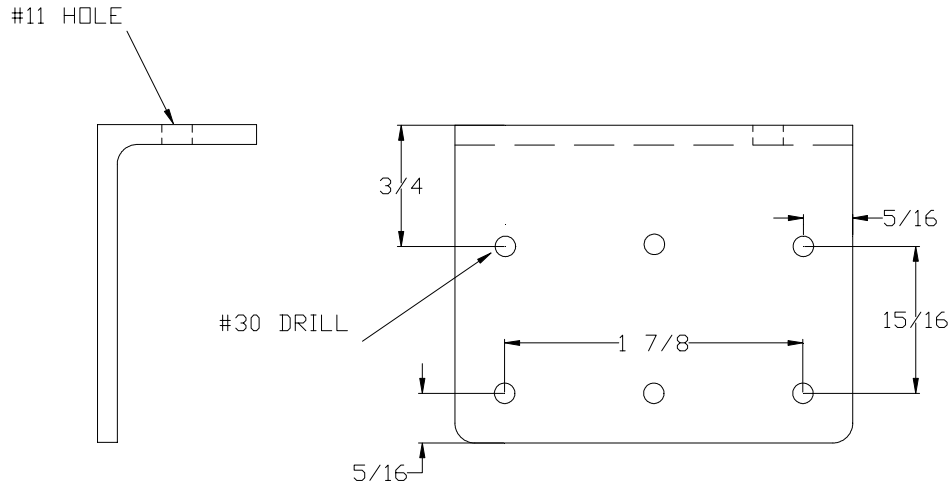


Figure 8.12.2

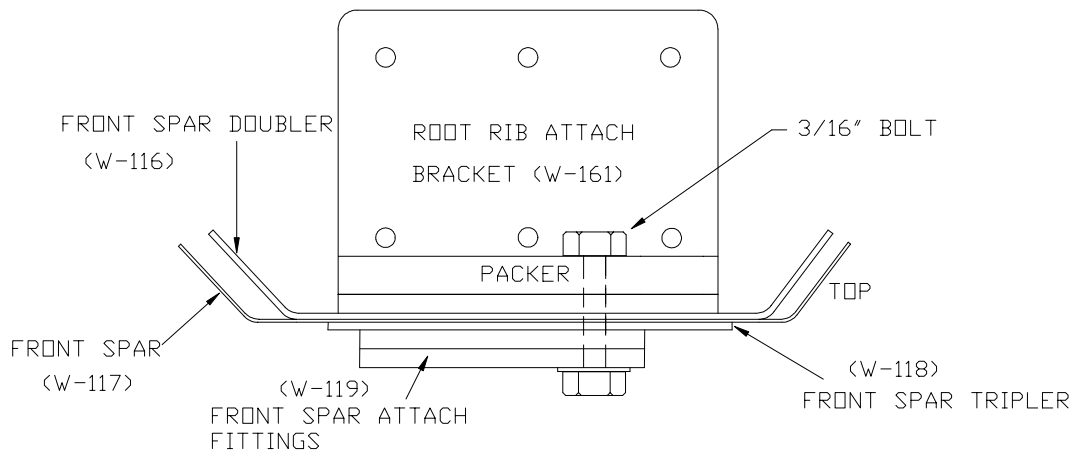
- 3) Drill six #30 holes into the Root Rib Attach Bracket (W-161) as in Figure 8.12.3.



HOLE PATTERN FOR ROOT RIB ATTACH BRACKET (W-161)

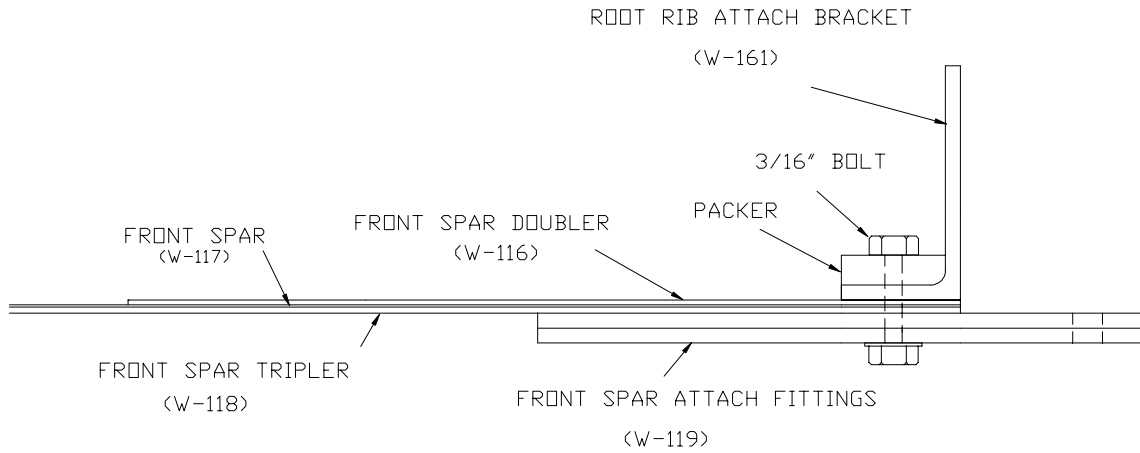
Figure 8.12.3

- 4) Use a AN3-10A Bolt to temporarily attach the Root Rib Attach Bracket, Packer , two Front Spar Attach Fittings and Front Spar Tripler to the Front Spar. See Figure 8.12.4 and Figure 8.12.5.



SPAR ASSEMBLY VIEWED FROM OUTBOARD END

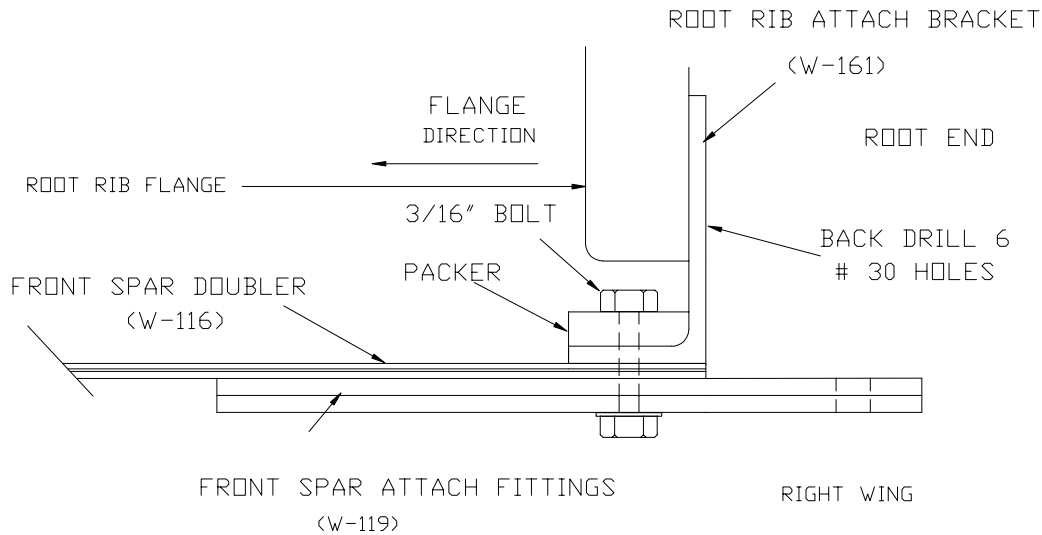
Figure 8.12.4



NOTE: FLANGES OF SPAR AND DOUBLER REMOVED FOR CLARITY  
 FRONT SPAR ASSEMBLY AS SEEN FROM THE TOP OF THE SPAR

Figure 8.12.5

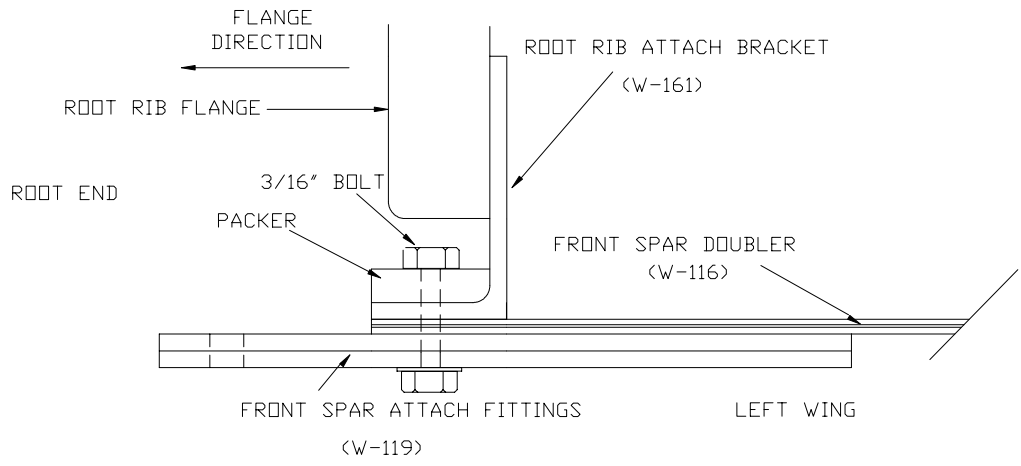
- 5) Ensure the line on the flange of the Root Rib Attach Bracket is in the center of the other hole in the Spar. Then drill to #11.
- 6) Use another AN3-10A bolt to temporarily secure the assembly.
- 7) Back drill the six #30 holes through the Root Rib Attach Bracket into the Root Rib and doubler. Figure 8.12.6.



NOTE: FLANGES OF SPAR AND DOUBLER REMOVED FOR CLARITY  
 VIEW OF FRONT SPAR ASSEMBLY AS SEEN FROM THE TOP OF THE SPAR

Figure 8.12.6

**Note:** It is important that you let the Front Spar and Root Rib Attach Bracket find their own position on the rib. Do not force it back. As there are no left and right ribs, the root rib installation will be different for each wing. See Figure 8.12.7 for the left wing view.



NOTE: FLANGES OF SPAR AND DOUBLER REMOVED FOR CLARITY  
 VIEW OF FRONT SPAR ASSEMBLY ON LEFT WING AS SEEN FROM THE TOP OF SPAR

Figure 8.12.7

8) Open up the six #30 holes to #11. Cleco.

**8.13 Root Rib Stiffener**

- 1) Cut a Root Rib Stiffener (W-142) into two equal lengths.
- 2) Hold a Root Rib Stiffener (W-142) against the Leading Edge Root Rib. Trim length to suit. Figure 8.13.1.

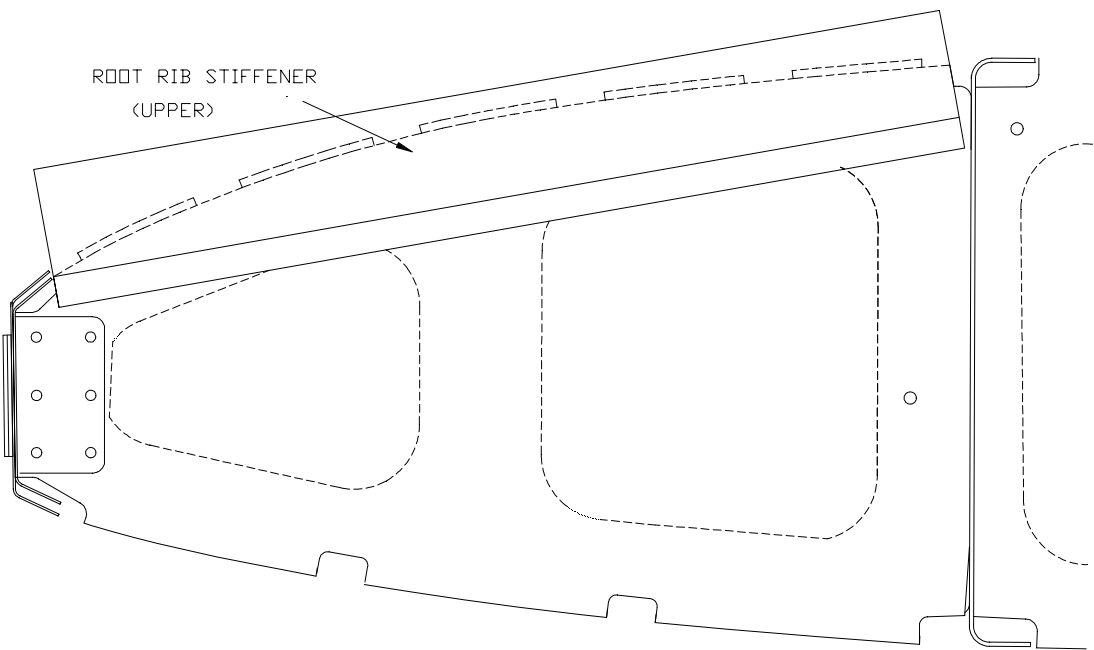


Figure 8.13.1

- 3) Trace the shape of the Leading Edge Root Rib (W-172) on the back of the Root Rib Stiffener (W-142).  
Figure 8.13.2.

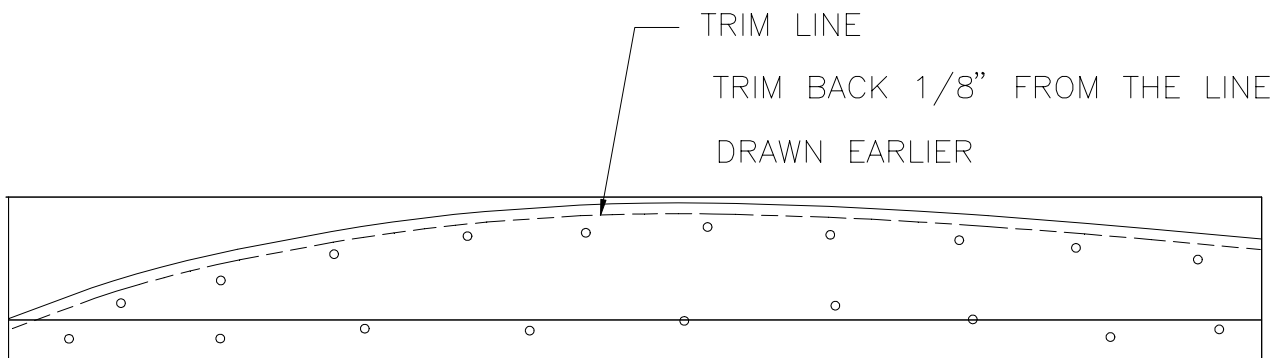


Figure 8.13.2

- 4) Trim and drill to #40 as in Figure 8.13.2.  
5) Reposition against the Leading Edge Root Rib, drill and cleco.  
6) Repeat steps for the bottom edge of the Leading Edge Root Rib. Figure 8.13.3.

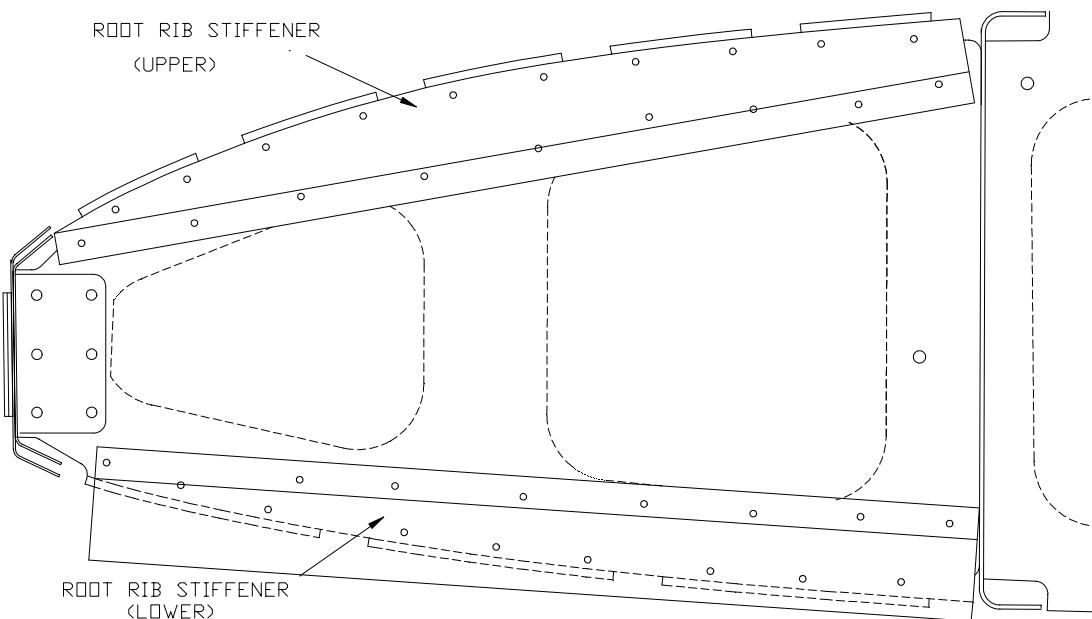


Figure 8.13.3

**Note:** When doing the left wing, the Root Rib Stiffeners will be inside the wing.

- 7) Drill #40 holes into the Leading Edge Root Rib and Doubler as in Figure 8.13.4.

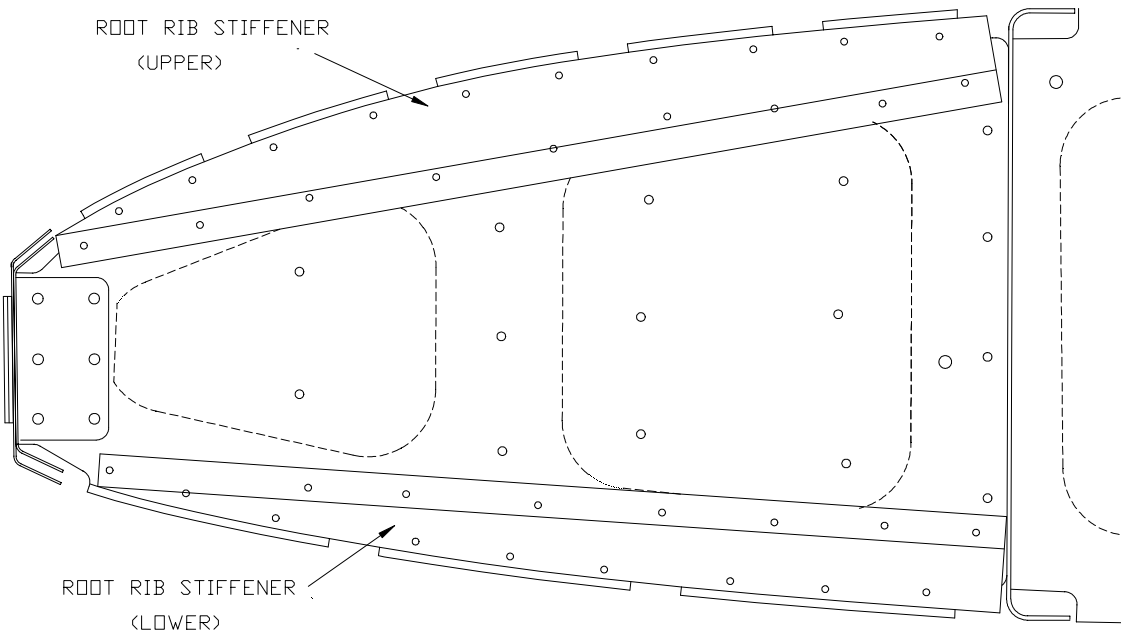


Figure 8.13.4

- 8) Drill out all #40 holes in the Leading Edge Root Rib, Doubler and Root Rib Stiffeners to #30.
- 9) Drill out the four attach holes for the Front Spar Attach Fittings (W-119) to 1/4".
- 10) Disassemble the root section and debur all parts