

SECTION 6: EMPENNAGE

BUILDING THE HORIZONTAL STABILIZER

The assembly of the horizontal stab and following references are shown on DWG 3.

REAR SPAR ASSEMBLY

- ❑ Use a file or Scotchbrite wheel to "break" the edges of the HS-609PP (See Sec E-E). Lay the HS-609PP rear spar reinforcement bars inside the HS-603PP spar channels and check to see that the faces rest against one another when the holes are aligned. If the bend of the channel tends to lift the edge of the bar, use a coarse Vixen file to round the edge of HS-609PP to fit. Round the ends of the HS-609PP bars as shown in Rear View.
- ❑ Smooth the edges and surfaces of the HS-609PPs to a satin finish equivalent to that left by 400 grit wet/dry sandpaper, removing all the milling and file marks (See "Edge Finishing", Section 5.2).
- ❑ The pre-punched holes used to attach HS-603PP to HS-609PP are slightly undersized, and must be "final drilled" to the correct size. Cleco and drill every second or third hole, drill #30, then move the clecos and drill #30 all the remaining holes.
- ❑ Carefully locate the holes that attach HS-708 to the rear spar assembly (it is the eighth hole from the end of HS-609PP) and enlarge it to #21 (See Rear View).
- ❑ Cleco the HS-412PP and HS-413PP elevator hinge brackets to the rear spar assembly and run a #30 drill through all the holes.
- ❑ There are two HS-411PP brackets, but only HS-411BPP is pre-punched for the VA-146 attach holes (See Exploded Isometric View). Clamp HS-411APP and HS-411BPP around the VA-146 bearing and cleco the assembly to the spar.
- ❑ Using HS-411BPP as a drill guide match drill and cleco the aft four VA-146 attach holes.
- ❑ Remove the assembly from the spar and match drill the forward two VA-146 attach holes.
- ❑ Deburr the parts, prime VA-146 if desired, then rivet them together (the -5 rivet is the correct length, see Section 5.4). This sort of one at a time priming makes having a spray can of self etching primer nice.
- ❑ Cleco the HS-411 assembly back to the spar. Drill/enlarge the bolt holes that will attach the HS-411 assembly to the spar to #12.
- ❑ Mark all the parts in the rear spar assembly so they can be returned to their previous positions. Use a "Sharpie" pen or equivalent for all marks on aluminum, but in this case the ink will be lost if you clean the parts for priming.

FRONT SPAR ASSEMBLY

- ❑ Separate the two HS-00003 spar doublers and draw the rivet lines as shown in the HS-00003 Detail View.
- ❑ Place the two HS-702 front spar channels on a work table, end to end, with the flanges facing down. Cleco HS-810-1 reinforcement angle, HS-814-1 splice angle to the two HS-702 spar channels.
- ❑ Clamp the HS-00003 spar doublers to the HS-702 spar channels. Position the top edge of the doublers flush with the top edge of the spar channels. Position the doublers left and right from the center line of the horizontal stab as shown in View B-B. Match-Drill #30 the inboard holes shown in Vew A-A. Cleco the doublers to the spar.

- ❑ Drill/match-drill all the holes inboard of the HS-00006/HS-00005 rib attach points (See View A-A). DO NOT drill the holes that will attach the HS-00006 and HS-00005 ribs or the holes outboard of the bend line. The holes outboard of the bends will be drilled later, after the bends are made. Also see Figure 6-6.
- ❑ Remove HS-810-1, HS-814-1 and HS-00003 from the two HS-702 spar channels. Taper the ends of HS-810-1 and HS-814-1 (See HS-810-1/HS-814-1 Taper Detail).
- ❑ Bend the outboard ends of HS-810-1, HS-814-1 (See View B-B). Clamp the aluminum angle between wood blocks in a vise and bend with a mallet. Use a simple cardboard template to check the angle.
- ❑ Lay the spar on the workbench with the flanges facing up and mark the bend line on the spar as shown in the HS-702 Front Spar Tab Detail.
- ❑ Drill a #30 relief hole 1/8" inboard of the bend line and centered on the bend radius of the flange (See HS-702 Front Spar Tab Detail and HS-702 Front Spar Tab Detail). Turn the spar over and enlarge this hole to 1/4" using a unibit.
- ❑ Trim the inboard ends of the HS-702 flanges as shown in the HS-702 Front Spar Tab Detail. Be sure to only trim the flanges down to about halfway along the bend. Flatten the remainder of the bend.
- ❑ Bend the tab as shown in HS-702 Front Spar Tab Detail using a hand seamer or blocks of wood.
- ❑ Refer to View A-A for the rivet pattern at the center of the front spar. Note that the center four rivets are AN426AD4 rivets with the flush heads aft. Dimple HS-702 and countersink HS-810-1 and HS-814-1 (See "Countersinking", Section 5.5).

PREPARING THE RIBS

- ❑ Notch the aft end of the HS-00006 ribs to fit around HS-814 and HS-810 (See HS-00006 Trim Detail). Make sure to make one left and one right.
- ❑ Prepare the HS-00006, HS-00005, HS-706, HS-707 and HS-708 ribs (See "Fluting and Straightening Ribs and Bulkheads" and "Edge Finishing", Section 5.13 & 5.2).

DRILLING THE HORIZONTAL STABILIZER

- ❑ Choose which ribs will be used on the right and which will be used on the left then mark them.
- ❑ Using the dimensions given in SEC D-D, mark the hole locations on the centerline of the aft side of the aft flange of HS-00006. These holes attach HS-00006 to the forward spar assembly and HS-00005. Make a light mark with a center punch to keep the drill bit from wandering then pilot drill the holes to #40.
- ❑ Draw a centerline on the forward side of the forward flange of HS-00005.
- ❑ Select the left side HS-702, HS-603PP, HS-706, HS-707 and HS-708 and cleco them together.
- ❑ Drill all HS-706, HS-707, HS-708 rib to spar attach holes to #30 (except the HS-708 and HS-603PP holes)
- ❑ Un-cleco, deburr holes, clean out chips and re-cleco.
- ❑ Cleco on the HS-801PP skin.
- ❑ Enlarge the HS-708 to HS-603PP holes to #21.
- ❑ Cleco HS-00003, HS-810-1 and HS-814-1 to HS-702.
- ❑ Slip the HS-00006 and HS-00005 ribs into place and mark the approximate hole locations on the top and bottom rib flanges with a pen using the holes in the skin as a guide.

- ❑ Remove the HS-00006 and HS-00005 ribs and flute as necessary between the rivet hole marks.
- ❑ Reinstall the HS-00006 and HS-00005 ribs. Clamp HS-00006 to the HS-801PP skin and spar assembly.
- ❑ Match Drill #30 and cleco the aft flange of HS-00005 rib to HS-603PP spar, using the holes in the spar as a drill guide. Remove HS-00005, clean out any chips.
- ❑ Match Drill #40 the holes in the aft flange of the HS-00006 rib to HS-702 and HS-00003.
- ❑ Mark and drill #40 the two holes common to the HS-00003, HS-702, HS-810-1 or HS-814-1 on the forward side of the spar bars, keeping the holes in line with the holes in the aft flange of the HS-00006. See SEC D-D.
- ❑ Reinstall HS-00005. Align the centerline line drawn on the forward flange to the previously drilled holes in the spar assembly and HS-00006 rib. Clamp the rib in place, making sure it fits tightly against HS-00003. Next, cleco the aft flange of the HS-00005 rib to the aft spar. Finally clamp the top and bottom flanges to the HS-801PP skin, then Match-drill the holes in the forward flange of the HS-00005 rib.
- ❑ Cleco the ribs and spar assembly together.
- ❑ Beginning at the rear spar and working forward, match drill the holes in the HS-801PP skins to the HS-00005 rib.
- ❑ Be sure that the front flange of HS-00005, HS-702, HS-810-1 and HS-814-1, HS-00003 and the aft flange of HS-00006 are pulled up tight. Re-clamp the upper and lower flanges of HS-00006 to HS-801PP.
- ❑ Drill to final size or match drill all the remaining holes attaching the HS-801PP skin. The suggested drilling sequence begins at the intersection of the HS-708 center rib and the rear spar and proceeds both up along the rib and outward toward the tip. Put clecos in every second or third hole as you drill them.
- ❑ Remove the skin and drill the remaining holes in HS-814-1, HS-8101 and HS-00003. Remove HS-810-1, HS-814-1 and HS-00003.
- ❑ Repeat the above steps for the right side.

**PREPARING THE HORIZONTAL STABILIZER PARTS FOR ASSEMBLY**

- ❑ Mark and disassemble all parts.
- ❑ Deburr all the holes in both the skin and the skeleton (See “Hole Deburring”, Section 5.2).
- ❑ Dimple the understructure using a pneumatic or hand squeezer. Dimple the rivet holes in the skins using a C-frame dimpling tool (See Section 3).
- ❑ Smooth the edges of the parts (See “Edge Finishing”, Section 5.2).
- ❑ Prime all parts as required (See “Priming”, Section 5.1). The HS-609PP rear spar reinforcement bars, HS-810-1 reinforcement angle and HS-814-1 splice angle are not made of Alclad material, so before riveting, they must be primed.

**RIVETING THE HORIZONTAL STABILIZER**

- ❑ Locate the rivet holes in the rear spar that will attach the HS-706, HS-708 and HS-00005 ribs and the HS-412PP hinge brackets. Put tape over them to prevent accidentally riveting these holes before the ribs are attached.

- ❑ Rivet the HS-609PP bars to the HS-603PP spar channels. The rivet callout is correct on the plans. See Section 5.4. This can be accomplished with either a gun, pneumatic or hand squeezer. You may find it takes a bit of "grunt" to set -4 rivets with a hand squeezer.
- ❑ Rivet the HS-412PP and HS-413PP hinge brackets to the spar.
- ❑ Bolt the HS-411PP center bearing to the spar (See Torque Value Chart, Section 5.20).
- ❑ Rivet HS-810-1 and HS-814-1 and HS-00003 to the HS-702 front spars. Remember the flush rivets in the center of the assembly (See View A-A and Section D-D.)
- ❑ Rivet HS-00006 and HS-00005 to the front spar assembly. The ribs may be gently flexed out of the way to allow better access during riveting.
- ❑ Lay the HS-801PP skin marked for the left side down on a clean surface. Use foam padding if desired.
- ❑ Cleco then rivet HS-707 to the top side of the skin.
- ❑ Cleco HS-706 to the skin. Temporarily cleco HS-708 to HS-801PP and the aft flange of HS-707 to help hold the skin tight against HS-707, then rivet the bottom side of HS-707 to HS-801PP. Remove HS-708.
- ❑ Cleco the forward spar assembly to HS-706, HS-707 and HS-801PP, then cleco on HS-708.
- ❑ Blind rivet HS-702 to HS-707 and HS-708.
- ❑ Rivet HS-702 to HS-706.
- ❑ Rivet HS-702 and HS-708 to HS-801PP.
- ❑ Repeat the above steps for the right side then cleco on the rear spar assembly
- ❑ Rivet the rear spar assembly, HS-00006, HS-00005 and HS-706 to HS-801PP. These holes can all be reached by a hand squeezer.
- ❑ Blind rivet the rear spar assembly to HS-708.

Congratulations! You've finished the first major sub-assembly on your new airplane.

**BUILDING THE VERTICAL STABILIZER**

The assembly of the vertical stab and following references can be found on DWG 6. Construction of the vertical stabilizer is very similar to the horizontal stabilizer.

**DRILLING THE VERTICAL STABILIZER**

- ❑ Cleco the VS-808PP spar doubler to the VS-803PP rear spar. Then cleco on the hinge brackets VS-410PP, VS-411PP and VS-412PP (See Exploded Iso View).
- ❑ The VS-410PP hinge brackets have two holes missing from the pattern. Use the holes in the spar channel and spar doubler as drill guides and back-drill the entire six-hole pattern through the upper VS-410PP only. The corner holes in the lower VS-410PP will be drilled for bolts later, in assembly with the fuselage (See DWG 78).
- ❑ Prepare the ribs VS-704, VS-705, VS-706 and VS-707 (See “Edge Finishing”, “Fluting and Straightening Ribs and Bulkheads”, Section 5.2 & 5.13).

- ❑ Cleco the ribs to the front and rear spars.
- ❑ Final drill #30 VS-808PP, VS-410PP, VS-411PP and VS 412PP to VS-803PP.
- ❑ Drill all rib to spar attach holes to #30.
- ❑ Cleco on the VS-801PP / VS-901 skin.
- ❑ Drill / match drill to final size all the holes attaching the VS-801PP / VS-901 skin.
- ❑ Mark the location and orientation of VS-803PP, VS-411PP and VS-412PP. Disassemble, de-burr, dimple, machine countersink and prime parts as desired (See “Countersinking”, “Dimpling”, “Hole Deburring” and “Priming”, Section 5.1, 5.2, & 5.5).
- ❑ Note as shown on DWG 27/27A the lower portion of the rear spar must lay flush against the F-712/812 bulkhead assembly. Therefore the rivets in this region must be flush on the forward side of the rear spar that mates to the F-712/812 bulkhead (See Rear View, SEC A-A and “Countersinking and Dimpling”, Section 5.5).

**FINISHING THE VERTICAL STABILIZER**

- ❑ Cleco VS-803PP to VS-808PP, VS-410PP, VS-411PP and VS-412PP together. Then tape over the holes that will attach VS-704, VS-706 and VS-707.
- ❑ Rivet the rear spar together remembering the flush rivets on the lower rear spar.
- ❑ Rivet VS-704, VS-705, VS-706 and VS-707 ribs to the front spar.
- ❑ Cleco on the VS-801PP / VS-901 skin.
- ❑ Rivet on the skin. Begin at the intersection of VS-707 and VS-702 and work towards the tip, then restart at the same place and rivet along the front spar toward the root and along the VS-707 rib starting at the front and riveting toward the rear spar.
- ❑ Cleco on the rear spar assembly and install the remaining rivets along the rear spar and end ribs with a squeezer.
- ❑ Blind rivet the rear spar assembly to VS-707.

**BUILDING THE RUDDER**

The assembly of the rudder and following references are shown on DWG 7. The rudder is a balanced surface, having lead weights forward of the hinge line to counteract the weight of the structure behind it. This improves the control "feel" and helps prevent flutter.

**TRIMMING THE STIFFENERS**

- ❑ The R-801PP rudder skin and R-815 (A-H) rudder skin stiffeners are provided with pre-punched holes. The various R-815 stiffeners are snipped from the pre-punched lengths of aluminum angle. The double notch in the edge denotes the overall length of the stiffener. Use aviation snips to cut from center to center of the guide holes (See R-815 (A-H) Detail).

- ❑ Trim the flange of the stiffener (surface perpendicular to the skin) to fit inside the tapered rudder. Single notches on the edge of the stiffener note the beginning points of these trim cuts. Trim the stiffeners and clean up the edges with a file and the Scotchbrite wheel (See R-815 (A-H) Detail).

**FITTING AND RIVETING THE STIFFENERS TO THE RUDDER SKIN**

- ❑ Cleco the stiffeners according to their position on the rudder skin.
- ❑ Drill all skin to stiffener holes to #40.
- ❑ Mark the stiffeners positions and disassemble.
- ❑ Deburr holes, smooth edges, dimple and prime (See “Hole Deburring”, “Edge Finishing”, “Dimpling” and “Priming” Section 5.2, 5.5 & 5.1). Be careful deburring the thin R-801PP rudder skin, too much pressure will ruin a hole in 0.020 aluminum.
- ❑ Rivet the skin and stiffeners together. Back Riveting is the best technique here (See “Back Riveting”, Section 5.6).
- ❑ Bend the rudder trailing edge (See “Folded Trailing Edges”, Section 5.7).

**BUILDING THE RUDDER SKELETON**

- ❑ Cleco the R-606PP, R-607PP and R-608PP reinforcement plates to the R-802PP rudder spar. NOTE that the R-606PP lower reinforcement plate goes on the forward (flange side) of the spar web, while the R-607PP and R-608PP plates go on the rear (See Exploded Iso View).
- ❑ Fabricate the R-717 spacer and both R-716 rudder bottom attach strips.
- ❑ Trim R-710 (See R-710 trim detail).
- ❑ Enlarge the bottom most rod end hole in the forward flange of R-704 to 3/8” diameter with a unibit.
- ❑ Cleco R-704, R-405PD, R-710, R-717 and the platenuts that will hold the rod end bearings to R-802PP.
- ❑ Prepare R-703 tip rib (See “Fluting and Straightening Ribs and Bulkheads”, Section 5.13) and cleco it to R-802PP.
- ❑ Drill/enlarge #30 the holes that attach R-703 to R-802PP. Then remove R-703 from R-802PP.
- ❑ Cleco the R-713 counterbalance skin on R-703. Flute the forward flange of R-703 as required so that the two holes in the forward face of R-713 match those in the forward flange of R-703.
- ❑ Drill to final size the holes that attach R-713 to R-703.
- ❑ Drill to final size all the pre-punched holes in the R-802PP spar web.
- ❑ Drill to final size the holes that attach R-710 to R-405PD and R-704.
- ❑ Cleco the R-801PP skin, R-703 tip rib and R-713 counterbalance skin to the to the understructure.
- ❑ Clamp the R-716 rudder bottom attach strips to the assembly (See Plan View and SEC D-D).
- ❑ Match drill R-710 rudder horn brace and the R-716 rudder bottom attach strips to the rudder assembly using the holes in R-801PP and R-704 as a drill guide.

- ❑ Drill the remaining holes in R-713 and R-801PP to final size.
  - ❑ Mark and disassemble the spar, deburr all holes and edges (See “Edge Finishing” and "Hole Deburring”, Section 5.2). Prime components if/as desired (See “Priming”, Section 5.1).
  - ❑ Dimple the skins, spar and ribs (See “Dimpling”, Section 5.5).
- RIVETING THE RUDDER (See “Riveting”, Section 5.4)**
- ❑ Rivet R-713 to R-703. Omit the three most aft rivets on each side that coincide with the R-801PP skin attach. Note that when fully assembled the R-801PP skin will lay on top of the R-713 counterbalance skin.
  - ❑ Enlarge the two 3/32 guide holes in the forward web of R-703 to #12 and install the E-614-020 lead counterweight as shown (See Exploded Isometric View). E-614-020 may be removed and temporarily set aside so that handling during assembly is easier.
  - ❑ Rivet R-703, R-704, R-405PD, R-606PP, R-607PP, R-608PP and R-717 to R-802PP.
  - ❑ Rivet R-710 to R-405PD then R-704.
  - ❑ Before installing the skin, place a fingertip size daub of RTV inside the trailing edge of the rudder skin at the end of each pair of stiffeners (See “Folded Trailing Edges”, Section 5.7)
  - ❑ Cleco the R-703, R-713 and E-614-020 subassembly, then the R-801PP skin onto the understructure.
  - ❑ Rivet the R-801PP skin to the understructure. Installing rivets in the narrow spaces at the aft ends of the ribs requires special tools. If desired, enlarge the last one or two holes to 7/64” diameter and install MK-319-BS blind rivets. Both AN426AD3 rivets and MK-319-BS blind rivets have heads that fit the same dimple. Add the R-716 rudder bottom attach strips to the R-704 bottom rib as you rivet the rudder skin in place.

**COMPLETING THE LEADING EDGE OF THE RUDDER**

- ❑ Before the rudder can be installed on the vertical stabilizer, its leading edge must be formed. The object here is to achieve a smoothly curved surface that fits neatly between the skin overhang of the stabilizer. Simply pulling the overhanging skins together results in an angle or crease where they cross the edge of the spar (See Rolled Leading Edges”, Section 5.9)
- ❑ Rivet the leading edge together. Blind rivets are used here. They are simple to set with a hand pop-riveting tool, but they are difficult to drill out. Make sure that the heads of the rivets are firmly against the rudder skin before squeezing.
- ❑ Re-install E-614-020 if it was removed during assembly.

**BUILDING THE ELEVATORS**

The assembly of the left elevator is shown on DWG 4. The assembly of the right elevator is shown on DWG 5. The elevators are built much like the rudder. The elevators are balanced surfaces, having lead weights forward of the hinge lines to counteract the weight of the structure behind it. This improves the control "feel" and helps prevent flutter. The major difference between elevators and the rudder is the installation of a trim tab in the left elevator. This need not be an especially difficult task, but it does require careful attention to detail. The majority of builder mistakes on the empennage are made on the left elevator and trim tab. Fair warning! Because of the complication of the trim tab, we'll leave it to last and start with the right elevator.

**PREPARING THE ELEVATOR SKINS**

**TRIMMING THE STIFFENERS**

- ❑ The E-701-L/R elevator skins and E-720 (A-L) elevator skin stiffeners are provided with pre-punched holes. The various E-720 stiffeners are snipped from the pre-punched lengths of aluminum angle. The double notch in the edge denotes the overall length of the stiffener. Use aviation snips to cut from center to center of the guide holes (See E-720 Trim Detail, DWG 5).
- ❑ Trim the flange of the stiffener (surface perpendicular to the skin) to fit inside the tapered elevator. Single notches on the edge of the stiffener note the beginning points of these trim cuts. Trim the stiffeners and clean up the edges with a file and the Scotchbrite wheel (See E-720 Trim Detail, DWG 5).
- ❑ Make stiffeners E-720J, E-720K and E-720L from the existing E-720D, E-720E and E-720F (See E-720 Trim Detail and Note 1, DWG 5). Set aside stiffeners for use in the left elevator assembly.
- ❑ Drill the stiffeners to the E-701-L/R skins. Drill E-615PP to E-701-L. Disassemble parts then, deburr, dimple and prime as desired (See “Edge Finishing”, “Hole Deburring”, “Dimpling” and “Priming”, Section 5.2, 5.5 & 5.1).
- ❑ Back rivet the stiffeners to the E-701-L/R skins (See “Back Riveting”, Section 5.6).
- ❑ Back rivet E-615PP to E-701-L.
- ❑ Bend the trailing edge of the elevator (See “Folded Trailing Edges”, Section 5.7). Remember do not add the sealant to the trailing edge until just prior to assembly.

**PREPARING THE RIGHT ELEVATOR**

- ❑ Separate the E-00001 A & B hinge doublers.
- ❑ Use a file to radius the top and bottom edges of the E-00001 outboard hinge doubler to nest against the spar radius
- ❑ Cleco and drill the E-610PP and E-611PP reinforcement plates, E-00001A & B hinge doublers and corresponding platenuts to the E-702 spar.
- ❑ Prepare the E-703 end ribs and E-704 counterbalance ribs (See “Edge Finishing” and “Fluting”, Section 5.2 & 5.13).
- ❑ Cleco and drill the E-703 end rib to the E-704 counterbalance rib then cleco and drill them to E-702. Remove the ribs from the spar.
- ❑ Place the E-714 counterweight on the forward end of E-703 and E-704 as shown (See View F-F, DWG 5). Cleco the E-713 counterbalance skin to E-703 and E-704, overtop of E-714. The step in the front face of E-714 should butt against the outboard edge of E-713.
- ❑ Use the two holes in the forward face of E-713 as a guide and drill #12 the holes for the screws that will hold E-714 in place. Use a drilling lubricant when drilling the lead E-714’s.
- ❑ Un-cleco E-713, remove and set aside E-714, re-cleco on E-713 to E-703 and E-704. Then cleco the E-703, E-704, E-713 subassembly to E-702.
- ❑ Cleco the E-709 root rib right to E-702.
- ❑ Final drill #40, E-709 to E-702.
- ❑ Cleco E-701-R to the understructure. Note that E-701-R lays on top of E-713.
- ❑ Remove the clecos connecting E-709 to the E-702 then cleco and drill the WD-605-1-R elevator horn to E-702

and E-709.

- ❑ Drill the E-701-R skin to the understructure.
- ❑ Disassemble the elevator.
- ❑ Dimple E-713 for the screw heads that will attach E-714 (See “Dimpling”, Section 5.5).
- ❑ Machine countersink E-714 for the dimples in E-713 (See “Countersinking”, Section 5.5).
- ❑ Machine countersink the E-709 attach holes on the forward face of E-702 (See “Countersinking”, Section 5.5). E-709 and E-702 will be riveted together with flush head rivets, so that the WD-605-1-R elevator horn can be mounted flush with the forward face of the E-702 spar.
- ❑ Bevel the inboard and aft edges of E-713 locally where E-713 overlaps the spar and rib flanges to provide a smooth transition between the counterbalance skin and the E-701-R elevator skin.
- ❑ Deburr, dimple and prime the parts as desired (See “Deburring”, “Dimpling” and “Priming”, Section 5.2, 5.5 & 5.1).

**RIVETING THE RIGHT ELEVATOR (See “Riveting”, Section 5.4)**

- ❑ Rivet E-703 to E-704.
- ❑ Rivet E-610PP, E-611PP, E-00001A & B and platenuts to E-702.
- ❑ Rivet E-709 to E-702 (flush heads forward).
- ❑ Rivet E-703/E-704 to E-702.
- ❑ Rivet WD-605-1-R to E-702 and E-709.
- ❑ Rivet E-713 to E-701, two rivets on the top and two rivets on the bottom (assembling this way eliminates the need for blind rivets).
- ❑ Loosely place E-714 in place nested inside E-713 with screws partially inserted.
- ❑ Insert the elevator skeleton into E-701-R/E-713 beginning at the front end of E-703/E-704 and then rotating the root end aft into proper position.
- ❑ Cleco and rivet E-701-R and E-713 to the understructure.
- ❑ Finish attaching E-714.

**PREPARING THE LEFT ELEVATOR**

The left elevator is similar to the right elevator, the only difference is the use of the E-615PP trim access reinforcing plate, supporting the trim cable or servo, and the E-606PP trim spar.

- ❑ Use a file to radius the top and bottom edges of the E-00001 outboard hinge doubler to nest against the spar radius
- ❑ Cleco and drill the E-610PP and E-611PP reinforcement plates, E-00001A & B hinge doublers and corresponding platenuts to the E-702 spar.
- ❑ Cleco and drill the E-703 end rib to the E-704 counterbalance rib then cleco and drill them to E-702. Remove the

ribs from the spar.

- ❑ Place the E-714 counterweight on the forward end of E-703 and E-704 as shown (See View F-F, DWG 5). Cleco the E-713 counterbalance skin to E-703 and E-704, overtop of E-714. The step in the front face of E-714 should butt against the outboard edge of E-713.
- ❑ Use the two holes in the forward face of E-713 as a guide and drill #12 the holes for the screws that will hold E-714 in place. Use a drilling lubricant when drilling the lead E-714’s.
- ❑ Un-cleco E-713, remove and set aside E-714, re-cleco on E-713 to E-703 and E-704. Then cleco the E-703, E-704, E-713 subassembly to E-702.
- ❑ Cleco the E-705 root rib left to E-702.
- ❑ Final drill #40, E-705 to E-702.
- ❑ Cleco E-701-L to the understructure. Note that E-701-L lays on top of E-713.
- ❑ Remove the clecos connecting E-705 to the E-702 then cleco and drill the WD-605-1-L elevator horn to E-702 and E-705.
- ❑ Cleco and final drill E-606PP to E-705 (at the root end of the E-606PP spar).
- ❑ Drill the E-701-L skin to the understructure.
- ❑ Disassemble the elevator. Deburr, dimple and prime the parts as desired (See “Deburring”, “Dimpling” and “Priming”, Section 5.2, 5.5 & 5.1).
- ❑ Dimple E-713 for the screw heads that will attach E-714 (See “Dimpling”, Section 5.5).
- ❑ Machine countersink E-714 for the dimples in E-713 (See “Countersinking”, Section 5.5).
- ❑ Machine countersink the top flange of E-606PP to accept the dimples in the E-701-L skin (See “Countersinking”, Section 5.5). Dimple the bottom flange of E-606PP.
- ❑ Machine countersink for the rivets that attach E-705 to E-606PP, the flush head can go on either the forward face of E-705 or aft face of E-606PP.
- ❑ Machine countersink the E-705 attach holes on the forward face of E-702 (See “Countersinking”, Section 5.5). E-705 and E-702 will be riveted together with flush head rivets, so that the WD-605-1-L elevator horn can be mounted flush with the forward face of the E-702 spar.
- ❑ Bevel the inboard and aft edges of E-713 locally where E-713 overlaps the spar and rib flanges to provide a smooth transition between the counterbalance skin and the E-701-L elevator skin.
- ❑ See DWG 4 for details of the trim system you have chosen. It is easier to install the necessary parts while access is still available to the inside of the skin. Note that the WD-415 trim cable anchor, related snap bushings and the manual trim cable will be sent in the finish kit.

**BENDING THE LEFT ELEVATOR TABS**

- ❑ Before the elevator is riveted together, the tabs that close the elevator at the trim tab cutout must be bent. Begin by removing any vinyl from the tabs and outboard of the tabs where the bending blocks will touch the skin surface (the vinyl allows the blocks to shift while bending the tabs).

- ❑ Lay a square reference along the trailing edge of E-701-L in the trim tab cutout (where E-606PP attaches). Mark the bend line perpendicular to the aft edge of the E-701-L trim tab cutout. While bending the tabs the bending blocks will move away from the bend line (outboard). Compensate for this by offsetting the bend line approx. 1/32 inboard from the desired bend location.
- ❑ Fabricate a set of bending blocks from particleboard or wood. The taper of the inside block should approximate the completed bend angle of the E-701-L elevator skin. Clamp the skin and blocks to the edge of a table (See Figure 6-1). Use double-sided tape between the mating surfaces of the bending blocks and the E-701-L skin, to prevent the wedge shaped blocks from slipping.
- ❑ Note that the upper tab overlaps the lower one so the joint sheds water. Bend the bottom tab down using the face of a block of wood, working progressively back and forth across the tab (See Figure 6-2). Finish the bend by using a flush set and a rivet gun turned down low (See Figure 6-3). Work the rivet gun across the entire tab without stopping.
- ❑ With the block still clamped in place repeat the above steps to bend the upper tab up and over the bottom tab.

**RIVETING THE LEFT ELEVATOR (See “Riveting”, Section 5.4)**

- ❑ Rivet E-703 to E-704.
- ❑ Rivet E-610PP, E-611PP, E-00001A & B and platenuts to E-702.
- ❑ Rivet E-705 to E-702 (flush heads forward).
- ❑ Rivet E-703/E-704 to E-702.
- ❑ Rivet WD-605-1-L to E-702 and E-705.
- ❑ Rivet E-713 to E-701, two rivets on the top and two rivets on the bottom (assembling this way eliminates the need for blind rivets).
- ❑ Loosely place E-714 in place nested inside E-713 with screws partially inserted.
- ❑ Insert the elevator skeleton into E-701-L/E-713 beginning at the front end of E-703/E-704 and then rotating the root end aft into proper position.
- ❑ Cleco and rivet E-701-L and E-713 to the understructure.
- ❑ Rivet E-606PP to E-701-L along the bottom flange only. Leave the top flange unriveted at this point for installation of the trim tab hinge. Rivet E-606PP to E-705.
- ❑ Finish attaching E-714.

**BUILDING THE TRIM TAB**

- ❑ Complete the trailing edge bend of the E-619-1-020 trim tab skin (See “Folded Trailing Edges”, Section 5.7).
- ❑ Fabricate a set of bending blocks from wood or particleboard (See Figure 6-1,6-2,6-3 and 6-4). Note that the upper block hooks over the lower block to prevent the wedge shaped blocks from slipping. The taper of the inside block should approximate the completed bend angle of the trim tab skin.
- ❑ Remove the vinyl from the ends of the trim tab and mark bend lines on the tab (See Trim Tab Bend Detail, DWG 4). While bending the tabs the bending blocks will move away from the bend line (toward the center of the trim tab). Compensate for this by offsetting the bend line approx. 1/32 from the desired bend location.

- ❑ Clamp the inboard end of the tab with the bending blocks to the edge of a table (See Figure 6-1) Use double-sided tape between the mating surfaces of the bending blocks and the trim tab skin to help prevent the wedge shaped blocks from slipping.
- ❑ Bend the bottom tab down using the face of a block of wood, working progressively back and forth across the tab (See Figure 6-2). Finish the bend by using a flush set and a rivet gun turned down low (See Figure 6-3). Work the rivet gun across the entire tab without stopping.
- ❑ With the block still clamped in place repeat the above steps to bend the upper tab up and over the bottom tab (See Figure 6-4).
- ❑ Repeat the above steps for the outboard tabs.
- ❑ Cleco E-607PP to the inside bottom surface of E-619PP-1-020.
- ❑ Clamp E-718 to E-717 and run a clevis pin through the clevis pin attach hole for alignment. Cleco the E-717 outboard horn to the trim tab skin. Using the holes in E-718 as a drill guide, match drill E-718 to E-619-1-020 and E-607PP.
- ❑ Use the dimensions given on DWG 4 to position and clamp E-721 to the top flange of E-607PP. Mark the inboard edge of E-619PP-1-020 and E-607PP on E-721.
- ❑ Drill the remaining holes attaching E-619PP-1-020 to the bottom flange of E-607PP. Drill the holes attaching E-619PP-1-020 to the top flange of E-607PP and E-721.
- ❑ Disassemble the trim tab.
- ❑ Machine countersink the top of the E-607PP trim tab spar to accept the dimples in the trim tab skin (See “Countersinking”, Section 5.5). Dimple the bottom flange of E-607PP.
- ❑ Trim off the excess material from the E-717 outboard trim tab horn and the E-718 inboard trim tab horn depending on the type of trim system used (See Manual Trim Assembly or Electric Trim Assembly, DWG 4).
- ❑ Trim the inboard edge of the aft portion of the E-721 trim tab hinge.
- ❑ Prepare the parts (See “Edge Finishing”, “Deburring”, “Dimpling” and “Priming”, Section 5.2, 5.5 & 5.1).
- ❑ Cleco the trim tab back together.
- ❑ Rivet the bottom of E-619-1-020 to the bottom flange of E-607PP, E-717 and E-718.
- ❑ Remove the clecos along the top flange of E-606PP and clamp E-721 to the upper flange of E-606PP and the aft edge of E-701-L.
- ❑ Adjust the position of the hinge on the elevator so that the inboard and trailing edges of the trim tab are aligned with the corresponding edges on the elevator (The trailing edge being more critical than the inboard edge). Use a long straight edge to aid in aligning the trailing edge.
- ❑ Match drill and cleco the forward portion of E-721 #40 using the holes in E-701-L and E-606PP as a drill guide.
- ❑ Mark the inboard edge of the E-701-L skin on E-721.
- ❑ Remove E-721 and trim the inboard end to match the inboard edge of the E-701-L skin.
- ❑ Re-cleco the tab hinge and trim tab assembly onto the elevator.

- ❑ Sight down the trailing edge of the elevator, with the trim tab in trail. If the tab has any twist and does not continue the straight line of the elevator trailing edge, now is the time to correct it. Even with the clecos installed, there is enough play in the holes to gently twist the tab as necessary to align it perfectly. When the tab fits, use tape or a second pair of hands to hold it, and drill the folded ends of the inboard tabs.
- ❑ With a pair of clecos in the inboard tabs, and a couple of reference marks for alignment, remove the trim tab from the elevator.
- ❑ Carefully maintaining the alignment, set the rivets on the top of the trim tab.
- ❑ Set the blind rivets in the ends of the trim tab, making sure they don't interfere with the rivets in the inboard tabs of the elevator.
- ❑ Rivet the forward (elevator) half of E-721 to the elevator.
- ❑ Install and bend the trim tab hinge-pin and secure as shown on DWG 4, View A-A. The hinge pin supplied is too short to do this now. You will receive longer pins with the fuselage kit.

**FINISHING THE ELEVATORS**

- ❑ Roll and rivet the leading edges (See “Rolled Leading Edges”, Section 5.9).
- ❑ Install the rod end bearings as shown (See Detail D, DWG 5).
- ❑ Make a preliminary check to see that the elevator will swing through its full up and down travel without any interference’s (See “Flight Controls”, Section 15). Travel is best measured with a protractor or an electronic "smart level". It will probably be necessary to remove the bottom flange of HS-603PP to allow the elevator horns enough swing. DO NOT remove any of the HS-609PP bar!
- ❑ Align the trailing edge on the extended chord line of the stabilizer: "in trail." The counterbalance arm should align evenly with the stabilizer. Secure the elevator in this position.
- ❑ Fabricate a “drill bushing” with an outside diameter of 1/4" and an 3/32" inside diameter. Any small metal tube can be used. The bushing will protect the VA-146 hinge bearing from the drill bit and act as a drill guide to locate and drill the hole in WD-605-1-R for the bolt that attaches the horn to the center bracket.
- ❑ Insert the drill bushing into the HS-411PP hinge bracket/bearing assembly. Using the drill bushing as a drill guide, pilot drill WD-605-1-R to #40.
- ❑ Remove the elevator from the horizontal stabilizer and carefully drill the hole in the WD-605-1-R horn to final size.
- ❑ Repeat the above steps for the left elevator assembly.
- ❑ At this point the E-714 counterweights will overbalance the elevators. Final adjustments are made after the elevators are complete and painted. It is impossible to make the elevator balance exactly until is finished. The best approach is probably to leave the counterweights a little heavy, then drill the inboard side of the counterweight with a series of small holes until the elevator balances. A correctly balanced elevator will remain "in trail".
- ❑ Install the elevators on the horizontal stabilizer and make a check for alignment. There should be no binding in the hinge line.

**INSTALLING FIBERGLASS TIPS**

You can add the fiberglass tips to the completed empennage now or you may chose to wait and do all the fiberglass work at a later stage. Fiberglass is abrasive and will dull your countersink.

After dimpling the skins and machine countersinking the fiberglass, the tips are attached with CS4-4 “pop” rivets. Installing the rudder and elevator tips first will make it easier to fit and trim the tips of the horizontal and vertical.

Figure 6-5 details ideas on closing the open ended tips.



Figure 6-1



Figure 6-4

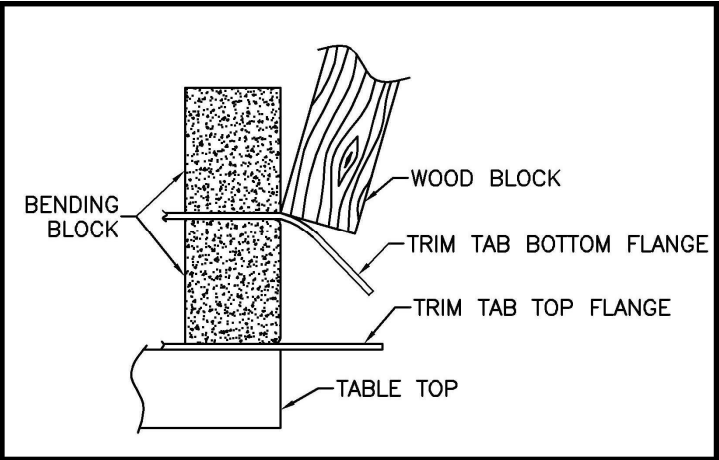


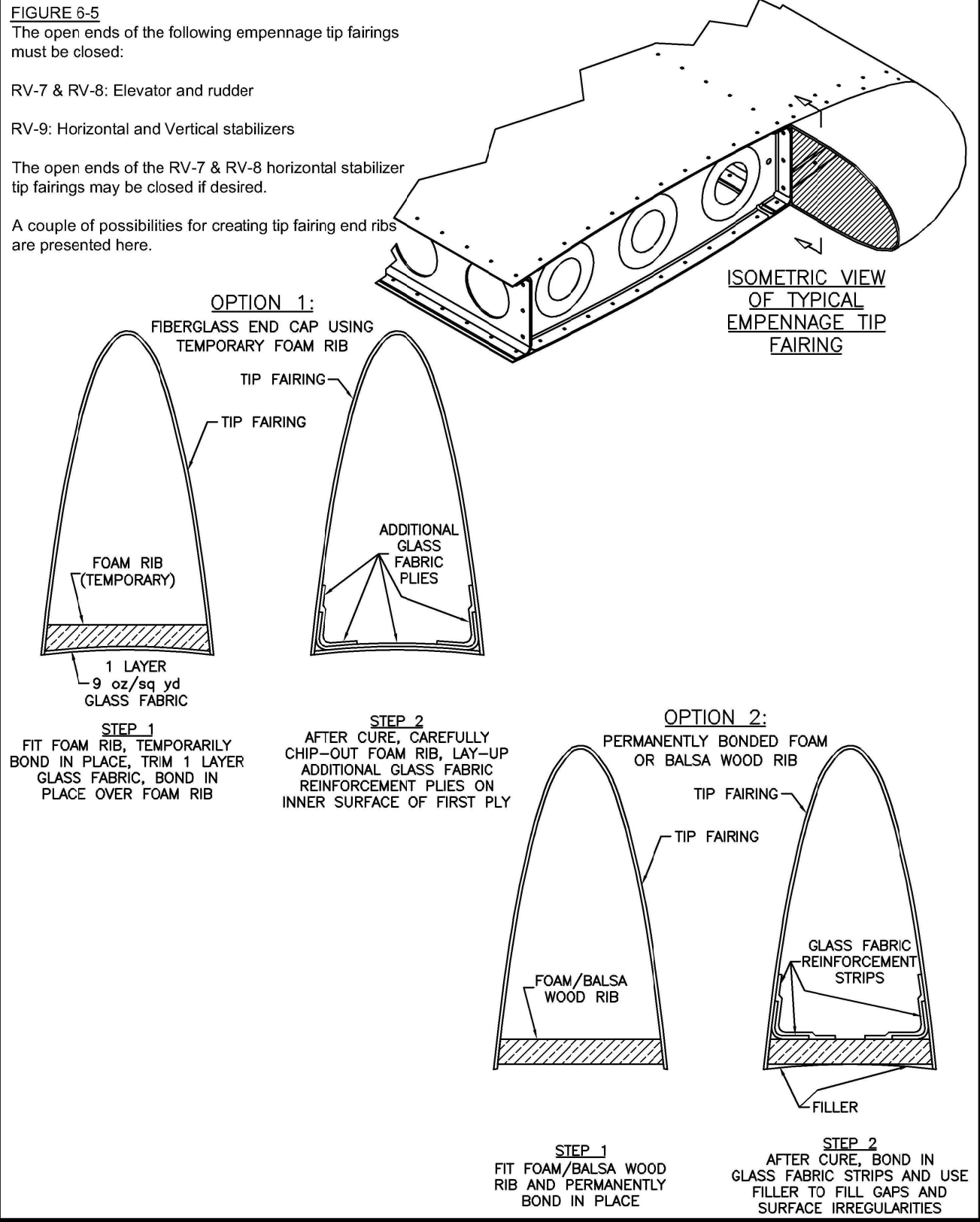
Figure 6-2



Figure 6-3



NOTES:





## SECTION 7: BUILDING THE WING

### FIRST, A NOTE TO QUICKBUILDERS

All information necessary to complete the RV-8/8A QuickBuild Kit is contained in the standard Builder's Manual. The empennage, built from the Standard Kit, should be completed before starting the wings and fuselage. The skills learned during empennage construction are necessary during the rest of the project.

After completing the empennage, we suggest finishing the wings. They will not take long, and are relatively easy to store. The jig shown in the Builder's Manual is not required to align QuickBuild wings, but you may find it a convenient way to hold the wing while fitting and riveting.

Obviously, not all the information needed to build wings from the Standard Kit is necessary for wings built from the QuickBuild Kit. However, we still recommend reading the entire chapter to gain the "big picture." Once you understand the basics of wing building, you can extract the relevant information for the QuickBuild Kit.

Use the following sequence as a place to start.

- Install Wd-421L&R-PC bellcranks. See Builder's Manual section ATTACHING AILERONS TO THE WING and DWG 15A. Remove the top bracket to facilitate installing the bolt.
- Make the W-818 and W-816 pushrods. See Builder's Manual section ATTACHING AILERONS TO THE WING and DWG 15A.
- Install W-413L&R and W-414L&R aileron brackets on rear spar. See Builder's Manual section INSTALLING THE AILERON BRACKETS in the RIVETING THE WING SKIN Section and DWG 13A.
- Be sure lighting, wiring, and pitot line provisions are complete.
- Prepare and rivet the W-705 outboard bottom skin. See Builder's Manual sections RIVETING THE WING SKINS and FINISHING THE WING and DWG 12.
- Install the W-715-1 wingtip. See Builder's Manual section WING TIP INSTALLATION and DWG 12.
- Complete details of access panel in W-705. See DWG 12.
- Install the ailerons and flaps on the wing. See Builder's Manual sections FLAPS, ATTACHING AILERONS TO THE WING and DWGS 13A, 14A, 15A.

### OVERVIEW

The wing assembly sequence begins with the construction of the main and rear spars. Leading edge and tank assemblies are then fitted to the main spar. The wing main ribs are then prepared and installed to the spars. The skeleton is placed in a holding fixture where the main skins are fitted. The wing is then checked for overall dimensions and twist. The leading edge and main skins are then taken off for dimpling, priming, and subassembly prior to final riveting on the wing. The bottom skins are left off until last. The internal parts of the wing (aileron and flap hangers, aileron and flap braces etc.) are installed. Riveting the lower outboard skin closes the wing.

### GETTING READY

Before construction begins, spend some time building a few simple fixtures. Modify the vertical stabilizer jig into a wing assembly stand by adding arms and supports as shown on DWG 12A. Also on DWG 12A is a simple tool for aligning the ailerons and flaps.

The biggest fixture project is the wing stand shown on DWG 12A. If you take the time to build this before starting wing construction, you will have a convenient, safe place to store the finished wing panel. Some builders add custom details, like swiveling casters, to make the wing stand even more useful.

### PREPARING THE MAIN SPAR

The main wing spar is supplied completely assembled and anodized for corrosion resistance. Carefully inspect the spar for shipping damage. Use a large marking pen to mark the orientation of the spar ("right top", "forward", "left bottom", etc.) and study the plans until you understand how the spars are installed. You do NOT want to build a wing upside down!

To begin wing construction, rivet the tank skin attach platenuts to the spar as shown in DWG 16A, Detail A.

Machine countersink (trying to dimple the 0.063 thick spar flange will result in severe distortion!) the platenut attach holes in the W-806A spar flange. See Section 5E. Use a microstop countersink with a #30 pilot to countersink the screw holes in the spar to the proper depth for the #8 screw. The pilot will center in the countersunk platenut well enough to keep the hole round and concentric. (Tip: cut a #8 screw short so that it enters the K1100 nutplate easily and use it to gage the depth.)

Attach the K1000-06 platenuts for the W-822 access plate to the W-706A flange (note that the access plate uses #6 screws on the spar flange and #8 screws around the perimeter.) See DWG 9A. Dimple the access plate for a #6 screw, then machine countersink the spar flange to fit the dimples. Use a #40 piloted countersink cutter to center in the platenut. Make another test patch to determine the depth adjustment of the countersink.

Attach the two K1000-4 center section attach platenuts to the forward side of the spar. Countersink the W-706C doubler plate to allow the flush heads of the rivets to rest on the aft side of spar. This allows the doubler plate to fit flush against the F-804G-1 vertical bars (DWG 11A).

Spot prime all countersunk holes where the anodizing has been removed.

Fabricate the tie-down assembly (DWG 15A). Make the two W-726 spacers, but leave them undrilled. Cut the W-731 Tie-down bar to length from the AEX stock provided and drill the match hole at the dimensions shown. Clamp the W-731 and W-726 spacers to the spar and slip a bolt through the location hole and the hole in the spar. Align the W-731 and back drill all the bolt holes through the spar.

Remove the tiedown and spacers from the spar, cleco or bolt them together and drill the holes for the platenut rivets. Use a platenut as a drill guide. Rivet the platenuts, spacers and tie-down together and bolt the assembly to the spar. Note that the platenuts are NOT riveted to the spar web. If a platenut must be replaced, the tiedown assembly can be removed and the repair made out on the bench, without drilling rivets out of the spar.

Remove the assembly, deburr and prime. Install the tiedown assembly and the W-823PP bellcrank brackets on the spar. The tie-down rings are not supplied in the kit, as they are simply 3/8 inch eyebolts available from most hardware stores. Weld the eyes closed to add strength. If you prefer you can order forged tiedown rings (p/n Bolt Eye 3/8x16TD in Van's Accessories Catalog.)

Drill the W-706-L Spar for the stall warning system wire run. See OP46-02 Step 8 and OP46-02 Figure 3.

### ASSEMBLING THE REAR SPAR

The W-707 rear spar assembly, shown on DWG 10A, is a "Z" section channel, reinforced where it joins the fuselage and at the aileron brackets.

Deburr the edges of the W-707A rear spar channel, W-707G reinforcement fork, W-707D doubler plate, and the W-707E and W-707F doubler plates.

Begin rear spar assembly by clamping the W-707E and W-707F doubler plates to the spar. Vertical placement is correct when the flanges of the spar and the reinforcement plates are tight. Lateral placement for W-707F is determined by aligning the outboard edges of W-707F and the W-707A spar channel. To place W-707E measure the distance between the outboard edges of W-707E and W-707A (See DWG 10A).

Using the spar as a template, clamp, drill and cleco W-707E/F to the W-707A spar channel. Mark and cut out the holes for the aileron pushrods. You can use a Unibit to remove a major portion of the area, and then use a round file or a rotary cutter in a die grinder to remove the remaining portion. Carefully smooth and deburr the inside of the holes.

Cleco the W-707G reinforcement fork and the W-707D rear spar doubler plate to the W-707A spar channel and drill the rivet holes to full size.

Deburr, prime and prepare the rear spar components for riveting. Note that some of the holes in the W-707F are machine countersunk for flush rivets (DWG 10A, Detail A).

Once the reinforcement fork is riveted to the spar, it is difficult to dimple some of the holes in the upper flange of the spar. On the inboard top flange, for the length of the W-707G, drill the holes for the main wing skin to final size (#40) and dimple them before attaching W-707G.

Some rivets in the rear spar reinforcements also attach ribs, aileron brackets, aileron gap fairings and the flap braces. Tape over these holes so you do not inadvertently put a rivet in one.

Rivet the components of the rear spar together.

**PREPARING THE WING RIBS**

You will save time if you set up and prepare all the ribs for both wings at the same time.

Begin preparing the ribs by deburring the edges of the flanges and lightening holes. A small Scotchbrite wheel mounted in a die grinder prepares the inside edges of the holes quickly and easily. Pay particular attention to the forward parts of the leading edge ribs. Remove all bumps around the notches to insure that the skin fits well.

Wing ribs come in seven flavors. Part numbers are marked on the ribs at the factory, but if you cleaned them off by mistake, they may still be identified:

- There are three types of main ribs, W-710, W-711 and W-712. At first glance they look identical, but they are not. W-710 is 0.032" thick. W-711 and W-712 are 0.025" thick. W-712 is slightly longer than W-711 and the 7/16" dia. hole near the front flange for the pitot tube line is omitted.
- There are two different leading edge ribs: W-408-1 and W-709. The W-408-1 rib is slightly (0.032") undersized around the perimeter to accommodate the W-423 joint plate, is 0.032" thick, and does not have holes in the curved flange.
- Tank ribs differ in thickness and hole pattern. T-703 ribs, used on the ends of the tanks, are 0.032" thick. The internal T-704 ribs are 0.025" and have a pattern of large holes to allow the fuel to run from one bay to another. The holes in the upper side are for venting air, and are located at the high point of the tank in a three-point attitude and in cruise flight. DON'T CONFUSE LEADING EDGE AND TANK RIBS. They look much the same, but the tank ribs are shorter.

Ribs may be either "left" (suffix L, i.e.: W-709-L) or "right" (suffix R, i.e.: W-709-R). You may identify the "hand" of a rib by holding it with the leading edge away from you with the flange closest to the tooling holes toward the floor. If the flange is on your left, the rib is an "-L", if it is on the right, it is an "-R".

Adjust rib flanges 90° to the web using hand seamers.

The forming process leaves ribs bowed, particularly the leading edge ribs. Straighten the webs with fluting pliers. Place the center of each flute at the midpoint between the prepunched holes. Use a straightedge or holes in a wing skin to check for straightness of the line of rivet holes. The straighter the parts, the better they will fit.

Make provisions for running stall warning system wires (left wing only) and, if you intend to install them, wingtip position lights, strobes or landing lights. Drill holes in the ribs for grommets, or conduit sold in VAN'S ACCESSORIES CATALOG. Opening up the tooling holes works well. Be careful not to interfere with the pitot line or control systems. Leave the tooling hole in the outboard tip rib undrilled for now. The smaller hole is useful for aligning the aileron. The 7/16" hole in the inboard ribs of the left wing get plastic grommets for routing the pitot tube line.

**ASSEMBLING THE WING SKELETON**

**MAIN RIB/SPAR ASSEMBLY**

Cleco the W-710, W-711 and W-712 ribs to the main and rear spars. Be sure the proper ribs are in the right locations and that wire and pitot tube routings are aligned. The ribs do not have all their flanges facing the same way.

Drill the holes attaching the ribs to the spars to full size. Most of the ribs simply fit to the spar without modification, but the rear flanges of the three inboard W-711 ribs require two new rivet holes. Drill these, using the holes in the spar as guides. The holes left unused in the rib are simply abandoned.

Remove the ribs and do the necessary deburring and priming.

Reassemble the ribs and spars with clecoes.

Put protective tape on the W-706B/D spar flange bars to prevent bucking bar damage when installing the top and bottom most rivets. Rivet the main ribs to the front and rear spar, EXCEPT for the outboard W-712 rib, which is riveted to the rear spar, but not the main spar. Place the manufactured head of the rivet on the rib flange (side with thinnest material), to prevent distorting the parts.

**WING STAND**

Although the matched-hole process eliminates the need for the traditional wing jig, mounting the wing in a stand will make it easier to build. A stand allows access to both sides of the wing and makes it easy to take measurements and assure the wing is straight. The wing has no washout, twist or taper.

The stand (shown on DWG 12A) is simple; two vertical posts run from floor to ceiling. Horizontal arms of steel angle or wood, bolted to the posts, support the main spar. The size of the posts and arms is not important, but they must be sufficiently strong and rigid to support the wing.

Clamp or bolt the wing skeleton to the horizontal arms of the jig. To provide a mounting point on the outboard end of the wing, drill and bolt a temporary 5" long piece of aluminum angle, parallel to the spar web, to the outboard rib with 3/16" bolts. The small additional holes in the ribs will not compromise strength.

The center of the skeleton will sag toward the floor when it is mounted in the stand. To make installing and removing the skins easier, support the skeleton in the middle. Run a fishing line along the rivet holes in the main spar. Then adjust the middle of the skeleton with a 4x4 wood block and shims, screw jack, etc., (almost anything that will remain stable works) placed under a rib. Raise the skeleton just enough to bring the rivet holes even with the fishing line along the length of the spar.

**FITTING THE WING SKINS**

Wing skins are pre-punched with pilot holes for the ribs and spars. The vinyl can be left in place when fitting and drilling the main wing skins to prevent scratches (except on the inside of the leading edge and tank skins, where the vinyl should be removed before fitting.) Remove the vinyl before dimpling to prevent pounding trapped drill shavings into the skin with the dimple die.

**FITTING THE WING WALK DOUBLERS**

The wings have doublers under the main skin next to the cabin sidewall to add strength and help support the loads imposed by people entering and leaving the airplane. Make the wing walk doubler (DWG 17A) from AS3-025x9 3/8x26. Lay W-702 on a bench and slip the doubler underneath it. The doublers nearly butt against the aft edge of the main spar channel and overhang the rear spar by about an inch. Align the inboard edges and set the forward edge of the doubler 9/16" aft of the forward edge of the skin. Using the skin as a guide, drill all the holes for each rib in the wing-walk doubler.

**FITTING THE MAIN SKINS**

Cleco the forward row of holes in W-702 and W-703 skins to the matching holes in the main spar. Cleco the W702 and W-703 skins in place using a cleco in every fourth hole.

Don't forget to insert the doubler between the ribs and the W-702 skin. The main skins overlap at the eighth rib from the root. The outboard skin should fit on top of the inboard one.

Gently pull ribs into position if the matched holes do not align with the skin holes. Drill all the holes to final size.

Start drilling in the upper middle of the panel and work down and out toward the edges, work out any slack as you go.

Move the clecoes down one hole (into the drilled holes) and drill all the remaining holes.

Draw a couple of lines on the main skins that intersect at the center of the hole for the tiedown eye.

Remove the bottom main skins before fitting the leading edge and tank skins. Leave the top skins clecoed.

**LEADING EDGE ASSEMBLY**

**BUILDING THE CRADLE**

Construct a cradle as shown on DWG 12A to hold the tank and leading edge during construction. Don't waste time making the cradle perfect, since it simply holds the leading edge, and has no bearing on alignment. Use a W-709 rib to trace the shape. Pad the surfaces of the cradle to prevent skin scratches.

**FITTING THE LEADING EDGE**

Remove the vinyl from the inside surface of the W-701 leading edge skin.

Modify the W-701-L leading edge skin for the stall warning assembly. Complete OP46-02 Steps 1-4 and OP46-03 Steps 1-5.

Place the W-701 leading edge skin in the cradle. The ribs are much easier to install with it pre-bent to shape in the cradle.

Cleco the W-709 ribs into the W-701 Leading Edge Skin. The rear flange hole patterns of the two W-709 ribs just outboard of the tiedown do not match the hole pattern on the spar. In this case, use the spar as a guide to drill the ribs and abandon the unused holes in the rib.

Install the clecoes on the top first; working from the front to the rear. Then cleco the bottom, also working from the front to the rear. Cleco the VA-195F mount bracket to the W-701-L leading edge skin (OP46-04 Step 8). The most inboard rib (W-408-1 Leading Edge Rib) is not pre-punched with holes and will be installed later. Mark the ribs so they may be reinstalled in the same location.

Remove the leading edge assembly from the cradle and place it on the spar. Put clecoes through the spar into the ribs. Also cleco the W-701 Leading Edge Skin to the wing spar through about every third hole.

Slide the W-408-L Leading Edge Rib in place starting at the lower aft edges of the Leading edge skin. Back drill the rear flange from the spar and cleco in place. Mark a line on the W-423 Joint Plate 1/2" (with the vinyl removed) from the edge. This line will match up to the holes in the skin, leaving 11/16" exposed to support the tank skin. You can pre-bend the W-423 to make it fit better around the leading edge.

Work the W-423 Joint Plate into place between the W-701 Leading Edge Skin and W-408-1 Leading edge rib. You can gently tap the rib or strip with a soft hammer to coax things into place. When the strip is in position you will see the line through the pre-punched holes in the skin. Re-check the position of the W-408-1 rib by measuring from the edge of the joint plate to the web of the rib.

Drill all the ribs and the joint plate through the pre-punched holes in the leading edge skin.

Extend the lines for the tiedown eye onto the leading edge. They should intersect at the pre-punched hole but variations will occur. If necessary, file the hole in the correct direction to center it over the tiedown hole, then drill it full size with a Unibit.

Leave all of the clecoes in place and get busy on the tank.

## **ASSEMBLING THE FUEL TANKS**

The fuel tanks are also the inboard leading edge of the wing, so they are constructed in a manner similar to the outboard leading edge. However, the tank is removable so the tank ribs can not be permanently attached to the spar. The tank is attached to the wing two ways. Flush machine screws fasten the skin to the spar flanges and bolts hold the T-712 fuel tank attach brackets (mounted on the rear tank baffle) to the spar web. The tank is also held to the fuselage by the T-405 attach angle.

Fuel tank construction and details are on DWG 16A.

### **FITTING THE ATTACH ANGLES TO THE SPAR AND REAR TANK BAFFLE**

Mark a vertical centerline on the forward and aft flanges of all the T-712 attach angles.

Find the exact lengthwise center of each flange. Drill a 1/8" hole in one flange of each angle. Set one T-712 aside and drill a #12 hole in the center of the other flange on the remaining six. When you are done, six of the attach angles will have a 1/8" hole in one flange and a #12 in the other. The seventh attach angle will have one 1/8" hole in one of the flanges and the other flange will be blank.

Cleco the drilled T-712 Attach Angles to the aft side of the pre-punched main wing spar so you have good access with the drill. Position them so the centerline is centered in the pre-punched holes in the spar. Clamp the angles in place and drill the remaining holes using the spar as a guide.

Remove the angles and rivet the platenuts to them, then bolt them in place on the front of the main wing spar.

Cleco the T-702 Baffle to the forward side of the T-712 Attach Angles. Check to see that the centerlines on the angles are visible through the holes in the baffle.

Cleco the seventh attach angle to the tank baffle between the baffle and the spar. Verify that you can see the centerline on the angle through the holes in the baffle and the spar. Back drill through the spar for the three AN3 bolts that attach the angle to the spar. Do not drill the other four holes through the baffle to the angles yet.

Install the three nutplates on the aft side of the spar.

### **FITTING THE TANK SKINS TO THE RIBS AND REAR BAFFLE**

Complete any remaining rib preparation details. Bend flanges 90° and flute ribs. Use a square to check the flanges and a straight edge and/or skin to check the ribs for rivet hole alignment.

Make all T-711 A through D stiffeners as shown on DWG 16A. Round all stiffener corners, deburr edges, then cleco and final drill them to the T-701 skin.

Cleco the tank skin to the baffle (still fastened to the spar) and the wing spar. The fit between the spar, baffle, tank

skin and leading edge should be perfect. If not, elongate the holes in the baffle inboard or outboard as necessary to allow the baffle holes to align with the T-701 holes when T-701 is clecoed to the spar.

Remove the T-701 skin and cleco all the tank ribs to the baffle. Drill the rib/baffle/attach bracket holes full size. Use a drill stop to prevent damaging the spar.

Remove the vinyl from the inside of the tank skin and cleco the skin to the ribs, baffle and spar.

Match drill T-701 to W-423.

Remove the clecoed tank assembly from the wing, and drill all rivet holes to final size. (Doing so off the wing prevents accidentally drilling into the spar).

Machine countersink the spanwise rows of holes in the T-701 tank skin (not the baffle) that attach the skin to the T-702 baffle. Have the baffle in place so that the pilot has a good hole to guide the countersink. This makes it easier to slide the baffle into position on final assembly.

Drill the spar attachment screw holes and the W-423 screw holes to final size using a #19 drill.

Disassemble the tank, marking all parts so they may be easily returned to the same location.

Fabricate the T-405 tank attach angle and pre drill with the rivet holes per DWG 16A.

Clamp the T-405 and T-410 reinforcing plates in place on the end ribs and drill the attach holes.

If you plan to use the capacitive fuel gauge senders offered in the VAN'S AIRCRAFT ACCESSORIES CATALOG you should complete their installation at this point using the instructions supplied in the sender kit.

### **FINAL PREPARATIONS**

Modify the inboard end ribs as shown in the right side view of DWG 16A. The large hole for the access cover is best cut using a flycutter on a drill press.

Stiffener ring T-407 and access plate T-708 are supplied pre-punched. (The T-708 access plate is designed to mount the Stewart-Warmer float-type sender offered in VAN'S ACCESSORIES CATALOG. If you wish to install a different sender, the T-411 plate is available without the sender mounting provisions).

Clamp the T-708 cover plate on the rib with the flat forward edge aligned with the stiffener bead, and an equal distance to the top and bottom rib flanges. Drill all of the screw holes, clecoing as you go (be sure the hole for the fuel pick-up tube is oriented toward the top of the tank). Remove the T-708 and cleco the T-407 in place. If you are using the standard fuel pick-up tube, make and install the T-715 anti-rotation bracket on the inside of the T-708. Install the AN833 fitting at the same time, you can't get it in later. Because a gasket does not seal this location, install the bracket with sealant.

Drill all of the platenut rivet attach holes. Remove the T-407, deburr all holes, dimple the rivet holes in the rib, and machine countersink the rivet holes in the T-407 for the dimples. Rivet the T-407 and the platenuts in place. The gasket under the T-708 cover plate will seal these rivets, so they do not have to be set with tank sealant.

Fit and drill the T-406B fuel cap flange. Use the cap (installed in the cap flange) as a guide for centering the flange in the tank skin opening. Note that the cap flange has two slight bends in it to help it to conform to the curve of the tank skin. Make the T-714 clip from a scrap piece of aluminum and drill it for installation sharing one of the cap flange rivets. Countersink the top of the T-406B to accept the dimples in the tank skin.

Center the VA-112 drain flange on the prepunched hole and drill it to the tank skin. Machine countersink the holes for the attach rivets.

Dimple the skins and ribs. Dimple the holes for screws with the C-frame tool and a hammer, instead of trying to form them with a rivet squeezer. It looks nicer.

Do not prime any area that will be on the inside of the tank. Fuel could have an adverse effect on the primer, or (worse) vice versa. At this point, all parts of the tank should be deburred, dimpled, and primed as necessary.

### **ASSEMBLING AND SEALING THE TANK**

Plan on two or three work sessions to seal a tank. Working on both tanks at once will help to speed things up. See section 5S for more information. The tank is riveted together just like any other structure with one very important difference. Apply sealant between the parts to any seam through which fuel could conceivably leak. This includes every rivet. The recommended sealant, MC-236-B2 is available through VAN'S ACCESSORIES CATALOG.

Although the sealant used to seal the tanks is not particularly noxious, only use it and the solvents used in tank

construction with adequate ventilation. Use a respirator, gloves (which also keep oil from your skin off the surfaces to be sealed) and protective cream when sealing the tanks. Why expose your skin and lungs if you can prevent it?

Roughen all mating surfaces using a scotchbrite pad. Don't be bashful; score the aluminum well, so the sealing compound will have more surface to grip.

Clean the manufacturing residues and oils off all the rivets by sloshing them in a jar of solvent and drying them on a clean rag. Clean the mating surfaces of the skin, stiffeners and ribs. Clean every surface that the sealer is applied. Recommended cleaners include naphtha or MEK. Builders have also reported excellent results with etching using a light phosphoric acid (brand names include AlumaPrep or Twin Etch).

It is essential that the surface of the aluminum be clean when the sealer is applied. Not just kind-of-clean or clean enough. Clean.

After cleaning, do not pollute the areas to be sealed. Don't even touch them. Oils from your skin will affect the bond of the sealant.

The tank sealant should be mixed as accurately as possible. This is done by weight. Follow the instructions supplied with the sealant. When mixing sealant, do not mix too much at one time. A batch the size of four or five golf balls is usually enough for one work session. The sealant provides 45 to 90 minutes of working time (less in warmer temperatures). Measure by volume or weight as accurately as possible and mix thoroughly before applying. To use the sealant as soon as possible, have all the work well planned and tools all laid out. Have a container of acetone, MEK, or lacquer thinner nearby for the frequent tool cleanings necessary during riveting. You can peel away overflow on areas you want to keep clean by strategically applying plastic tape before spreading the sealant (such as along any areas of the skin that have to mate flush with the wing spar or W-423 splice plate).

After thoroughly mixing the sealant, use Popsicle sticks to apply an approximately 1/16" thick layer to the parts being riveted. In the first work session rivet on the T-711 stiffeners. Back-riveting works well here, so spread a thin layer of sealant on the inside of the skin, covering the area the stiffener will contact, then insert the rivets into the skin from the outside and tape them in. Press the stiffener into place. Sealant will ooze out around all the stiffener edges. When the stiffener is firmly seated, back rivet it permanently into place. Even more sealant will squeeze out as the rivets set. Clean this away, making neat fillets around all the edges of the stiffener with the curved end of the Popsicle stick. Dab a bit of sealant over every rivet head.

Rivet the VA-112 drain flange, T-406B fuel cap flange and T-714 clip to the skin, using sealant in the same way. Cover the aft tooling holes in the outboard T-703 end ribs by riveting on a small plate, or by filling the hole with an AN470AD6 rivet. (See Figs. 7-8, 7-11.) After each session clean everything that you do not want to have a permanent coat of sealant. It is much easier to clean up before the sealant sets.

For the next session, rivet all the interior ribs to the skin (if you can only do a few ribs at a time, that's fine.) Work in the "cradle." When assembling the tank, cleco all ribs to the skin. This keeps the assembly straight. You may want to start riveting with the rib next to the outboard one. After this rib is clecoed in place with sealant you can remove the outer end rib for easy riveting access. Remove the ribs one at a time, apply sealant, and rivet. When riveting the ribs to the skin work from the leading edge to the trailing edge.

Insert the rivets and set them with a squeezer or a rivet gun, as appropriate. Use the Popsicle sticks to form the squeezed-out sealant into fillets in the rib/skin joint. Apply extra sealant to the rivet heads.

Next, install the inboard end rib. After the rivets joining this rib to the skin are squeezed, install the T-405 and the T-410 (fitted to the inside contour of the skin as shown on DWG 16A) on the leading edge. Put a thin layer of sealant on the sealing surfaces. (If T-405 were installed on the rib before riveting the rib to the skin, the skin rivets around the leading edge would be very difficult to set.)

Seal and rivet the other T-410 to the outboard end rib. Three or four AN470 rivets is sufficient.

Apply a generous fillet of sealant around the inside of the end ribs where they join the skin, particularly at the very leading edge. Also make sure the outboard end rib aft tooling hole has been sealed. Finally, clean any excess sealant from the rear of the ribs and skin where the baffle will later rest and clean any sealant smeared on the outer surfaces. Once cured, it is difficult to remove.

### **CLOSING AND FINISHING THE TANK**

If you are using a float type fuel sender, adjust and check it before closing the tank. Dimensions for the float arm of the IE F-385 B/C sender in VAN'S ACCESSORIES CATALOG are shown on DWG 16A. Make an electrical check with a 12-volt battery and a fuel gauge, or a multimeter should show about 32 ohms when the sender is in the "full" position and about 240 ohms in the "empty" position.

Install the fuel pick-up tube and position it so it lies on the bottom of the tank.

Check all final details before installing the baffle and closing the tank. Check that the tank vent line is in, and its outlet is at the tank high-point. Check the vent line bulkhead fitting to see that it is tight and that it has been installed with sealant.

Assured that everything is in order, apply sealant to the tank skin from the rivet holes forward. Upon installation the baffle acts as a squeegee and the bead of sealant will be pushed ahead as the baffle is moved forward. Use a maximum of 3/16" bead of sealant. Too much, and the thickness can start to build up, making the tank difficult to install on the wing. Put a bead of sealant along the inside edge of the flange on each end rib. Put a heavy glob of sealant where each corner of the baffle will meet the end ribs (this is one of the most common locations for leaks).

Put a very thin smear of sealant around each of the rivet holes on the back flanges of the T-703/4 ribs.

With the tank sitting in the cradle, install the T-702 rear baffle assembly by dropping it straight down onto the rear flanges of the ribs.

Put a cleco in every hole of the T-701 skin to T-702 baffle joint. After clecoing, inspect the skin to see if it is pillowed out between the clecoes. The contact surface of the tank baffle flange may require pressure to force out excess sealant. The easiest method is to apply a c-clamp or strong spring clamp between each set of rivets and squeeze out the excess. If you are unsure, clamp the flange in a couple of spots and see if it makes a difference.

Twirl the AD-41 H closed end blind rivets in sealant and set them in the top and bottom baffle-to-rear rib-flange holes. The T-712 brackets are installed last. Check to be sure the platenuts have been installed on them because it is much more difficult to do once they are riveted to the tank. Put a very light smear of sealant over each hole for mounting the T-712 brackets. While double-checking with DWGs 16A and 10A, cleco each T-712 bracket in place. Be sure you get them oriented correctly because they will shortly be very difficult to change. Install the AD-42H blind rivets in the T-712 brackets after twirling them in sealant. This may require modifying a blind rivet tool by grinding enough of the puller "nozzle" away to get into the corner of the Z angle.

Finish all riveting and clean any excess sealant off the tank.

To mount the T-708 cover plate use an 1/8" inch thick bead of fuel tank sealant between the cover plate and the inboard rib. Dab a small blob of sealant on threads of each attach screw, insert into the holes, and tighten them sequentially until sealant bulges evenly about 1/32" from underneath the perimeter of the sender plate. Some builders may optionally seal the T-407 gasket to the tank with sealant as well, viewing the cork ring as sacrificial if the cover is removed. The sealant will also form a small gasket around each screw head.

Install the IE F-385 Sending Units with sealant using the appropriate hardware. DO NOT install the rubber gasket supplied by the manufacturer. Use the same procedure for sealing the sending unit as was accomplished above.

A continuous electrical path is necessary between the airframe and the sender plate so be sure that at least one of the screw heads is making metal to metal contact with the outside of the sender plate. Conduct a final electrical continuity test for the sender units with an Ohm Meter by probing the tank body and the sender center screw to ensure proper operation.

Wait at least 24-48 hours and then conduct a fuel tank leak check using the FUEL TANK TEST KIT available in the VAN'S ACCESSORIES CATALOG.

## **RIVETING THE WING SKINS**

There is a definite order in installing the wing skins. First, the leading edge (built off the wing) is installed. Then the top main skins are installed. The wing is then rigid enough to remove from the stand and install the ailerons, flaps and work on the internal details. After that is complete, the wing is laid, top down, on a large table and the bottom skins are riveted.

### **WING SKIN PREPARATION AND ASSEMBLY**

Remove the skins, deburr and dimple them. Complete OP46-02 Steps 5-6 deburring and dimpling (complete riveting when riveting the skins).

Prepare the skeleton while it is still fastened to the stand. Drill a 7/16" hole in the left W-701 leading edge skin and the left main spar flange for the pitot tube fitting (see DWG 15A.)

Dimple the ribs with a hand squeezer. The 0.063 main spar channel is too thick to dimple so it is machine countersunk. Make another 0.032 test patch with a #40 dimple, and use it to adjust your micro stop until the countersink in the spar is just deep enough.

Dimple the 0.040 rear spar and “touch up” the dimpled holes slightly with a sharp deburring bit or microstop countersink. This “touch up” operation removes just a small amount of metal to make the skin dimple fit better and is not critical, so it can be done by eye. Use your test patch to test the depth. The usual tendency is to remove too much metal, so use a light touch.

Drill the W-423 splice plates for installation of the platenuts. Deburr all holes. Dimple the screw holes and the rivet holes for the rib and the platenut attachment. The holes for attaching to the rib and skin can be slightly reamed (like the rear spar) to gain a better fit between the skin, the splice plate, and the rib.

Cleco the main skins to the wing skeleton. The skins overlap, outboard skin over inboard. This means that the doubled skins will protrude above the aft edge of the tank skin at the spar. File the corners of these skins, starting at a point 3 or 4 inches from the corner, making each of them progressively thinner toward the edge. This will form a sort of “scarf joint” and lower the forward edge, making a clean joint with the tank skin. It is NOT necessary to scarf the whole width of the skin, just the corner.

This is the point of no return; the point where things start going together permanently. Make a close inspection to assure everything is clean and proper before continuing.

### **ASSEMBLING THE WING LEADING EDGE**

Rivet the Leading Edge Assembly by fitting the skin into the cradle and then clecoing in the ribs and the W-423 splice plate. After making sure that the holes at the aft end of the ribs are exactly aligned, rivet the aft most rivets on the top and bottom using a rivet squeezer. Finish the riveting by working from the rear towards the L.E. one hole at a time.

### **INSTALLING THE LEADING EDGE**

Install the leading edge assembly on the wing skeleton. While the main skins are off, there is room to reach in and rivet the rib flanges to the spar web. This will require an offset rivet set. Remember the outboard W-709 and W-712 ribs are both riveted together in assembly with the W-706A spar web. After riveting the ribs to the spar, rivet the spanwise row of rivets, top and bottom, along the main spar web, using a rivet squeezer.

Install the fuel tank on the wing, with screws in every other hole, top, bottom and around the leading edge. Install about half the bolts in the Z-brackets.

### **RIVETING THE TOP SKINS**

With the outboard leading edge riveted in place and the tank installed it is time to rivet the top main skins. While it is possible for one person to install the first set of main skins, it is much easier with two. Rivet the W-702 inboard skins first, because the outboard skins overlap them.

Begin by clecoing the inboard skin in position (wing walk doublers, too) and start riveting. To assure maximum skin tightness, rivet from the center rib of each skin outward towards the root and tip. Do this on both the inboard and outboard skins, saving the double row of rivets at the lap joint until last.

Many builders find that they can get a nicer skin finish (especially when they are using less experienced helpers) if they back-rivet the wing skins. Use a large bucking bar laid over the rivet on the outside of the skin, and drive the head on the rivet from the inside using an extended back-rivet set available from some suppliers.

When the top main and leading edge skins are riveted on, remove the wing from the stand and put it on a padded worktable, top down. Block the wing so it doesn't rock around on the table.

If you are installing leading edge landing lights (p/n LL DW-01 in Van's Accessories Catalog) it is easiest to do it now, before the bottom skins are permanently installed.

### **INSTALLING THE AILERON BRACKETS**

Assemble the W-413 and W-414 Aileron bracket assemblies as shown on DWG 10A. Install them on the rear spar by lining up the matched holes, drilling, deburring, and riveting.

### **INSTALLING THE FLAP BRACE AND AILERON GAP FAIRINGS**

Drill, deburr, dimple where required, and rivet the W-721 flap brace (DWG 14A) to the rear spar.

**QUICKBUILDER'S NOTE:** The W-721 must be attached to the rear spar with blind rivets. See the note on DWG 14A, Section B-B'.

Drill the W-724 aileron gap fairing (DWG 13A) to the rear spar. Drill, deburr, and dimple where required, and rivet the W-724 aileron gap fairing to the rear spar.

### **INSTALLING THE PITOT LINE AND WIRES**

Install the pitot line and fittings shown on DWG 15A. Install SB437-4 snap bushings in the 7/16" holes for the Pilot line in W-710 and W-711. Put the low profile face of the bushing on the flange side of the rib, to ease access to the skin rivets later.

Complete the stall warning assembly instructions OP46-04 Steps 1-7 and OP46-05 Steps 1-6. Complete OP46-06 Steps 1-7 when installing the electrical system.

Double check that you have done everything else inside the wing that you wish to do such as installing wiring for wing tip lights, installing a wing leveler servo, etc., before closing up the wing. If you have not decided on some of these items, riveting the bottom skins can wait until much later in the project.

### **RIVETING THE BOTTOM SKINS**

The bottom skins are riveted while the wing lies top down on the bench. Begin with the inboard skin and rivet it to the rear spar, between the inboard wing walk ribs. This means pulling the skin back until you can reach the rear spar with a bucking bar. While it is possible for one person to rivet the bottom skins working solo if they use some sort of tape/rope/clamp system to peel the skin back, many builders find the job easier with a helper.

Be careful when pulling the skin back. If you try to bend it too sharply, you will get an unsightly, and irreparable, kink.

Work in an “L” pattern, riveting toward the tip along the rear spar, then about halfway up the wing rib. Before the skin is riveted all the way to the main spar, move to the next bay and repeat the process. After the second bay is partially riveted, complete the first. Riveting gets much easier as you move forward, because of the improved access through the larger holes in the ribs and the inspection openings. Once the inboard skin is riveted, the outboard is installed the same way, beginning on the inboard rib and working toward the tip. Leave the inboard line of rivets that joins the two skins only (no rib) until last. Those rivets can be reached through the access holes.

Lay the skin back down after every bay or so and check to see that all the holes in the skin and the skeleton still align and that the skin is not “creeping” outboard.

Drill the access panels to the bottom of the wing. Install the platenuts in the wing skin as shown in Section A-A', DWG 17A.

## **AILERONS**

The construction technique for RV-8/8A ailerons (DWG 13A) is similar to that of the elevators. The aileron uses ribs at the ends only; light angle stiffeners support the rest of the skin. The A-710 skin stiffeners are provided with the rivet holes pre-punched but not cut to length. The aileron skin is punched to match. These are match-drilled much like the stiffeners in the empennage. Cut and trim the stiffeners as shown on the drawing. Locate the stiffeners on the inside of the A-801-1PP rear aileron skin and drill.

Dimple the stiffener angles and skin. After priming (if desired), rivet the stiffeners onto the skin, preferably using the backriveting method described in Section . Following this, complete the trailing edge bend using the homemade bending brake used on the empennage. The bent skins must be straight up to the radius and the radius must be between 3/32" to 1/8". Match the degree of bend to the full size end view drawings. The upper and lower skin should just touch the spar when placed in position.

The A-403PP aileron spar is not symmetrical; the top and bottom flanges are bent to different angles. Check and label each spar for top, bottom, inboard and outboard. Make the A-408 aileron spar reinforcement brackets from supplied .040" material. Match-drill using spar holes as a guide and cleco as you go. Cleco the A-406-1 and A-407 aileron brackets in place and drill #12 for attach bolts. Label the parts, disassemble, deburr & prime as desired. Making sure that you leave the holes that will later attach the ribs empty, rivet the A-408 aileron spar reinforcement brackets on the spar along with the K1000-3 plate nut.

The wide tabs on the top of the A-704 nose ribs have no pre-punched holes, they will be match drilled from the nose skin. Flute the center of the tab slightly to remove any distortion from the manufacturing process. Use the nose skin holes as a check for straightness. Cleco and match drill the nose ribs to the spar.

Look closely! The A-705 aileron ribs are NOT symmetrical, so be sure you have them installed correctly. The tooling holes are nearer the bottom of the aileron. Cleco and match drill the A-705 main ribs to the spar.

Cleco the A-802PP leading edge skin and the A-801-1PP trailing edge skin to the spar with the A-409



counterbalance pipe in place. Match drill the skins to the skeleton including the #30 holes in the counterbalance pipe. The holes along the bottom of the spar are opened to #30 for the CS4-4 blind rivets. Remove the trailing edge portion and re-cleco the leading edge in place with the counterbalance pipe in position. Using a long 1/8" drill, go through the lower hole that attaches the A-704 nose rib to the spar and drill through the tab on the rib into the counterbalance pipe.

Disassemble the parts, deburr, dimple and prime as needed. Machine countersink the holes in the counterbalance pipe. The countersink need not be 120° to match that of the rivet heads. The .020" skin and the aluminum blind rivet will deform sufficiently to contour to a 100° countersunk hole.

Attach the nose ribs to the counterbalance with blind rivets. Bend the tab on the nose rib just enough to clear the rivet tool.

Cleco the leading edge skin to the counterbalance/rib assembly, rivet the nose ribs to the spar. Cleco the aft skin to the spar. Leave out the main ribs and the clecos along the bottom of the spar to allow access to the inside. Rivet the leading edge skin and trailing edge skin to the top of the spar. Rivet the nose ribs to the top half of the nose skin only. Insert the main ribs and rivet them to the spar and top of the aft skin. Install the A-406-1 and A-407 brackets.

Flip the assembly over, cleco it together and weight it down on a flat work surface. Blind rivet the counterbalance pipe to the leading edge skin. Keep checking that the aileron is flat. Rivet the bottom side of the nose rib to the skin. Rivet the bottom side of the main ribs to the aft skin. Last, blind rivet the leading edge and aft skins to the spar.

## FLAPS

Flap details are shown on DWG 14B. The flaps are the easiest control surfaces on the RV-8/8A to build. The only jiggling required is a level, flat surface at least 5' long and 1' wide. Easy or not, it is possible to build in an unacceptable twist, so work with care.

Prepare the FL-803PP-1-L&R flap spars by deburring the lightening holes and polishing the edges.

Drill and cleco the FL-704 and FL-705 ribs to the spar then cleco the assembly to the FL-802PP-1 bottom skin. Make the FL-708 spacers that go between the end ribs and the bottom of the top skin. The aft edge of the ribs should contact the "rear spar" bent into the bottom skin. Thin shims between the aft end of rib and the rear spar are acceptable.

After making any necessary shims, drill the ribs to the rear spar.

Drill the ribs to the bottom skin. The line of rivets along the bottom of the spar holds the hinge that will connect the flap to the wing. Drill and cleco on the hinge as well. Pinning the two halves of hinge together while drilling will help hold the hinge straight.

Instead of dimpling the bottom of the spar, dimple the skin and machine countersink the spar, with the hinge clecoed on to serve as a guide for the countersink pilot. The soft hinge does not have to be countersunk or dimpled.

Fit the FL-801PP-1 top skin to the assembly. Cleco the top skin to the spar, align the holes along the ribs and drill these before drilling the line along the bottom of the flap.

Fabricate the FL-706A. Fit the FL-706A and FL-706B to the inboard rib and inboard end of the spar. Rivet the FL-706A to the spar with the AN rivets only, leaving the holes that will attach the rib open.

After the necessary dimpling, priming, etc., begin riveting the flap together. A cradle, made with simple V-blocks like those used in the empennage, is a useful aid. Put the flap in the cradle and remove the spar to gain access to the rear row of rivets that join the top and bottom skins. Rivet the interior ribs to the skins, but leave the end ribs clecoed.

Rivet FL-706B and the platenut to the inboard FL-704 rib, then rivet the rib to the skins...you must set these rivets before "closing the door" by putting the spar in place.

When all the ribs are riveted to the skins, rivet the spar to the ribs with blind rivets, then rivet the spanwise lines that join the spar and hinge to the skins. Finish riveting the end ribs.

Expect to trim the upper skin of the flap slightly when the wing is mated to the fuselage, but for now, leave it untouched. **NOTE:** The bearing CM-4MS, shown on DWG 14B, is supplied in the fuselage kit, not in the wing kit.

## ATTACHING AILERONS TO THE WING

Completely finish the flaps and ailerons before mounting them to the wing.

Set the wing, with the leading edge and the top main skins riveted on, on a workbench, topside down.

Assemble the W-816 and W-818 pushrods as shown in DWG 15A. Prime both pushrods inside and out. Cover the inside by pouring a small quantity of primer inside the rod and slowly swirling it around. Rivet the AN49OHT8P or VA-169 rod ends to the pushrod.

Make sure the primer is fully cured, then thread the rod-end bearings and jam nuts on. Temporarily tape the pushrod where it passes through the rear spar, so when aileron is removed the primer won't be scraped away.

Install the WD-421 bellcrank as shown on DWG 15A. The bushing in the WD-421 needs to be reamed to final size for the slip fit on the AN4 bolt. The bushing should be slightly longer than the WD-421 aileron bellcrank. It is held firmly between the bellcrank brackets with the bolt. The bellcrank rotates around the bushing, not the bolt. This is the same way that the stick assembly is done also. Lubricate the bushing with your favorite grease when assembling for the final time.

Connect the W-816 and W-818 pushrods to the WD-421 bellcrank. Use the W-730 bellcrank jig provided to set the bellcrank in the correct neutral position. Use the alignment tool you built at the beginning of the wing construction to position the aileron in the neutral position. Clamp the aileron in this position and adjust the rod end bearings on the W-818 push rod until the pivot bolts at the bellcrank slip in smoothly. Tighten the jam nuts and label the push rod right or left as appropriate. Final adjustments will be made to the W-816 push rod later, when the wing is installed on the fuselage.

## ATTACHING FLAPS TO THE WING

There are two good methods of installing the flap hinge pin. The choice is yours.

Drill a small hole in the W-413 aileron hinge bracket assembly for the flap hinge pin to just go through. You will not be able to get this hole exactly in line with the flap hinge line, but this is a good thing. Drill the hole in the approximate position and when you insert the hinge pin for the flap, the pin will spring into position after being pushed all the way through and not be able to come out on its own. You may have to disconnect the aileron pushrod in the wing to remove this pin after the aircraft is fully assembled. This will allow you to swing the aileron out of the way for pin removal.

An alternative method is to remove one hinge eye at the center of the flap hinge and two hinge eyes at the center of the wing hinge. This will allow you to get two hinge pins in from the center of the flap, one in each direction. Bend a small portion of the hinge pin at a right angle to grasp with pliers as you slide the pin into place. With the flap hanging down the hinge is accessible from the opening at the top. Push the bent portion of the pins forward to lie on the inside of the skin. Drill two small holes in the skin and safety the hinge pins in place.

## WING TIP INSTALLATION

Delay wing tip installation until late in the construction process, preferably until the aircraft is nearing final assembly. This prevents the possibility of damage from handling and gives every opportunity for the installation of lights, wing tip antennae, etc.

The tips may be installed with the wing lying down on a table or with a wing positioned in a cradle style storage fixture. See DWG 12A.

The aileron control system is used to neutrally position the aileron, which helps to position the wingtip. Use the W-730 Adjustment Fixture to locate the aileron in its neutral position and hold them in place with a bungee cord.

Sand or file the flange on the W-715-1 tip so it is an even depth and width all around.

Portions of the aft end of the W-715-1 tip must be trimmed away to provide clearance from the aileron and W-414 Aileron Hinge Bracket.

Slip the W-715-1 tip into place. Push it forward so it is tight in the wing leading edge and align the trailing edge with the trailing edge of the aileron. An assistant is helpful.

Drill the W-715-1 tip using a #40 drill. Begin at the leading edge and work to the back. Alternate holes from the top to the bottom. If you are unhappy with the placement of the tip, adjust it slightly when the holes are drilled to full size.

Swing the aileron out of the way and slip the W-412 tip rib (DWG 17A) into place. Mark the location of the rib



trailing edge on the tip.

Remove the tip and lay out the rivet lines (top and bottom) 5/16" from the edge. Cleco the W-715-1 tip back on the wing and slip the W-412 tip rib back in place. The flange edge must be flush with the tip edge.

Locate the rib chordwise so it fits without distorting the tip.

Drill and cleco the W-412 tip rib to the W-715-1 tip. Remove the tip and machine countersink it. Rivet the rib in place.

The W-715-1 tip may be riveted or screwed to the wing (DWG 17A.) The choice usually depends on what kind of access is necessary to service lights, power supplies, etc.

If you decide to use the rivets the tip must be reinforced with a strip of aluminum to keep the rivets from cracking the fiberglass. Drill (#40) the aluminum reinforcement strips to the W-715-1 tip using the existing holes.

Scuff the aluminum reinforcement strip and W-715-1 tip with some 80-100 grit sandpaper. Bond the strip to the tip with resin (polyester or epoxy). Hold the strip in place with clecoes.

Remove the clecoes before the resin is fully hardened.

When cured, cleco the W-715-1 tips back on the wing and drill out to full size. Remove the tips and machine countersink the fiberglass to accept a 1/8" dimple.

Dimple the skins on the wing and blind rivet the W-715-1 tip on. This step may be postponed until later to permit easier access.

If you are using screws and platenuts the platenuts may be riveted directly to the fiberglass. You may delete the reinforcement strip. Screws and platenuts for this installation are not provided in the kit.

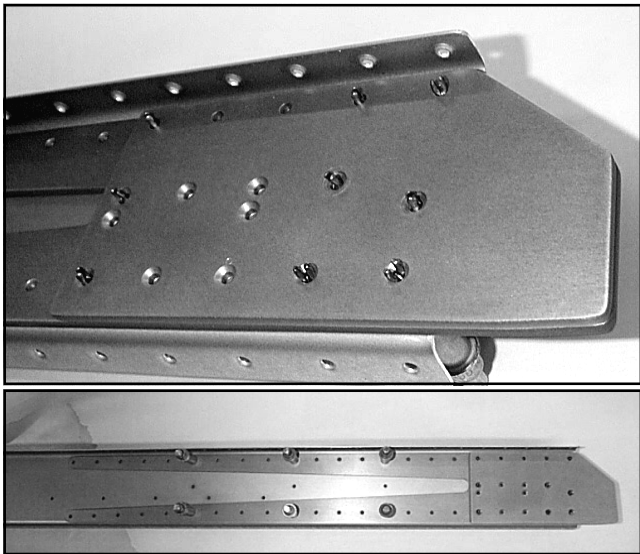


Fig. 7-1. The root end of the rear spar. Note that the flanges are already dimpled...it is hard to get a squeezer on them if the doublers are already installed. (RV-9/9A spar shown)

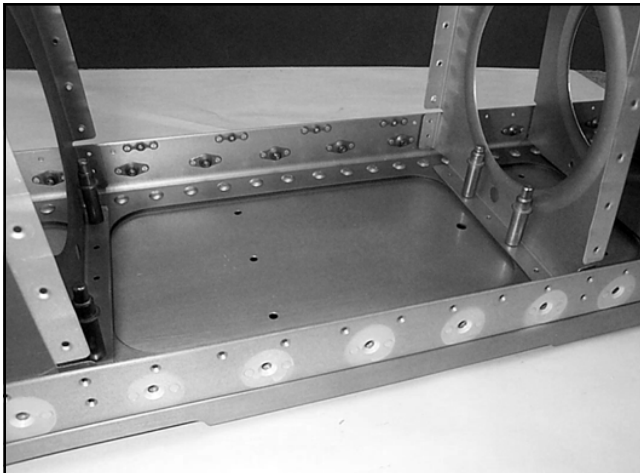


Fig. 7-2. Main ribs are fitted and drilled to the main spar.

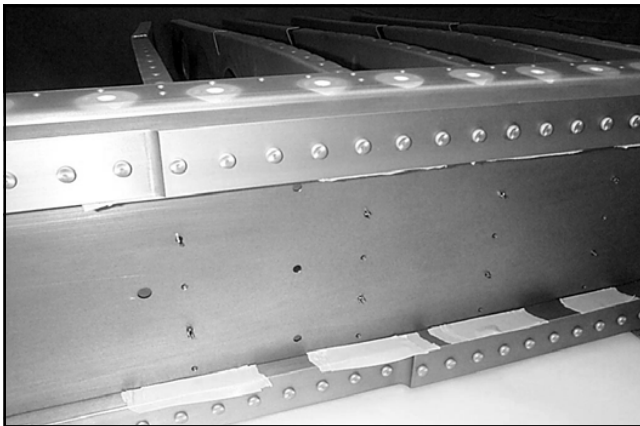


Fig. 7-3. Tape protects the main spar bars from damage when the ribs are riveted.

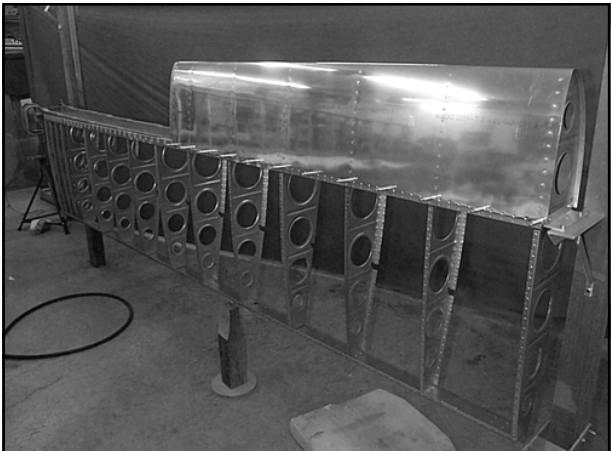


Fig. 7-4. A pair of posts and brackets hold the wing in a convenient position. The posts under the rear spar keep the structure from sagging. Here the leading edge is fitted to the wing skeleton.

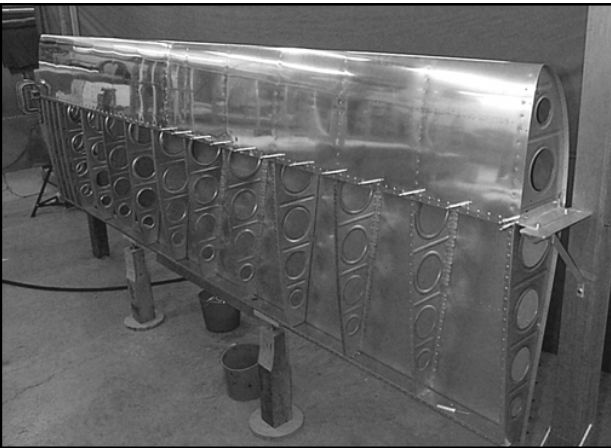


Fig. 7-5: The tank and top main skins are fitted.

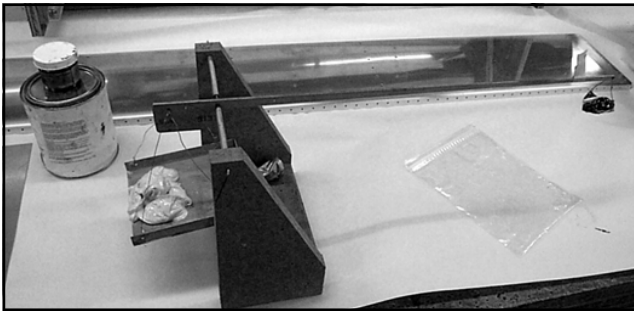


Fig. 7-7. Tank sealant is mixed in a shopbuilt 10:1 balance.

## NOTES



Fig. 7-8. The interior of the tank at the outboard end. The T-410 reinforcement helps seal around the nose. The blob on the rib is a 316" rivet set in the tooling hole and covered with sealant. The filler neck and vent line are also visible.

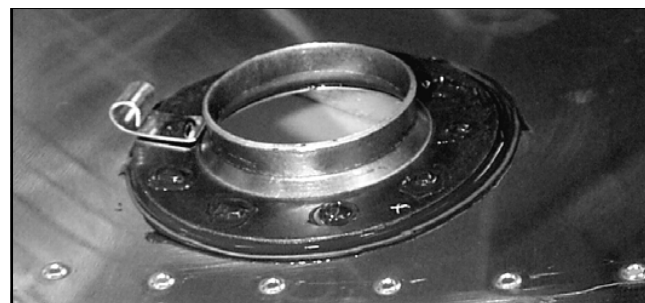


Fig 7-9. The filler neck riveted to the inside of the tank skin. A common rivet holds the T-914 clip to secure the vent line.

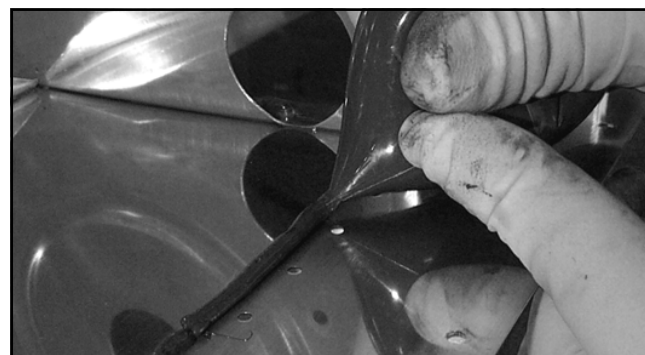


Fig 7-10. A bead of sealant for the rear baffle is squeezed out of a plastic bag.



Fig.7-11. The VA-112 drain flange riveted to the outside of the tank skin.

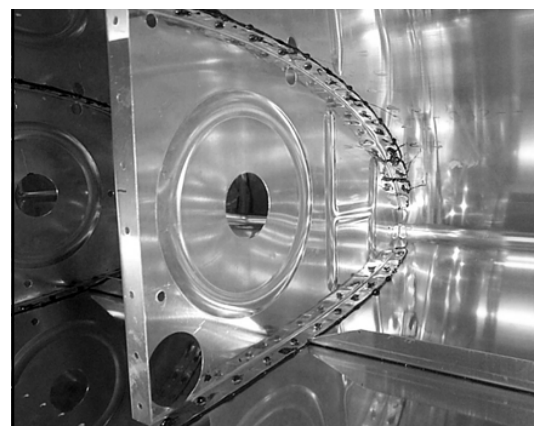
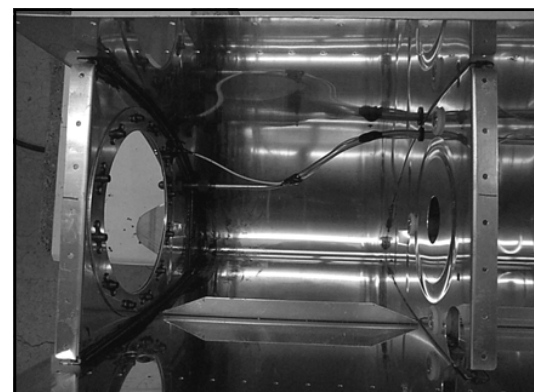


Fig. 7-12. An interior fuel tank rib, riveted and sealed.



Above: Fig 7-13. Details of the inboard bay. The access cover with the fuel sender attached will cover the large hole on the inboard rib. The vent line is looped forward to clear the sender float.