WING SECTION

The wing section is divided into 5 sub-sections. The first 3 sections are: Initial Layup, Alignment, and Pre-Covering Details. These sub-sections explain the work that should be done prior to covering the wings.

The wing must be covered before you proceed with the final two sub-sections, which describe Flaperon Installation and Rigging the Controls.

You should read the entire Wing Section before you proceed, to help you understand the entire procedure. If you plan to install a wing tank or wing locker you can integrate its installation with the building process. Plan ahead so you know the most efficient sequence to prep and paint the various components to fit your circumstances.

Tools required:

small mill files
small half-round rasp
sandpaper, 80, 100, 220, 360 grit
drill bits, #30, #40, 1/8", 3/16" 1/4"
sheet metal snips
sheet metal nibbler
1" paint brush
bench vice
spring clamps
four 2.5" hose clamps
two sawhorses
48" level
five 4" 'C' clamps or wood workers clamps
clecos
cleco pliers
deburring tool
felt tip marker "Sharpie"
hacksaw or bandsaw
small hammer
aligning punch
center punch
rivet puller
framing square
protractor
small hand wrenches
reamers (.1865", .1875", .2490", .2500", .3115", .3125")

Materials required:

Alodine, Zinc chromate, or epoxy chromate
varnish (stits epoxy varnish is best)
MEK, alcohol or acetone
masking tape
strapping tape
string
clean rags
structural epoxy (supplied with the fuselage kit)

Sub-Section "A" - Initial Layup

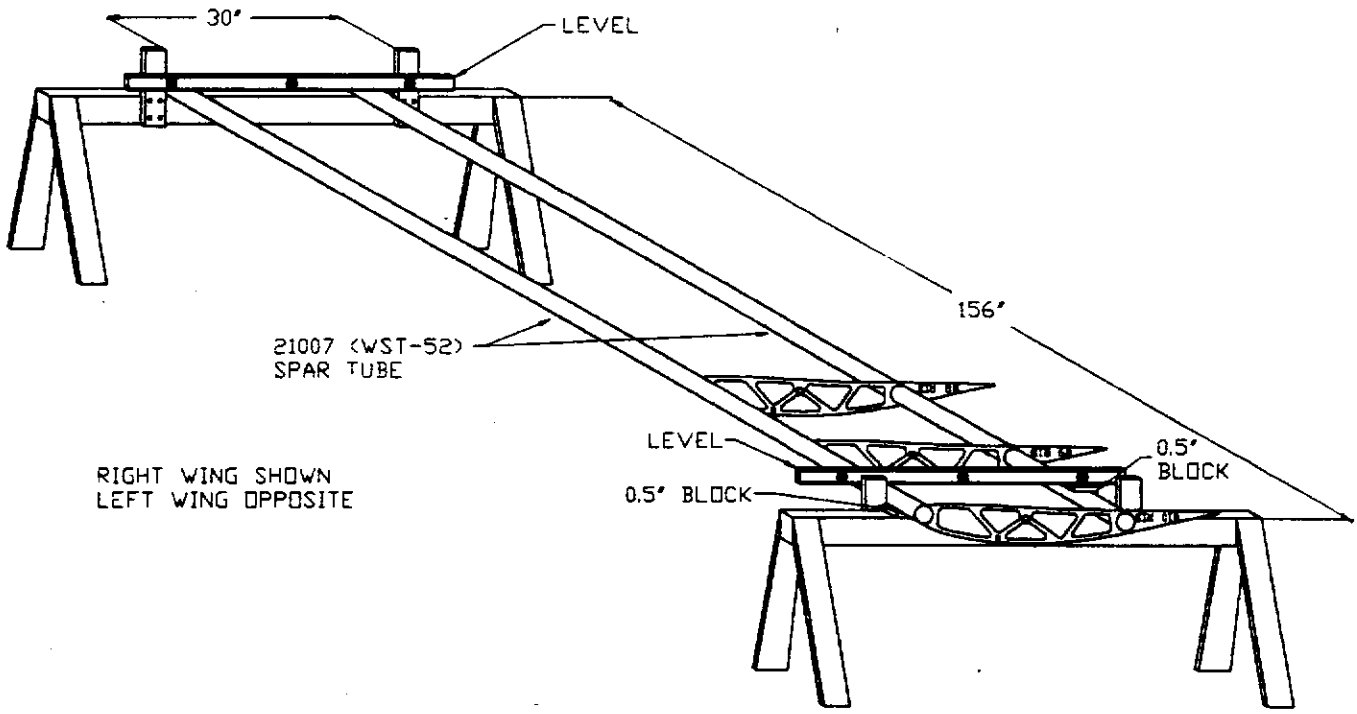
Objective:

Trim and insert the spar stiffeners. Trim, drill, paint, install the diagonal brackets and braces. Bond ribs #2-#10 to the spars with the wing set to 1/2" of washout between the spars. Drill the rivet holes in the strut attach brackets, trim and drill the spar reinforcement fittings, fabricate the jury strut attach brackets, trim and drill the bolt hole in the jury strut clamps. Trim and drill rivet holes in the mass balance weights, flaperon horns, flaperon end ribs and flaperon hanger brackets. Smooth and sand the lift struts and jury struts so that all the wing kit metal parts are ready to paint.

STEP (1): Both wings can be built on a simple jig that you can set up with two sawhorses. Lay out the ribs to build the wings upside down for easier access to the spar attach brackets. Build the jig according to the Figures W-1 and W-8. Level the top of each sawhorse. Nail, glue, or bondo the sawhorses to the floor while constructing the wing.

> NOTE: Remember you will build one left and one right wing. You will have to reposition the 1/2" washout block when you finish the initial layout of one wing and start the other. The leading edge will be on the opposite side of your jig, if you leave the stop blocks on the same sawhorse.

STEP (2): The four #21007 (WST-52) Spar Tubes are exactly alike. Prepare the four #21006 (WSI-51) Spar "I" Inserts at the same time. Lay the Spar Tubes across your sawhorses for now.



Wing Jig Setup
Fig. W-A-1

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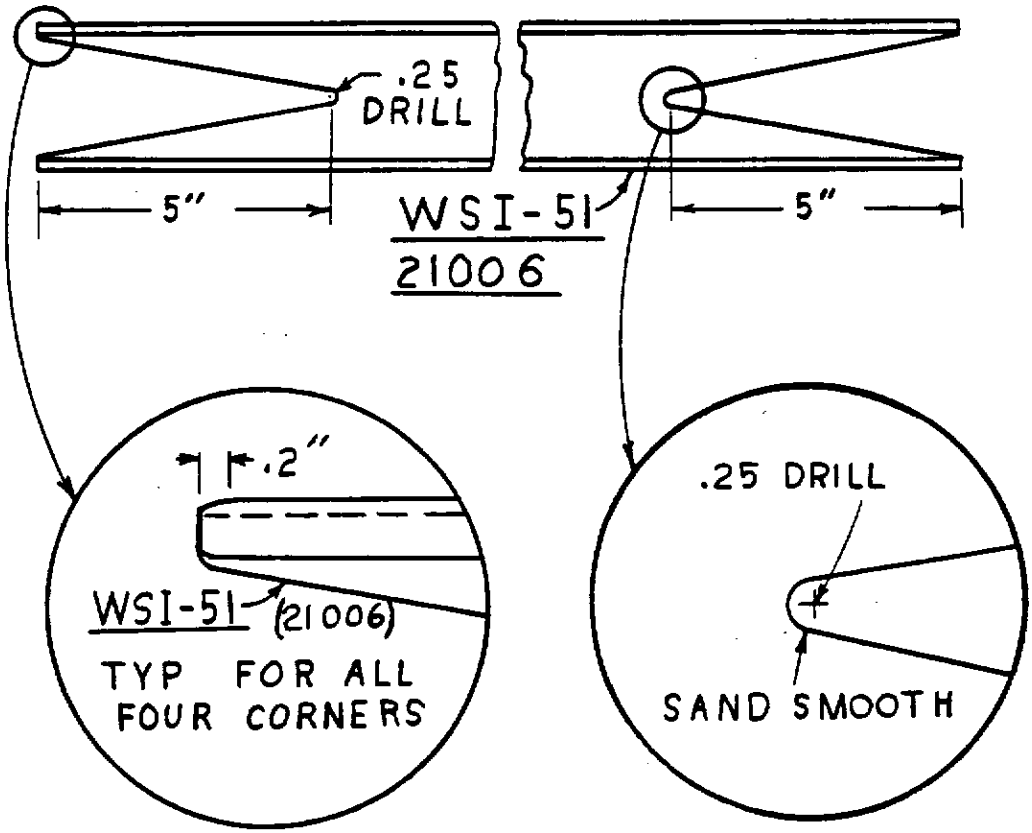
STEP (3): Drill a 1/4-inch hole five inches from each end on the centerline of the web of each #21006 Spar "I" Insert. Cut a fish-mouth notch in the web as shown in Fig. W-A-2 and file it smooth. Round the ends of each Insert as shown. Use 360 grit sandpaper to smooth the rounded ends of the insert and to remove any burrs or roughness on the top or bottom surface of the Insert. Refer to Plate W-1.

NOTE: You may want to treat each #21006 with Alodine before you insert it into the spar tube. You can purchase Amchem Alodine 1001 or a similar product at an automotive paint store. Some builders who live in coastal areas or those who plan to operate on floats coat the inner surfaces of the spars with alodine, zinc chromate, or epoxy chromate to prevent corrosion. If you decide to do this you should slosh the spars thoroughly after the wings are built and all the rivets are installed but before you install the wing tips or cover the wings. You can paint the outer surfaces of the spars, braces and trailing edges at the same time.



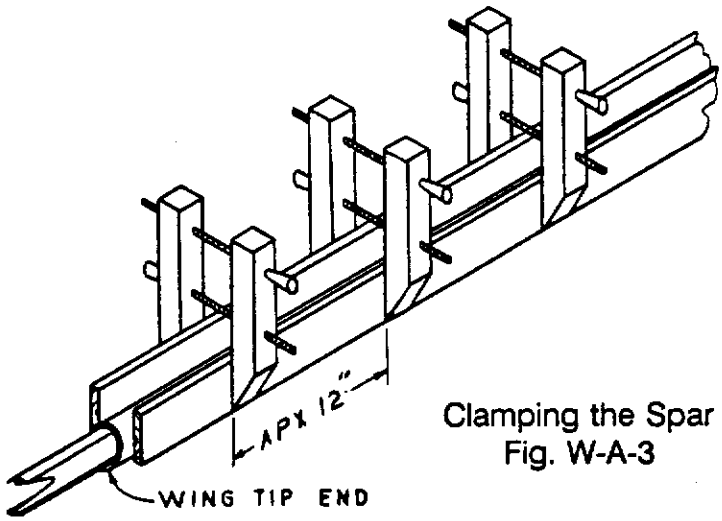
Spar "I" Insert
Fig. W-A-2

STEP (4): Use a round file to chamfer the inside of each #21007 Spar Tube at the wing tip end and sand smooth with 360 grit sandpaper. Make sure there is no dirt or filings inside the Spar Tube or on the Spar "I" Insert. Use a long wire to pull a cloth swab through the Tube. Wipe the outer surfaces of the Inserts clean.

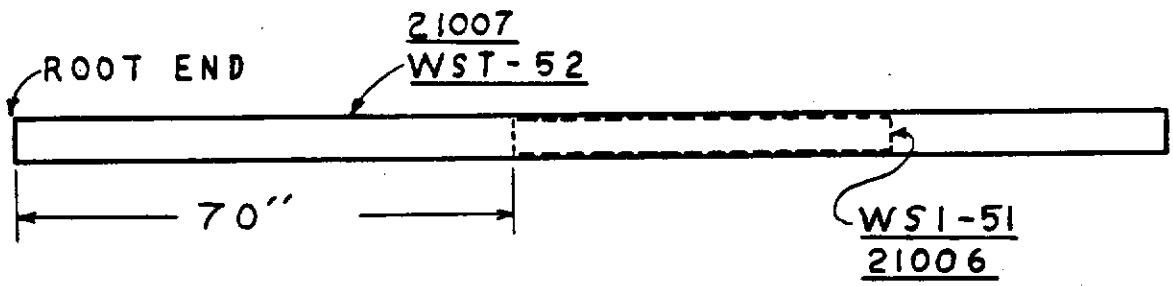
STEP (5): Insert a #21006 Spar "I" Insert into the wing tip end of each Spar Tube. **Use very little pressure**. Aluminum sliding on aluminum can gall very easily. Do not use force, or both parts may be ruined. If the "I" Insert does not slide into the Tube freely, use your "C" clamps or wood workers clamps padded with a couple of wood 1 X 4's, to slightly deform the Spar Tube as shown in Fig. W-A-3. Move the clamps down the Spar Tube as you slide the Insert into the position shown in Fig. W-A-4. Use a wooden stick to push the "I" Insert once it is past the end of the Spar Tube. Refer to Plate W-2.

STEP (6): If there is a noticeable difference in the Insert fit, use the tighter fitting pairs for the rear spars. Use a felt marker to mark the front spars, the rear spars and the root end of each spar. Set aside one pair of spars.

NOTE: DO NOT use pencil lead to mark aluminum, because graphite promotes corrosion.



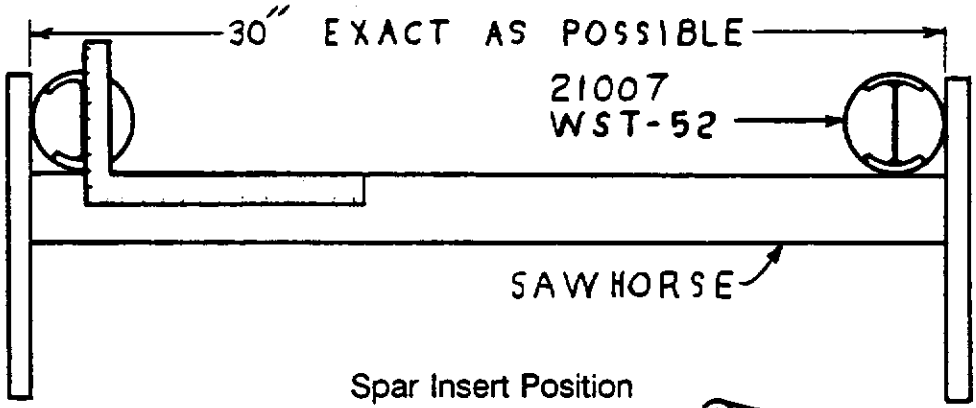
Clamping the Spar
Fig. W-A-3



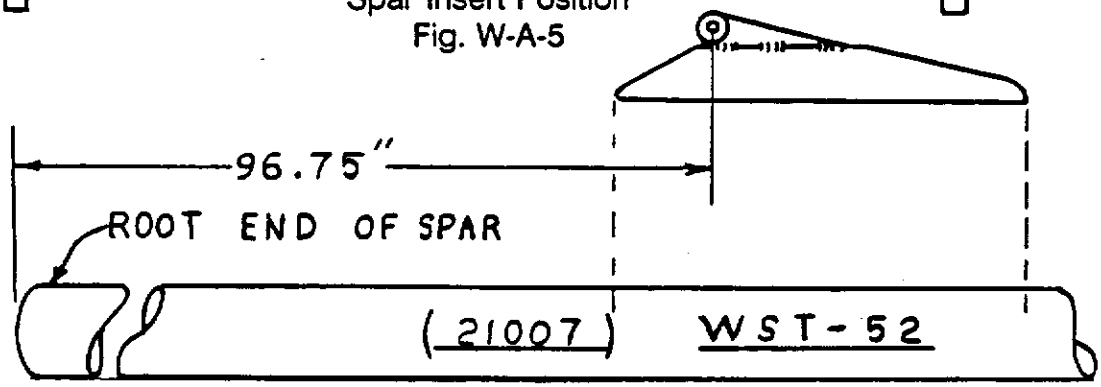
Installing the Insert
Fig. W-A-4

STEP (7): Decide whether you want to build the left wing first or the right. Place a pair of spars on the sawhorses without the washout block. Use a square as shown in Fig. W-A-5 as a sight gauge and turn the spars so the Insert webs are vertical. Secure the spars with tape or by some other means so they will not rotate.

STEP (8): Clean, de-burr and sand smooth the welded steel parts that attach to the spars. The #23004 (WBK-43), #23006 (WBK-53), #23007 (WBK-54) and the #25000 (WDB-50) Brackets may have weld lumps on the inside of their curved surfaces. File any such lumps flush and round the sharp edges. The slag left from the plasma cutting process on these Brackets is best removed by tapping the edge with a small hammer, or you can pry it off with a pair of diagonal cutting pliers. See Plate W-5.



Spar Insert Position
Fig. W-A-5

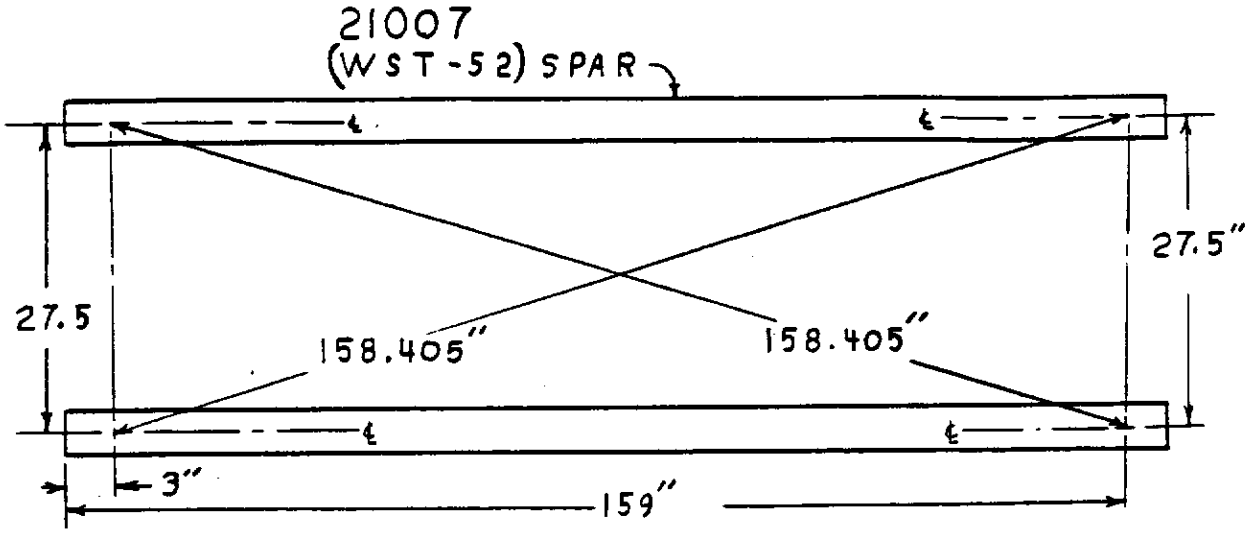


Strut Bracket Position
Fig. W-A-6

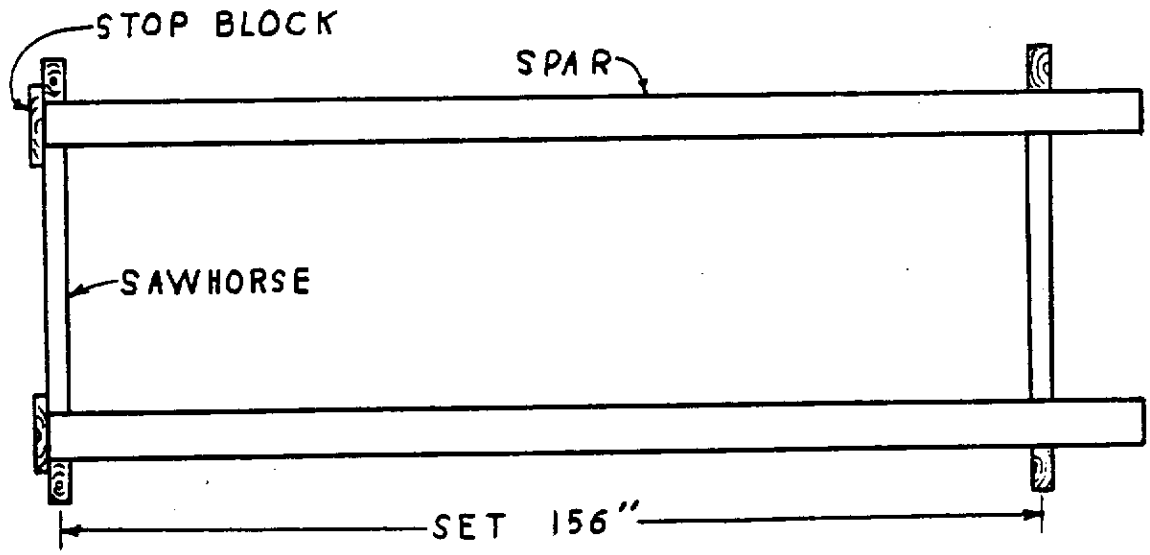
STEP (9): Place the appropriate Lift Strut Brackets onto the spars (the left and right rear spar Brackets are different) so that the center of the Attach Bracket bolt hole is 96.75 inches from the root end of the spar (see Fig. W-A-6). Install the rear spar Bracket with the ears vertical. Tilt the ears on the front spar Bracket rearward, approximately 26 degrees. Use 2.5-inch hose clamps to hold the Lift Strut Brackets in place.

NOTE: The tabs on the #23006 (WBK-53) and the #23007 (WBK-54) rear Brackets should extend rearward toward the trailing edge of the wing. These tabs connect to the wing lock back braces when the wings are folded.

STEP (10): Make sure the #12006 (WST-52) Insert webs are still vertical. Place a 3-foot straight edge across the spars approximately 3 inches from the root ends. Rub the straight edge back and forth for 3 or 4 inches on the spars to create wear marks on the exact tops (actually the bottom of the wing). Locate the tops, the same way, about 159 inches from the root end. Mark across these wear marks exactly 3 inches and 159 inches from the root ends of the spars. To set the spars square, measure diagonally from mark to mark as shown in Fig. W-A-7. This distance should be about 158.4 inches. In any case, the diagonal measurements must be equal. Fix a "stop" on the jig at the root end of each spar so that the spars can be removed and replaced in the jig without measuring. (see Fig. W-A-8).



Squaring the Spars
Fig. W-A-7



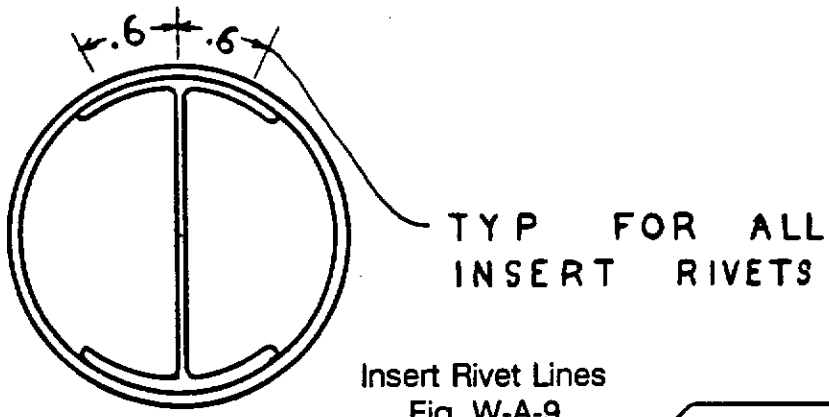
Stop Blocks
Fig. W-A-8

STEP (11): Use the procedure described in STEP (10) to mark the tops and bottoms of the spars along the length of the "I" Inserts. With your felt tip pen, mark straight lines along each side of the scraped marks as shown in Fig. W-A-9 and Plate W-3. Lay out the bottom rivet pattern as shown in Fig. W-A-11.

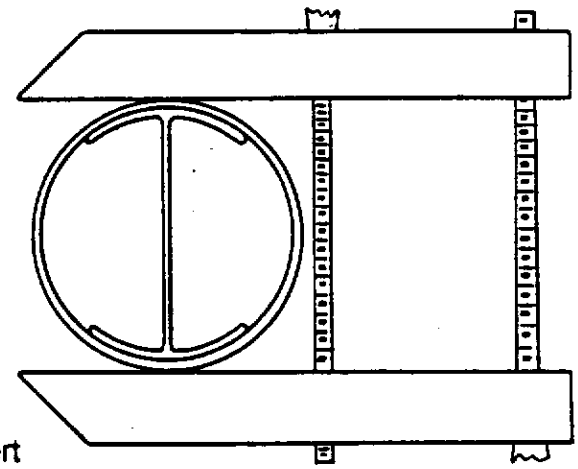
STEP (12): Check to make sure the Inserts are vertical and the correct distance from the tip, clamp the Spar Tube tight to the Insert as shown in Fig. W-A-10. Drill with a #30 drill and install two 1/8 X 3/16 inch stainless steel rivets adjacent to the clamp, in one location only. Use a drill stop so your drill bit will not extend too far into the spar and damage the "I" Insert Web.

NOTE: Use a deburring tool to deburr and chamfer the inside and outside edges of the rivet holes as best you can. Do not pull the Insert to deburr the holes.

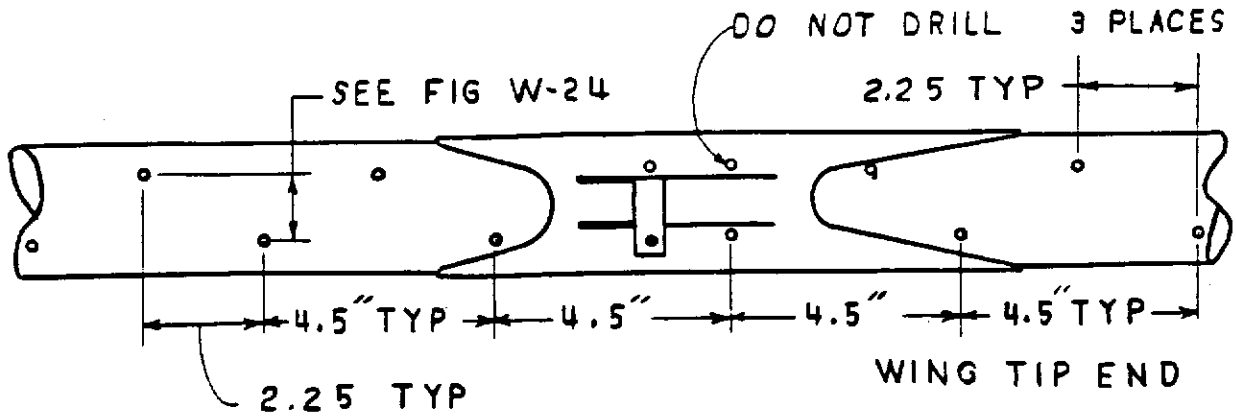
STEP (13): Remove the spar from the jig; remove the clamps, and lay out the top pattern according to the drawings in Fig. W-A-11. Clamp the spar near the center of the Insert as shown in Fig. W-A-10 Refer to Plate W-3. Drill and rivet, adjacent to the clamp on the top and bottom of the spar, before removing the clamp. Work from near the center of the Insert toward each end, clamping the spar against the Insert, drilling, deburring, and riveting. This will minimize the chance of chips lodging between the spar tube and the "I" Insert. Do not drill for the Lift Strut Bracket rivets now.



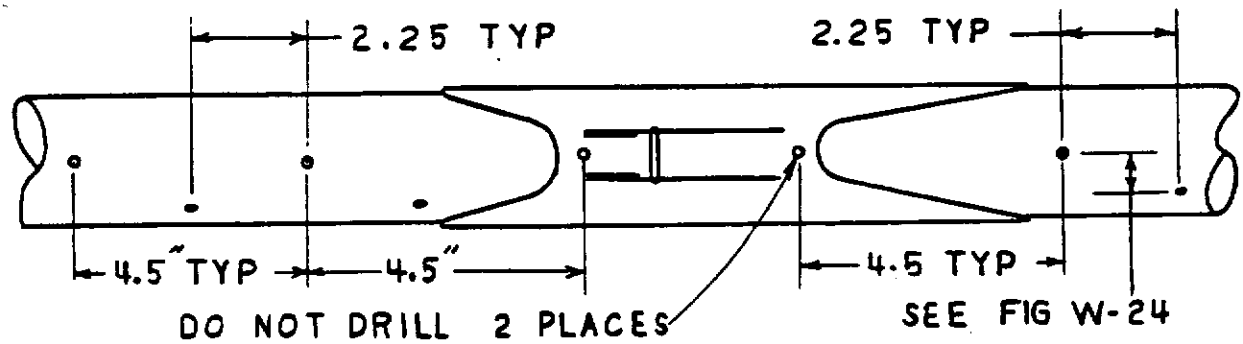
Insert Rivet Lines
Fig. W-A-9



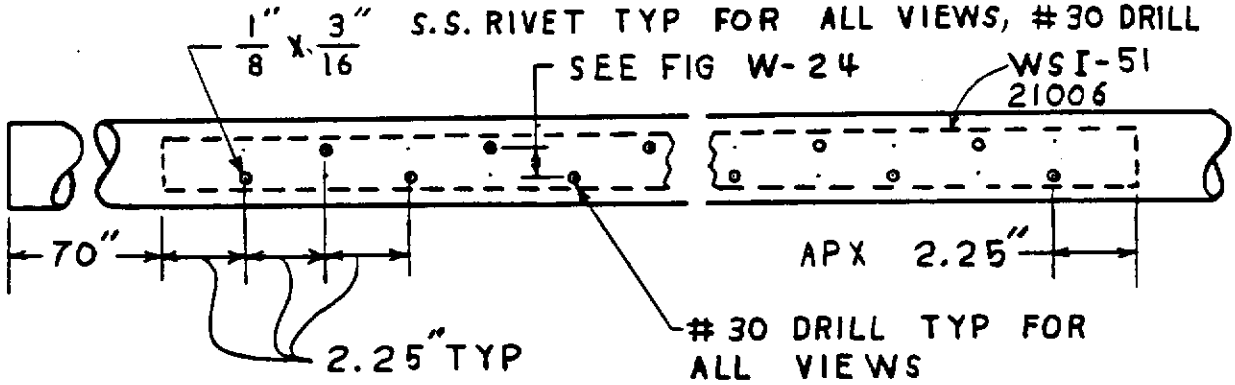
Clamping the Insert
Fig. W-A-10



BOTTOM VIEW REAR SPAR - LEFT WING SHOWN RIGHT WING OPPOSITE.



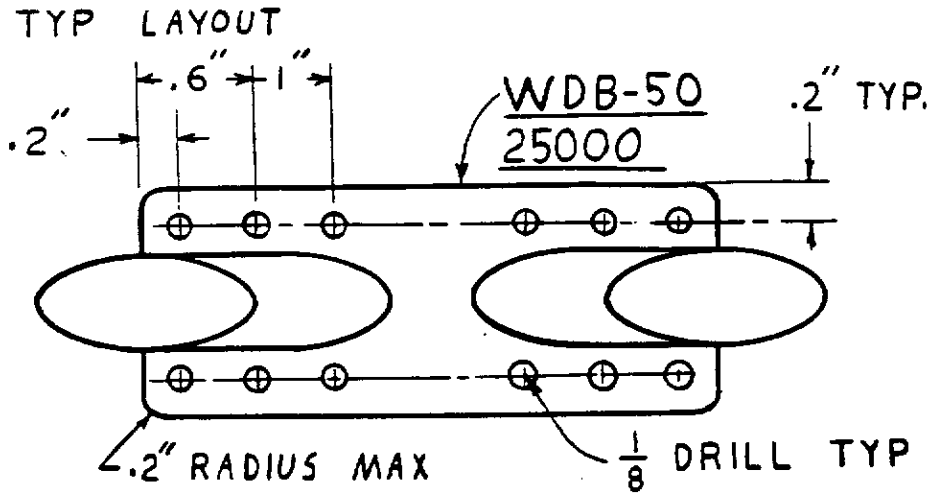
BOTTOM VIEW FRONT SPAR - RIGHT WING SHOWN LEFT WING OPPOSITE.



TOP VIEW ALL SPARS.

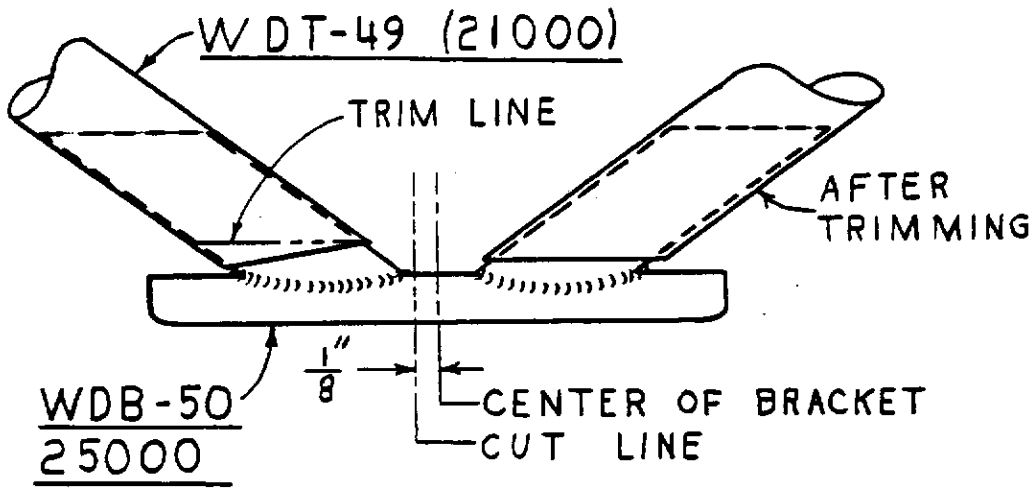
Spar Insert Rivet Pattern
Bottom View - Rear Spar
Bottom View - Front Spar
Top View - All Spars
Fig. W-A-11

STEP (14): Cut one #25000 (WDB-50) Drag Tube Bracket for each wing into two pieces as shown in Fig. W-A-13. The larger part will be installed nearest the root end of the wing and the smaller part nearest the wing tip. Round the corners of the #25000 Bracket plate as shown in Fig. W-A-12. Drill twelve 1/8-inch rivet holes in each #25000 Bracket plate as shown in Fig. W-A-12 and six holes in each half of the bracket which was cut in two.



#25000 Drag Tube Bracket Rivet Pattern
Fig. W-A-12

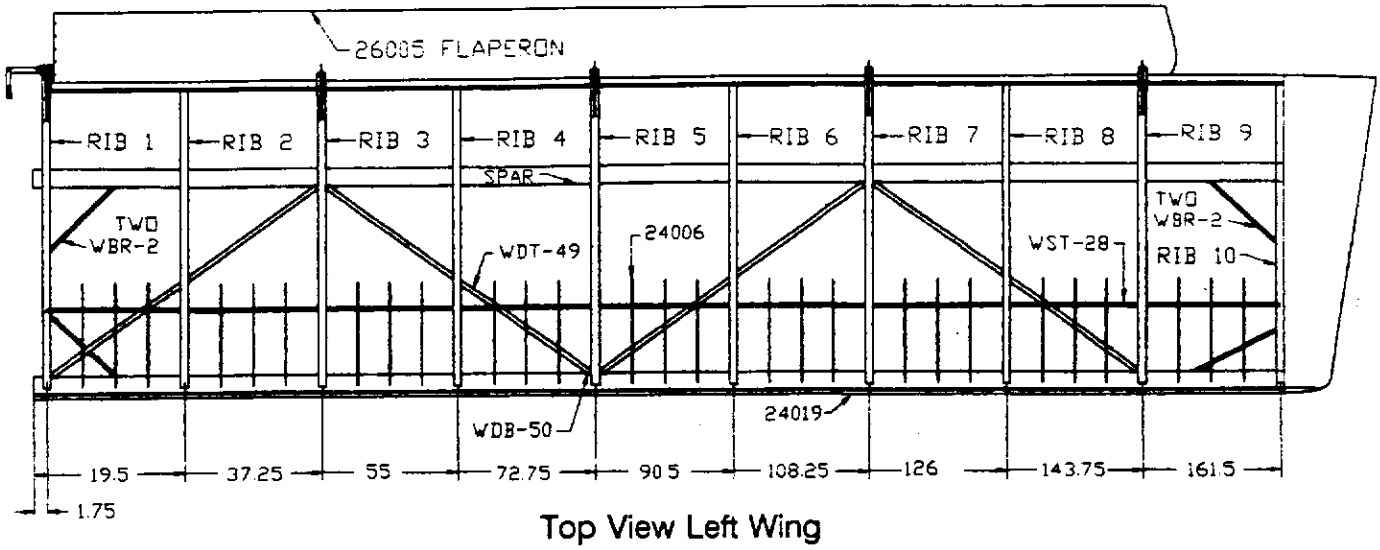
STEP (15): File the ends of each #21000 (WDT-49) Wing Drag Brace so the angled end is parallel to the #25000 plate, as shown in Fig. W-A-13 and Plate W-6. Be careful not to file the tip off the Tube.



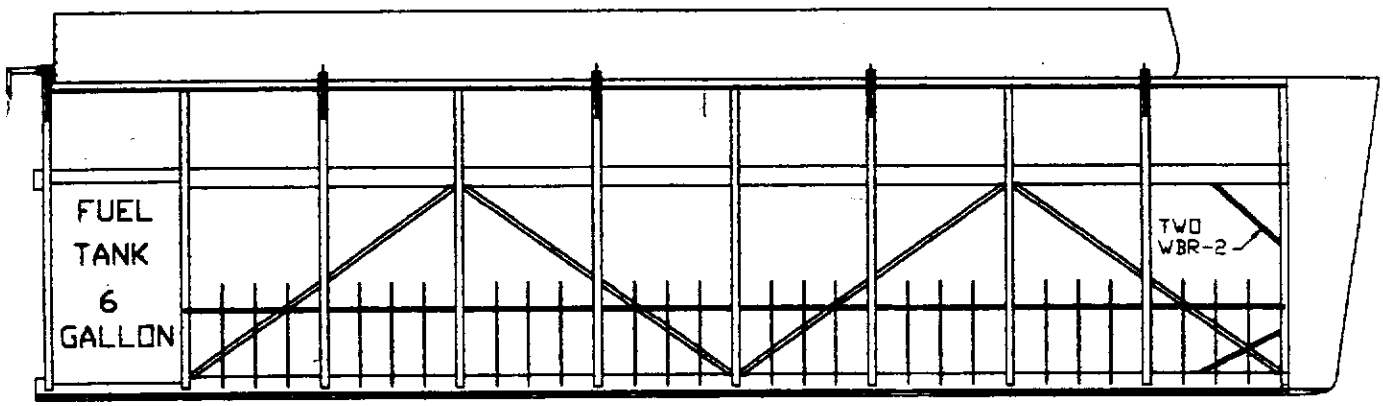
#21000 Drag Tubes and Bracket
Fig. W-A-13

STEP (16): Place a pair of spars with the Inserts riveted in place into the jig. Check that the webs are vertical and that the spars are square with one another. Place the 1/2-inch washout block under the front spar tip. Secure the spars to the sawhorses so they will not move. Mark each spar for the rib centers. See Fig. W-A-14 for rib lay-out. Extend each mark partway around the spar so it will be visible at the edge of the #25000 Bracket once it is in place.

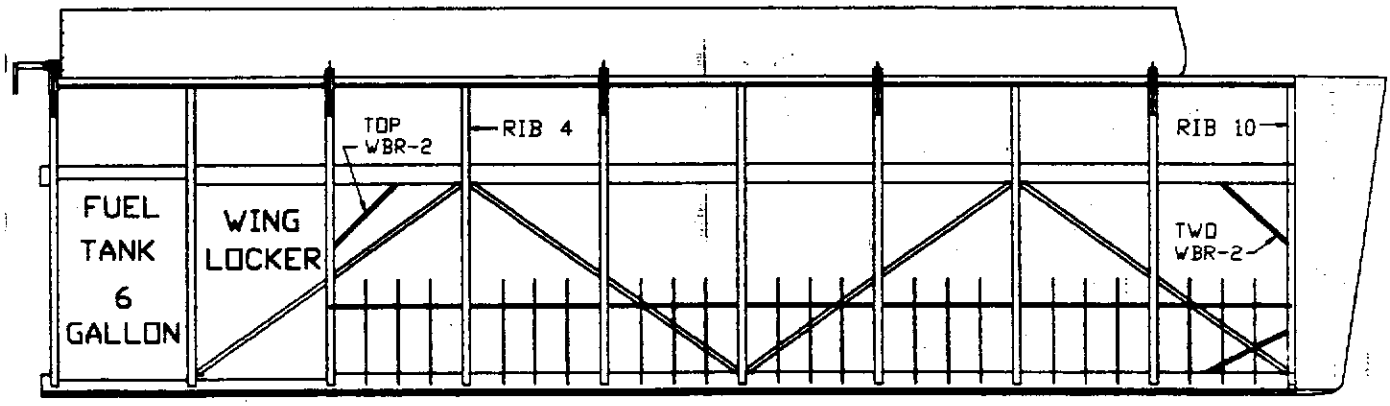
STEP (17): If you are going to use a wing tank in this wing, fit it in place now to assure a proper fit later. Tape it in place against the spars. Refer to Figures W-A-14 through W-A-19 and select the diagram for the wing you are building. If you are going to install a wing tank you should read the wing tank installation instructions before you proceed.



Top View Left Wing
No Wing Locker or Wing Tank
W-A-14



Top View Left Wing
No Wing Locker, Six Gallon Wing Tank
W-A-15



Top View Left Wing
Wing Locker, Six Gallon Wing Tank
W-A-16

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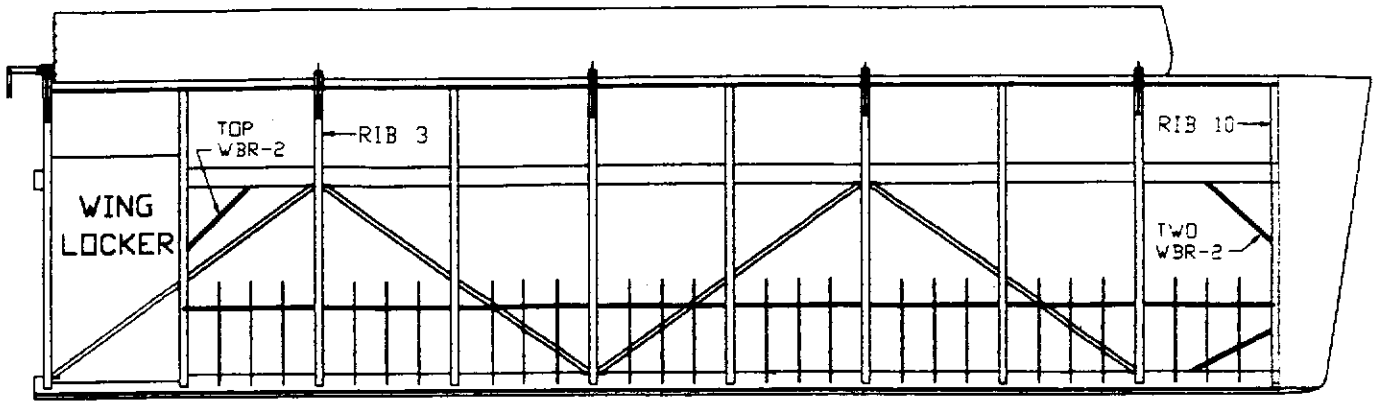
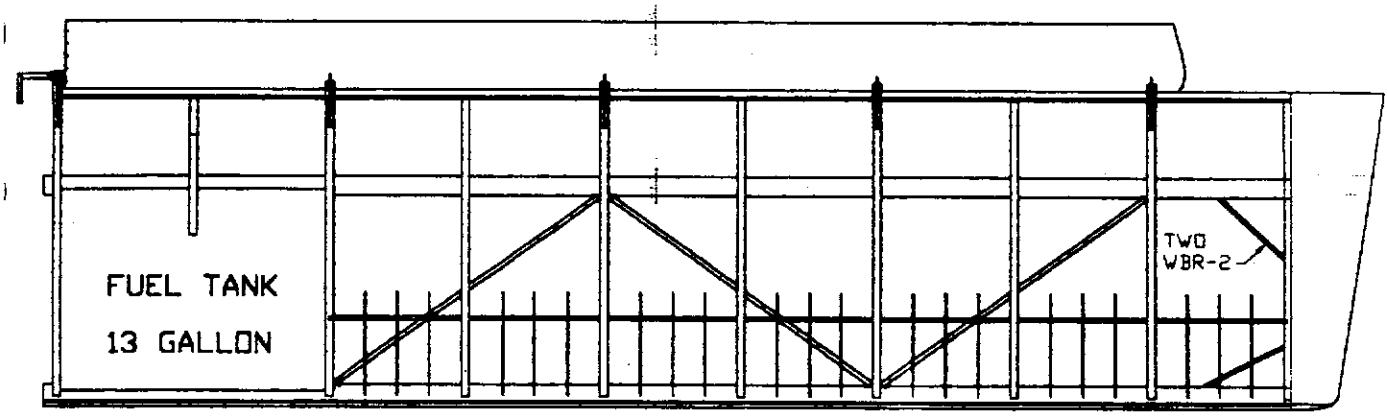
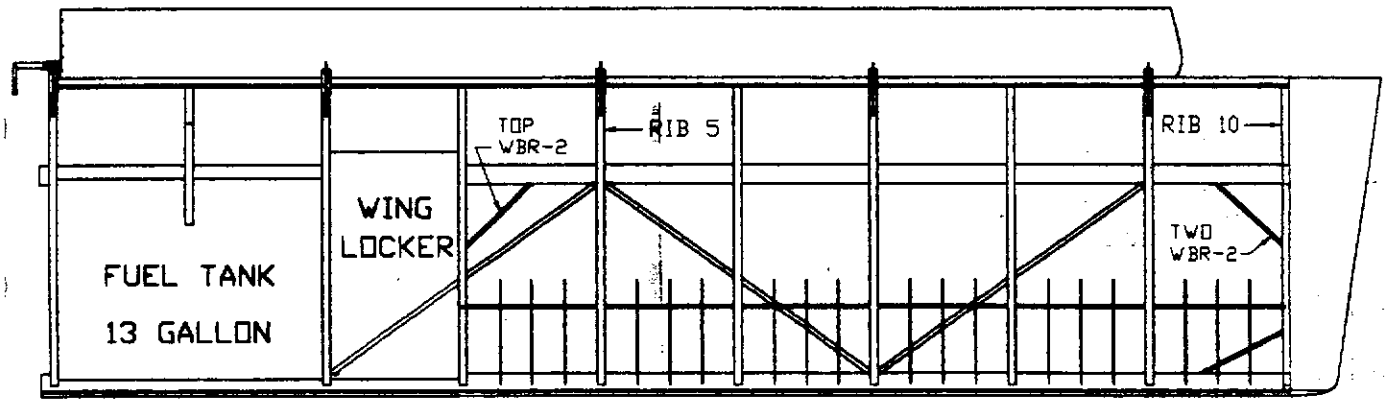


Top View Left Wing
Wing Locker, No Wing Tank
W-A-17



Top View Left Wing
No Wing Locker, 13 Gallon Wing Tank
W-A-18



Top View Left Wing
Wing Locker, 13 Gallon Wing Tank
W-A-19

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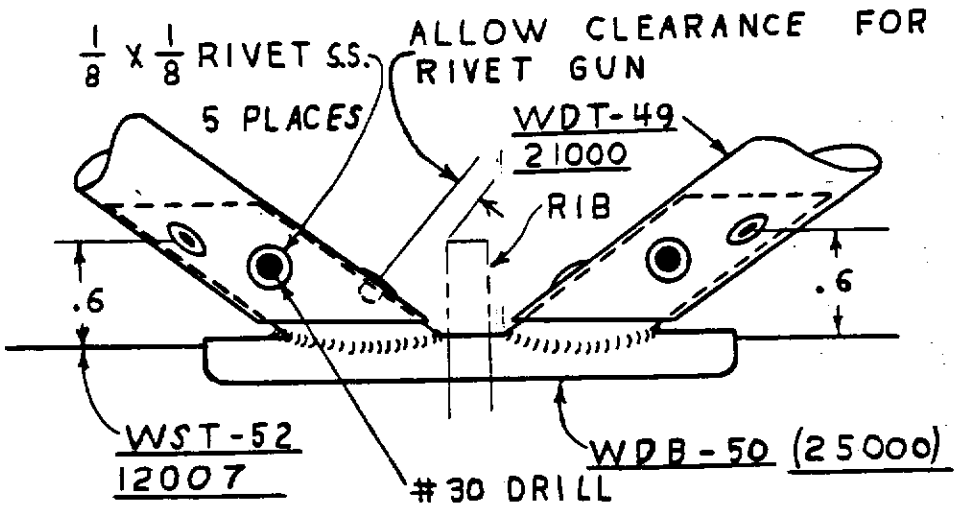
NOTE: The objective of the next four steps is to correctly position the Drag/Anti-Drag Braces and their Brackets so the spars are straight, parallel and the correct distance apart to fit the ribs. Read these steps now, so you thoroughly understand what you want to accomplish. Some builders choose to install one or more ribs starting with Step (18), to establish the correct distance between the spars, rather than use a spacer.

STEP (18): Start at the root end and install the #25000 Brackets according to the correct planform. Placement of the root Bracket on the spar depends upon your choice of wing tanks and locker (see Figures W-A-14 through W-A-19). Clamp the Brackets in place with hose clamps. You must install the #21000 Braces in sequence with the Brackets. Center the Brackets on the rib layout marks. The longitudinal centerline of each Bracket should align with the exact front or rear of the spar. For measurement purposes the root Bracket (the larger side of the cut Bracket) center is its center before it was cut in two. Refer to Plate W-7.

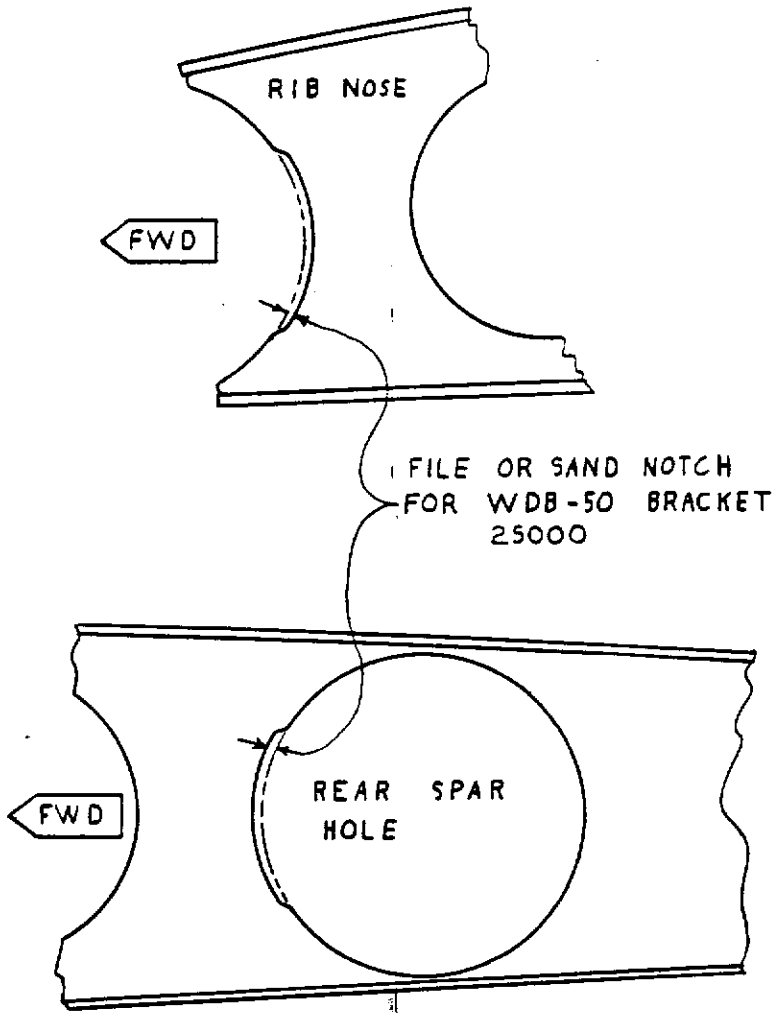
STEP (19): String a line along the front edge of the front spar, over small blocks of equal thickness, (about 1/4") at each end of the spar. Check carefully that the spars are against the stop blocks to hold the wing square. Drill the spar through each #25000 Bracket with a #30 drill and cleco the Brackets to the spars. Fashion a spacer exactly 25" long to check the distance between the spars. It must have perpendicular legs on each end so the spacer will straddle the diagonal Braces. Move the spacer along as you drill the ends of each Drag Tube through the rivet holes in the Brackets. Cleco the Drag/Anti-Drag Tubes to the Brackets as you go. See Fig. W-A-20 for the rivet pattern. Check the gap between your string line and the spar frequently to keep the spar straight.

STEP (20): Lay out the 10 Ribs on the top of the spars while the Drag Tubes and Brackets are clecoed in in place. Note that all the Ribs look the same, but have two different part numbers stamped on them. The 10 #27002 Ribs supplied with the Wing Kit have thicker webs and should be used as Flaperon Hanger Ribs in positions #1, #3, #5, #7, and #9. Number each Rib with a pencil, #1 through #10 as shown in Fig. W-A-14.



21000 (WDT-49) Tube Rivet Pattern
Fig. W-A-20

STEP (21): Now you can easily see which Ribs need to be notched to fit over the #25000 Brackets as shown in Fig. W-A-21. Cut the notches deep enough that the Brackets will not scratch the spar, when the Bracket and Rib are slid onto the spar. The tip-most Rib where the Drag Tube attaches does not require a notch, but the Rib nearest the root end where the Drag Tube attaches needs a notch. Notch the 3 Ribs that fit over the "I" Inserts to clear the Insert rivets.



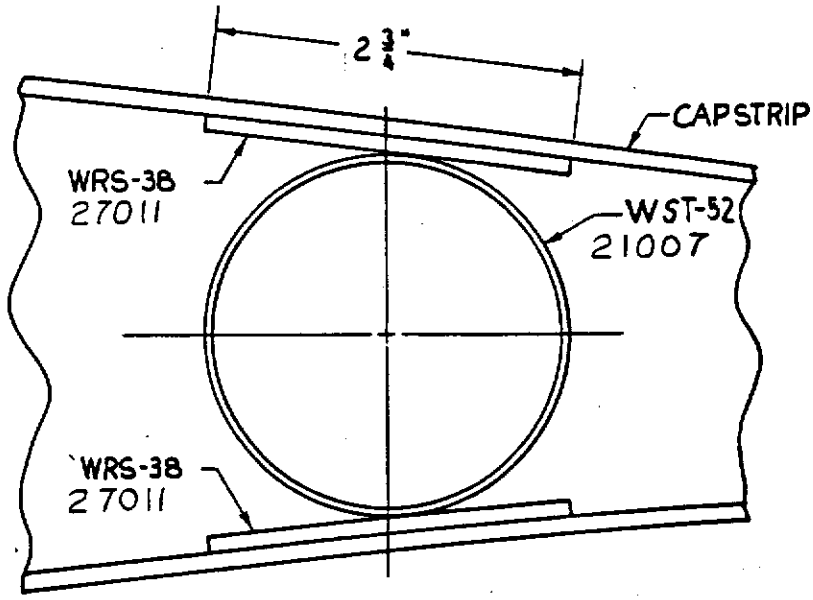
Rib Modification For Drag Tube Brackets
Fig. W-A-21

STEP (22): Mark or code each part with markings which will not be lost in the painting or plating process, so you can reassemble them in the same position. Remove the wing tank if there is one and disassemble the wing. Deburr all the rivet holes in the Spars, Brackets, and Diagonal Braces.

NOTE: If you plan to slosh the inner surfaces of the aluminum parts with alodine, zinc chromate, or epoxy chromate, you should slosh at least the Diagonal Braces now.

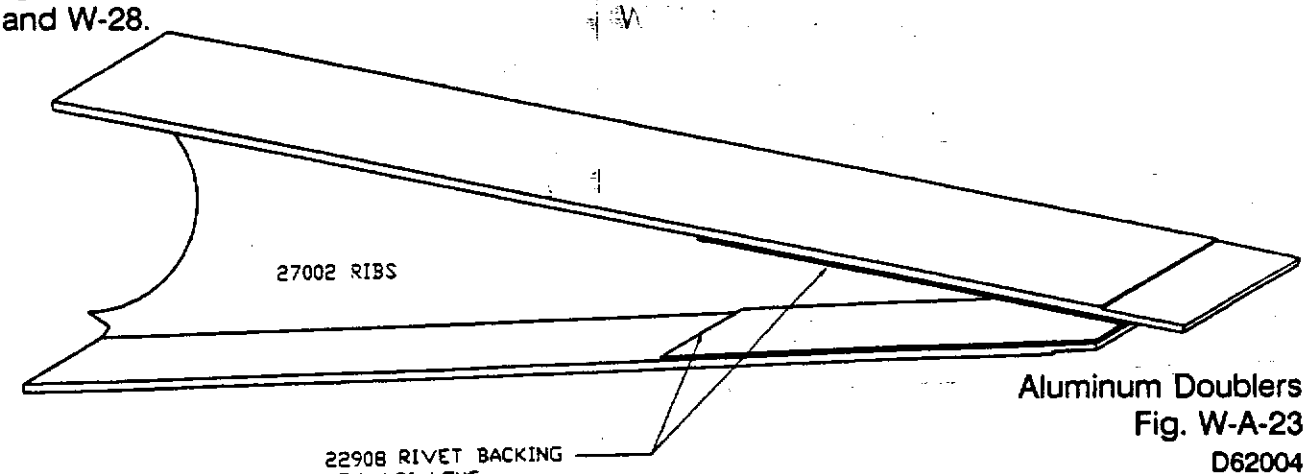
STEP (23): Sand all the Ribs and False Ribs with 220 grit sandpaper. Smooth all the sharp edges including the routed inner edges, and remove any splinters. Remove or drive in any staples that protrude above the capstrip surface. Round the trailing edge off of each Rib, to the Web so that the Aluminum Trailing Edge will snug up to the Rib end. Refer to Plate W-9.

STEP (24): Cut the #27011 (WRS-38) Plywood Doubler material into 3/8" x 2 3/4" strips. Rough-sand the mating surfaces and glue and clamp 4 pieces of the Rib Doubler on the inside of the capstrips of the Flaperon Hanger Ribs (#'s 1,3,5,7,9) adjacent to the narrowest part of the web where it surrounds the rear spar. Glue a Doubler on each side of the web, at the top and bottom of the Rib (Fig. W-A-22). Use the Structural Adhesive (epoxy) supplied with the Fuselage Kit, or another good aircraft-quality waterproof wood glue. Mix enough epoxy to bond the aluminum doublers on, also. (Step 25). Refer to Plates W-27 and W-28.



Plywood Doubler
Fig. W-A-22

STEP (25): The Wing Kit includes 8 pieces of #22908 Aluminum Backing Strip. Cut four of them into 40 pieces 4.8" long to back the rivets that will attach the Flaperon Hanger Brackets. Bond them in place on the #27002 Ribs as shown in Fig. W-A-23. You will use the other pieces of Backing Strip later when you attach the wing tips and rivet the end rib braces. Refer to Plates W-27 and W-28.



Aluminum Doublers
Fig. W-A-23
D62004

NOTE: The objective of the next six steps is to rivet the diagonal braces and their brackets in place and bond ribs #2-#9 to the spars. It is very important that the brackets be painted before installation to avoid direct contact between the steel brackets and the aluminum spars and braces, to prevent dissimilar metal corrosion. Some builders also slosh the inside of the diagonal braces with zinc chromate, alodine, or epoxy chromate to inhibit corrosion.

STEP (26): Place the spars in the jig. Clean the spars with acetone or MEK to remove any residues or oil. Use 80 grit sandpaper to sand a band 1 1/2" wide where the structural adhesive will contact the spars when the ribs are glued in place. This will greatly improve the tooth adhesion of the epoxy on the spar. When you are done sanding, blow the dust away with compressed air. Be careful from now on not to touch the sanded areas with your hands because oil from your skin may weaken the bond. Do not clean further with acetone or MEK after sanding, it may leave a film that will prevent a good bond.

STEP (27): Put the 1/2-inch washout block in place. The first Rib to be slid into position is the Rib inboard of the Lift Strut Bracket. Slide the other Ribs onto the spars. At the same time, slide the appropriate Drag Tube Bracket and Drag/Anti-Drag Tube in place. Reassemble all Drag Tube Brackets and Drag Tubes along with the Ribs. Each Drag/Anti-Drag Tube fits through the slot in a wing Rib. Rivet the Brackets to the spars and the Drag Tubes to the Brackets with 1/8" X 1/8" S. S. Rivets.

STEP (28): Mix a small batch of structural adhesive according to the instructions on the containers. Use a 1/2-inch brush or narrow spatula to apply a thin coating of adhesive to the spars where each Rib will attach except the #1 Rib. Get adhesive between the Ribs and the spars. Fit the wing tank back into place if you have one. Slip the #1 Rib into place and tape it securely over the front spar to help hold the spars together.

STEP (29): Trowel or lay a fillet of adhesive into each junction of Spar and Rib. (see note below). Do not bond the #1 Rib to the spar now. You will bond the #1 Rib in place later, after the wings have been aligned on the fuselage to properly locate the Spar Reinforcement Fittings and after the fittings have been rivetted to the spars.

NOTE: Carefully measure or weigh the two parts of the structural epoxy to assure the proper ratio recommended on the containers. When you have it thoroughly mixed, add enough cotton flox so the mixture will not run. Put the mixture in a large oral dosage syringe (available at a veterinarian supply house or through Denney Aerocraft) with at least a 3/16" to 1/4" opening in the nozzle. Apply the adhesive to the rib-spar junctions using the syringe like a caulking gun. (Refer to Plate W-11). Also apply adhesive around each #21000 Tube where they intersect the ribs. With the syringe you can make a very nice fillet. After the epoxy has set up slightly, smooth it with your fingers. Wear butyl rubber gloves and wet them with water periodically as you smooth the adhesive and press it into place.

STEP (30): When the adhesive is applied measure across the tips of the Ribs to ensure that they are positioned correctly, exactly 17.75 inches apart center to center, while the adhesive sets up. The adhesive may tend to run, if it does, trowel it after it starts to harden. Use bungee cords or strapping tape between the spars to seat the front spar snugly against the nose of the Ribs. Refer to Plate W-10.

STEP (31): Before the adhesive sets up check the Ribs again, making sure they are perpendicular to the spar, vertical and the correct distance apart. (Fig. W-A-24)

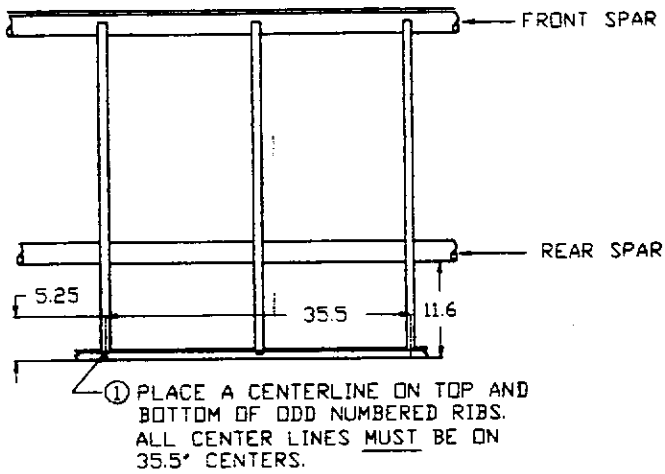
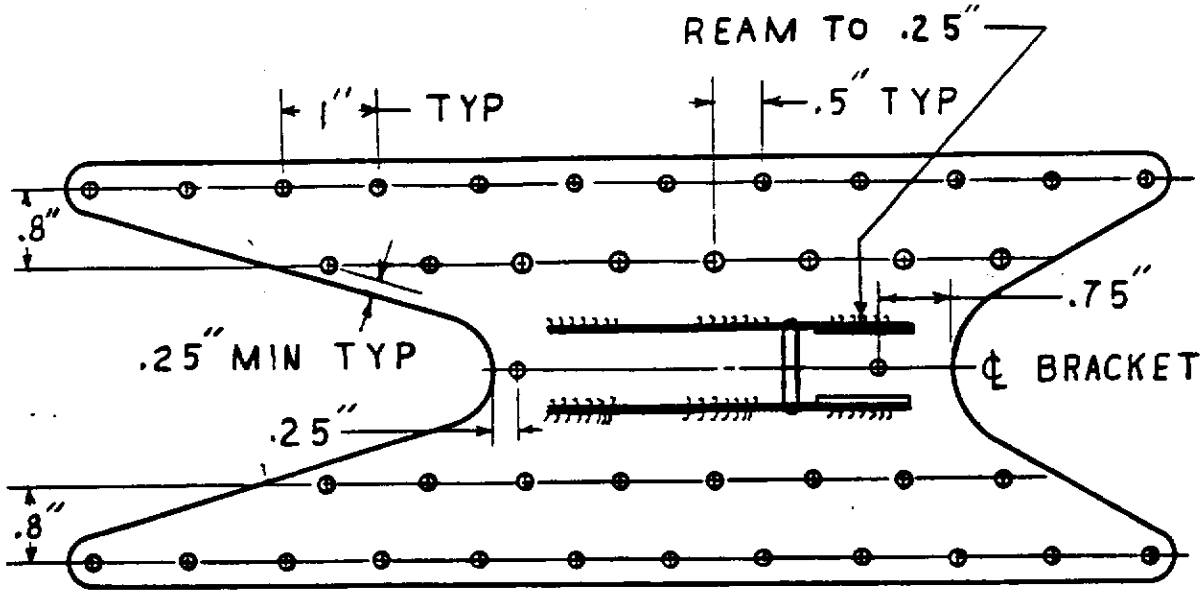


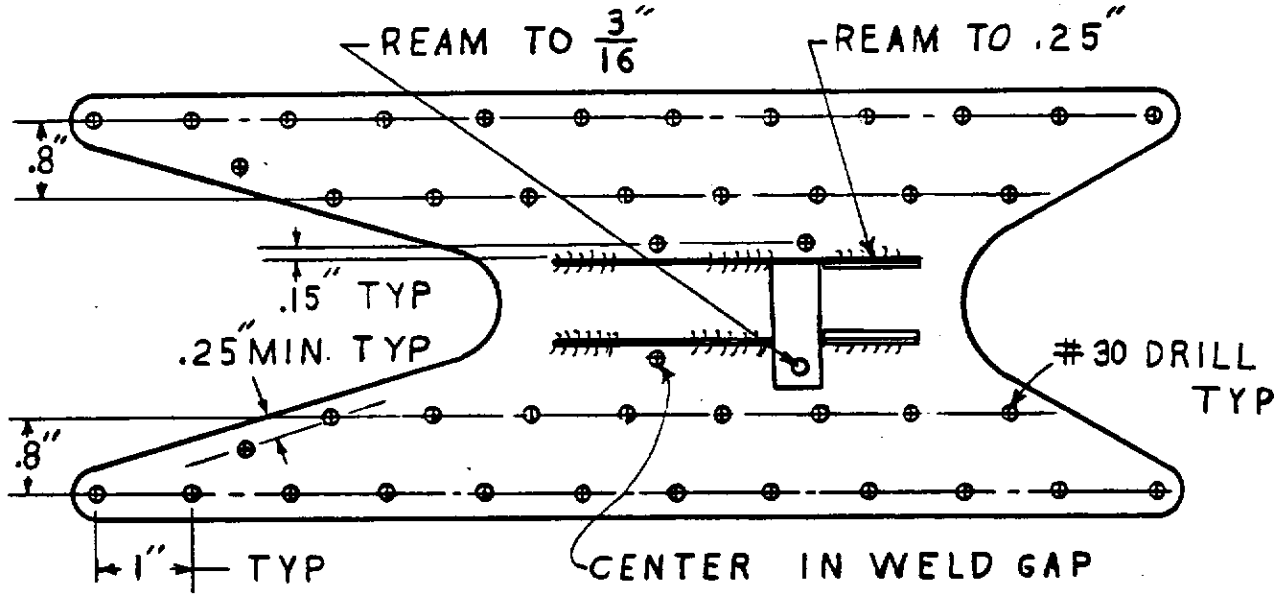
Fig. W-A-24
Rib Centerlines

STEP (32): When the first wing has set up (at least overnight). Longer if temperature is less than 70° F. Remove it from the jig and set it aside. Go back to Step 7 and build the other wing. Remember to build one left and one right wing.

STEP (33): Lay out the rivet patterns and drill the #30 rivet holes in the #23006 (WBK-53), #23007 (WBK-54) and #23004 (WBK-43) Lift Strut Attach Brackets as shown in Figures W-A-25 and W-A-26. (Also refer to Plate W-12). The holes on the center of each Bracket are used by Denney Aerocraft during the fabrication process. Do not use these holes for rivets, they may center on the vertical web of the "I" Insert. DO NOT drill into or through this vertical web. Ream the holes in the ears in each Lift Strut Attach Bracket to 1/4 inch, and the holes in the Lock Back Tab, to 3/16 inch.

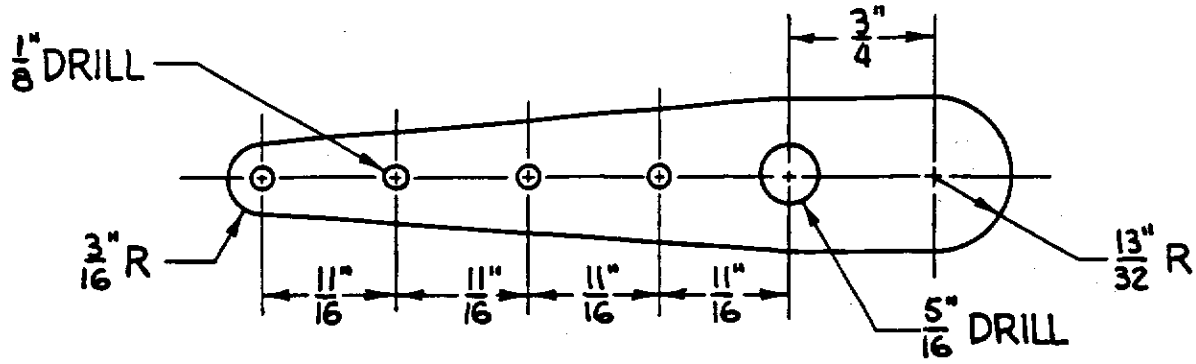


#23005 (WBK-43) Rivet Pattern
Fig. W-A-25

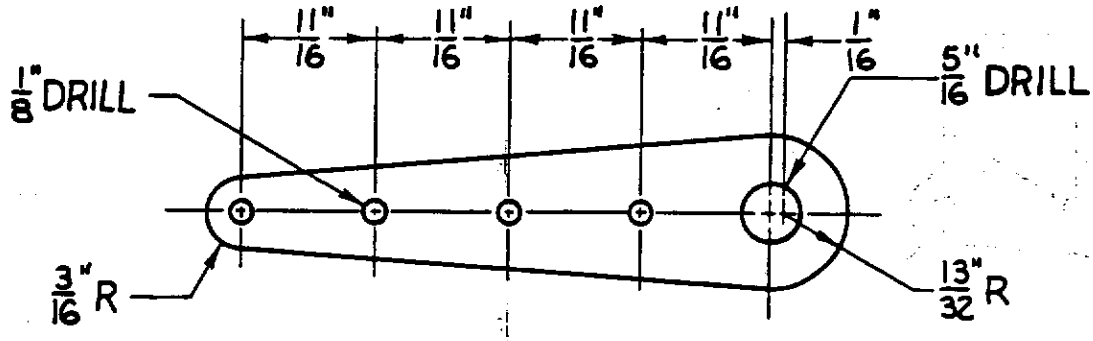


#23006 (WBK-53), #23007 (WBK-54) Rivet Pattern
Fig. W-26

STEP (34): Fabricate the four #22002 (WFT-13) and the four #22003 (WFT-14) Spar Attach Reinforcement Fittings (Figures W-A-27 and W-A-28)

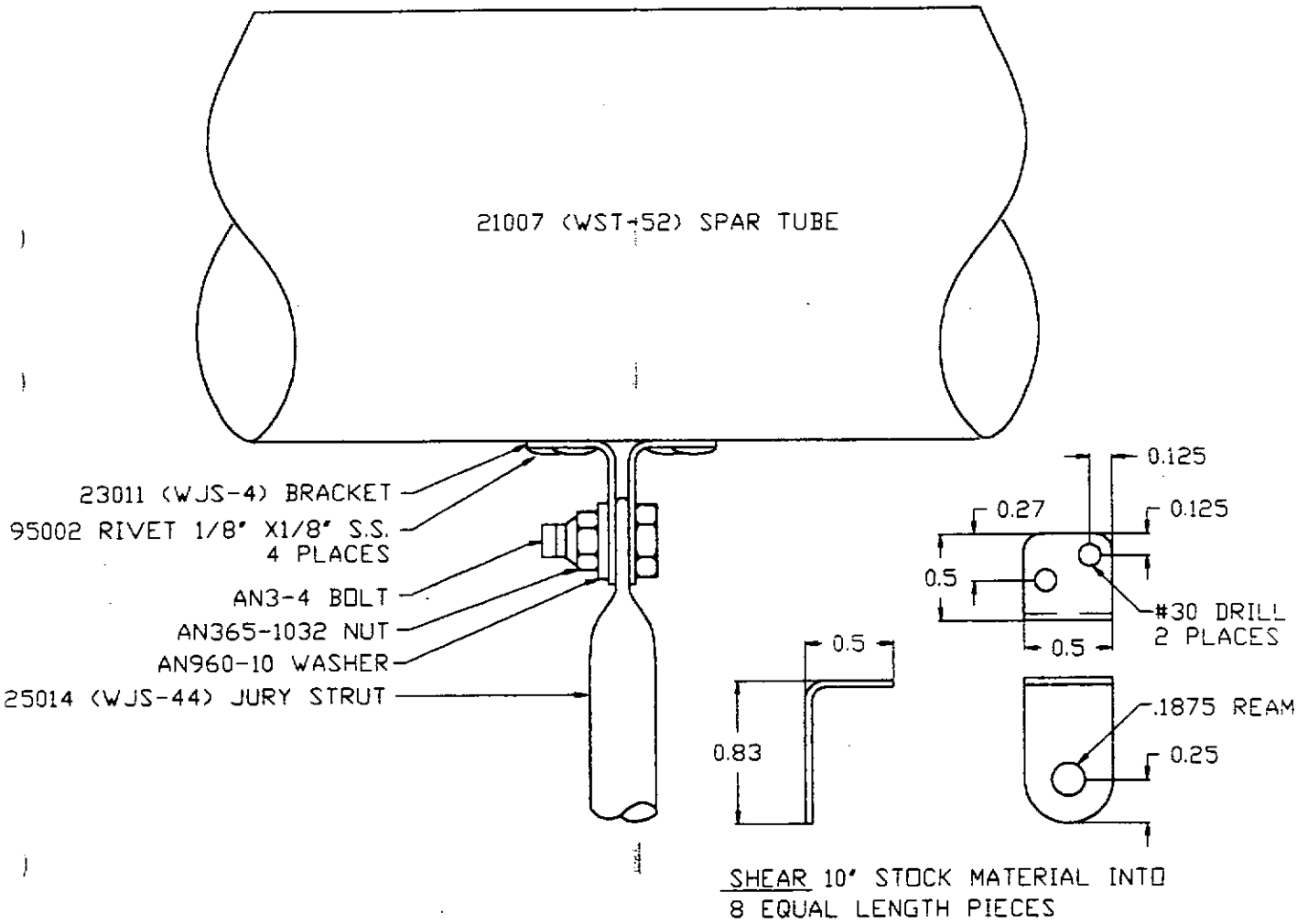


#22002 (WFT-13) Front Spar Attach
Reinforcement Fittings (Actual Size)
Fig. W-A-27



#22003 (WFT-14) Rear Spar Attach
Reinforcement Fittings (Actual Size)
Fig. W-A-28

STEP (35): Fabricate eight #23011 (WJS-4) Jury Strut Attach Brackets. The 90° bends can be made in a vice with a doubler of aluminum or light sheet metal to provide a greater radius in the bend, see Fig. W-A-29 and Plate W-25.



#23011 (WJS-4) Jury Strut Attach Brackets
Fig. W-A-29

STEP (36): File and sand smooth any rough edges on the Jury Struts and Lift Struts. Ream the bolt holes for a "tight" fit on the proper bolts.

STEP (37): You should have both wings assembled so they can be attached to the fuselage and properly locate the Jury Struts and the Spar Attach Reinforcement Fittings. All metal parts of the Wing Kit should be prepared for painting or powder coating, by sandblasting (assuming your kit was not powder coated at the factory). to save time, check the parts you have ready to paint against the powder coating check list so you can get everything painted at once. You should paint or apply zinc chromate primer to any steel part before you rivet it to the spar.