# KIS4 Cruiser

## BUILDERS MANUAL

S/N 4052

# WING ASSEMBLY

# SPAR INSPECTION

To assist you in making sure that your spars are correct we will provide you with some dimensions that you should check to verify that you have properly made spars. **It is highly recommended that these checks be made prior to any spar assembly . Your life could depend on it. These dimensions are minimum and it is acceptable and expected for these dimensions to be thicker.**

**Center main spar:** top cap measured at BL-0 .72
bottom cap measurement at BL-0 .53

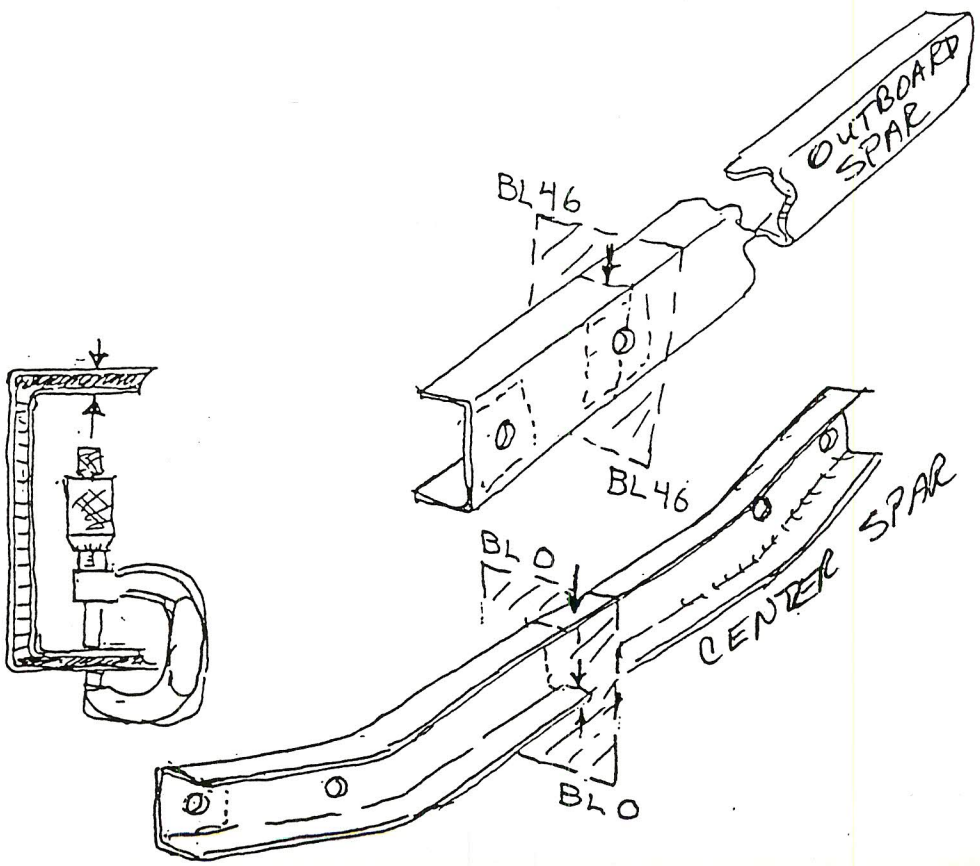
**Outboard main:** top cap measurement at BL-46 .32
bottom cap measurement at BL-46 .33

Verify the left and right identification of the outboard main spar. The upper spar cap is noticeably thicker in the outer portion of the span, and the spar "C" section caps face aft.

There are many reasons for the caps to vary in thickness ( manufacturing technics, overlaps of the materials during construction and varying material thickness from the manufacture.) This can add several thousands to the thickness .

Measure the thickness with a caliper or micrometer about one half inch in from the open edge.

Hard points: The hard points are located at BL-22 and BL-46 and are pre-drilled with a one inch hole. Verify that these holes are in the right buttline location in relation to the zero buttline centerline of the center main spar and the inboard scribe (BL-22) on the outboard spar. Note that these holes are angled slightly off the spar longitudinal centerline to hold the proper dihedral.



# WING ASSEMBLY

## MAIN SPAR AND OUTBOARD SPAR PRE ASSEMBLY

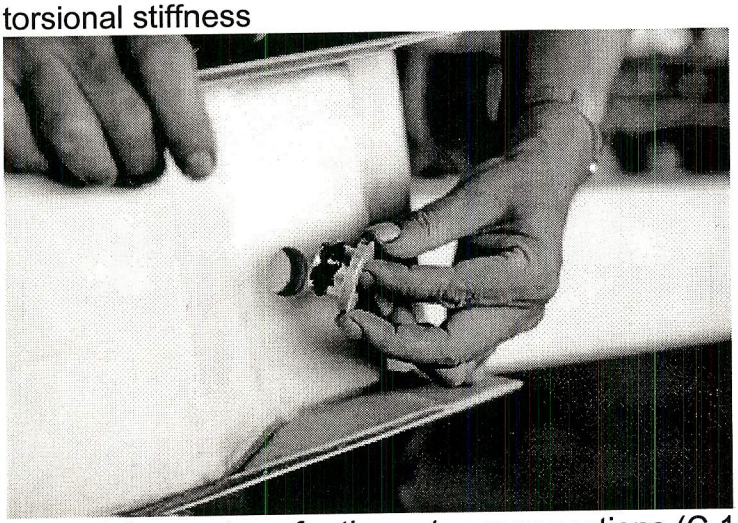
NOTE: Part of this procedure is also referenced in the fuselage assembly instructions, since you may have elected to start the fuselage assembly before the wing operations. The assembly of the spar sections is required before either installing the spar center section into the fuselage, or using the outer spar assemblies in building up the wing. Since this operation requires a fairly large flat area for fitting the outer sections to the inner section, it may be a good idea to completed this operation prior to starting the fuselage, or setting up for the wing.

Locate the center spar section (C13) and the center spar section close-out (C15). Remove all peel ply and other debris, and trim the flanges to of the close-out such that you can get a good fit when the parts are assembled. The end section of the closeout should lay flat against the spar web, so trim off any flange like overhang on this portion and trim the balance of the flange widths to roughly 2 inches wide. Check the inner surfaces of the spar section flanges, and grind down any lumpiness in the glass on this surface that may have built up due to overlaps in the glass lamination. You may grind through one or two layers of glass in this area wthout compromizing any structure, but DO NOT grind into any of the black cabon fiber in this flange. Test fit the closeout section with the spar section, and mark areas which must be sanded away from the close out insert before re- assembly. If the fit-up is too tight, heavy sanding may be required and is permissable on this part (The close out insert molded parts but not the carbon fiber spar cap section) . A snug fit is desired, but not so tight that it distorts the flanges of the primary spar section, nor displaces all of the adhesive from the joint areas. .

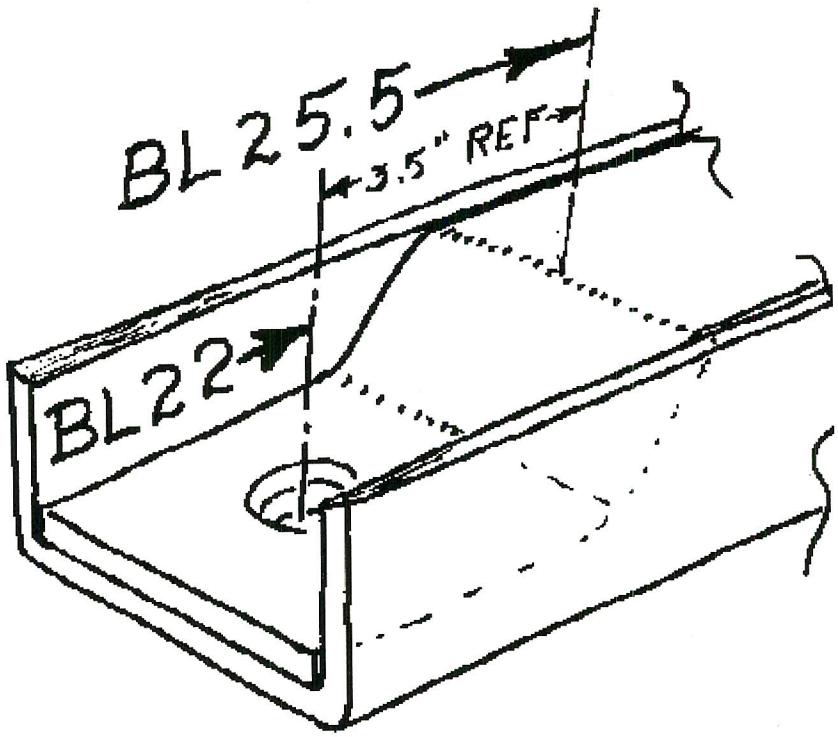
Transfer the location of the pre drilled holes in the center section to the close-out molding, and cut them out. Do this as accurately as possible, especially at the BL 46 holes where the bushing will be bonded into both parts, however, even these holes should be a little oversize to allow bushing insertion cleanly into the factory drilled holes without misalignment. Some judicious fileing or sanding may be required to allow free assembly of the bushing without wiping off all the bonding adhesive. The BL 22 holes in the close out side will have to be expanded to a bit over 1.5 inch diameter since the large diameter section of the bushing will be in this section. Note the contacting surfaces of the two parts where they will be bonded and and roughen and clean to prepare for bonding. Use the CS 18A and CS 19 bushings as an alignment aid in fitting the parts together, and verify that the assembled thickness will be 3 inches.

Bond the assembly together using Hysol adhesive (mixed per instructions) , be sure to clean up any excess adhesive, particularly in the holes where the bushings must be placed, and any other external surfaces where fit up may be

compromised. CHECK FOR TWIST - The basic spar section is incredibly strong in bending, but surprisingly flexible in torsion until the insert section is bonded into place forming the "box" section. This is your last chance - before the bond line cures, apply a level or other straight edge on the primary spar section factory molded web surface at each end and sight for any twist. If any twist is noted clamp the assembly to a solid surface and use the clamps and shims to eliminate ant evidence of twist and allow to cure. Apply a visual twist test to any assembly which which is being "closed out" which will result in increased torsional stiffness

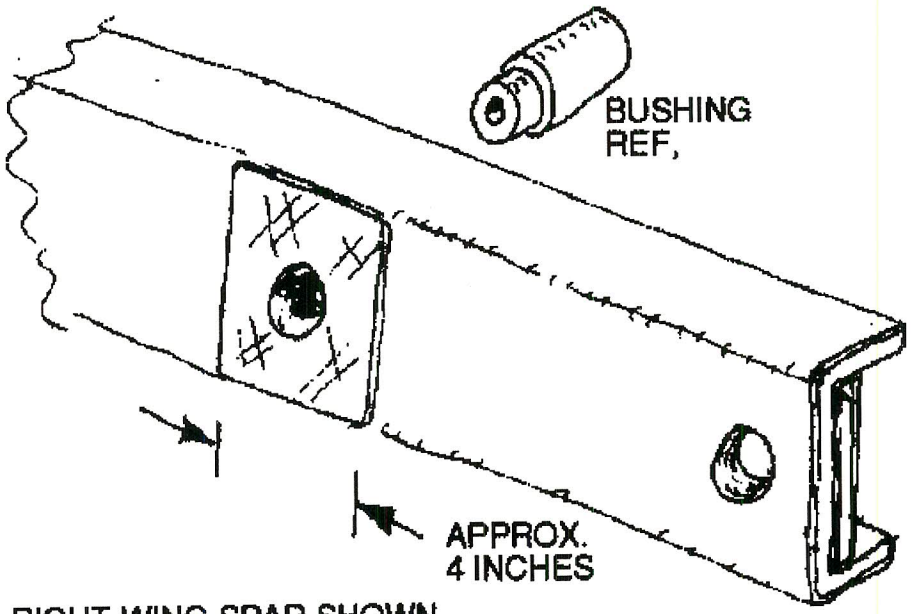


Repeat these steps for the outer spar sections (C 14 R & L) and close-outs (C16 R&L) aligning the close-outs with the scribe lines. The out board spars uses the CS-18 and CS-19 bushings. Remember to hold assembled spar thickness to 3 inches. The inboard mounting hole on each outer spar locates the 22 inch butt line. When installing the close-out to these spars set the distance to the outer angle of the close-out to 25.5 inches (3.5 inches from the hole SEE FIGURE BELOW).




Locating the spar insert using the BL 22 references will result in some overhang of the spar insert end. Trim the insert even with the end of the spar. For easy reference in future operations, mark the spars left or right and mark the top.

The wing spar joints at butt lines 48 left and right require an 8 ply pad to shim out the spar joint to match the 8 ply layer at the center spar junction with the fuselage. This pad can be functionally applied to this location on either the aft surface of the center spar or the forward surface of the outer spar as shown above. The installation above is the preferred method, to be made prior to the




RIGHT WING SPAR SHOWN
MAKE LEFT SPAR OTHER
HAND

**EIGHT PLY PAD ADDED AT BL 48**
**BUSHING LOCATION**

bonding of the bushing at this location. Re drill or otherwise cleanly cut away any portion of this pad covering the bushing hole to permit proper installation of the bushing. The resulting installed bushing face should be just below the surface of this pad.

Install Bushings - The bushings (CS18, CS-18A and CS19) are made a little long to allow for variations in layup thickness. Dry fit the bushings per the drawing . The faces of the small diameter end of the bushings should not protrude above the spar surface, slightly (as much as 1/16th inch) below the surface is desired. Carefully machine or file thse ends to this condition if they are too long. Prepare all bushings at one time and mark them for reference to be assured that you will get them back in the right location for bonding. Locate the AN-9 spar bolts and wax them liberally with a good paste car wax so they wont be bonded into place. Tape the facing spar surfaces with clear tape and carefully cut the holes for the bolts. On a flat surface set blocks beneath the center section to provide bolt end clearance, and at least two blocks 3 inches higher for the outer spar section. The outer spar sections should be both joined at the same time if you have sufficient room, ( one side at a time is permissable so long as the set up is straight and flat andthe dihedral verified uniform by seperate measurement).

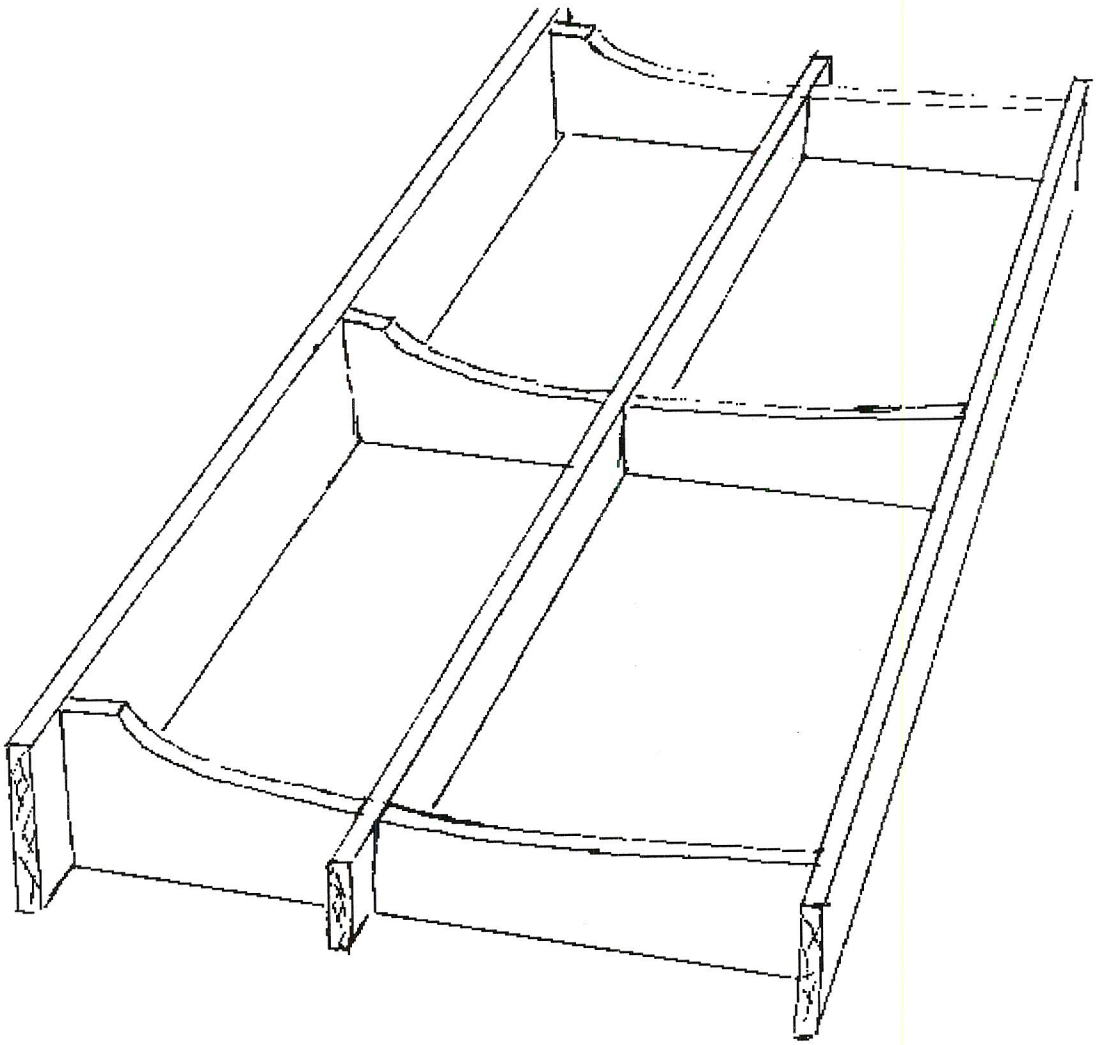
Glue the bushings in place with Hysol adhesive, cleaning up prior to clamping, to provide for successful disassembly. Do not worry about the fact that the large

(1.5 inch) diameter section of the bushings protrude from the surface, and do not be concerned with bonding in this area. After the two outer spars are bolted in place verify that no twisting has been induced, and use a string between spar tips to verify that the dihedral angle is the same on both sides (The bushings can move slightly in their bores before the adhesive sets up so loosen the bolts and make any required adjustments promptly before the adhesive starts to cure. Support the spar sections in their proper position during the curing even after the bolts have been tightened.

When the adhesive is cured, remove bolts and disassemble the assembly. Clean up excess adhesive, and fill the gap around the protruding 1.5 inch diameter bushing end with MICRO paste at this time.

## WING ASSEMBLY JIG

The first step for the wing assembly is to fabricate an assembly jig similar to the sketch shown. The upper contour of the airfoil should be traced from the full size wing jig pattern provided and carefully cut in the plywood or particle board ends (you will be building the wing sections upside down in this cradle). Cut far enough around the nose radius contour (as shown on the pattern) to provide a positive reference for positioning the nose of the upper skin. Some of the materials may be salvaged from the shipping crate, but most will have to be procured locally. Be sure the stringers between the contoured ends are straight and not warped (reinforcing the strips with straight strips of plywood, or ripping them from 3/4 ply may help ensure that they stay straight). The stringers should be located such that the central one is in line with the main spar, and the rear one centered beneath the rear spar. It is recommended that the stringers should be roughly 12 feet long, and the outer edges of the airfoil shaped cradles should be 130 inches apart (just about 2 inches shorter than the wing skins. The assembly fixture should be securely attached to a table or saw horses at a convenient height for working on. Leveling is the accepted way of setting up such a jig, but straightness, and lack of twist are the really important parameters. When positioned, secure in place so the jig will not move around and twist during fabrication (Using Bondo to glue the supports to the floor is recommended if practical). This same set up is used for both wing halves, so it is worth taking the extra time to feel confident with your set up.



**WING ASSEMBLY JIG**

It is recommended that the wing assembly jig be constructed more ruggedly than suggested in the basic instructions. More rib contour sections are desirable , probably one for each major rib location in the wing assembly would be optimum. The wing skins have a tendency to curl in post curing, to a tighter radius than the initial airfoil contour, so a very significant weight is required to fit to the rib countour. Also keep this in mind when fabricationg the table for assembly of these items. Long narrow sand bags (like made from old trouser legs) are ideal for skin attach for all flight surfaces, and a total bag load of 1000 pounds for the lower skin bonding would not be unusual..

UPPER WING SKIN PREPARATION

Select the proper wing skin for the wing side you are planning to assemble ( the inboard section of the upper wing skin can be identified by the extra ply of outer glass in the "wing walk" area). Peel off all peel ply and any residual molding materials, particularly in the areas where you will be bonding the spar and the ribs. Trim the rear edge of the selected upper wing skin along the scribe line provided on the outer surface for that purpose. The inner edge of the skin will be buttline 22 and also must be trimmed. Locate the joggle near the inner end on the upper surface - this is buttline 24. Layout a straight line 2 inches inboard from this reference (this will be buttline 22 ) and carefully trim to this line. (Make these trim cuts carefully and precise, since these cut edge will be an important measurement point for assembly). Position the upper wing skin in the assembly fixture, pulling the front contour in place on the templates, and center the skin for the same overlap at each end. 'Tack" in place with a few dabs of bondo, 5 minute micro, or hot glue (these materials will be very useful for temporary fixturing of parts during assembly. Any of the three are equally applicable, but in any case avoid excessive amounts, and do not let them displace final bonding materials in final assembly, since they are much weaker than the final adhesive materials.)

REAR SPAR PREPARATION

see page 9A

The wing rear spars are identical and interchangeable. Select a rear spar for the wing section that you are building at this time. Trim away any surplus edge material and remove all peel ply and other non structural manufacturing materials. Sand the edges of the fiberglass parts to make them safe for handling (potential slivers and cuts from these sharp edges can be very nasty - perform this operation as a matter of course when selecting premolded parts for assembly)

Locate the inner end of the selected rear spar. This is accomplished by identifying the end of the spar where the core material for the web is made from a 4 inch long section of Phenolic (hold the spar up to a bright light to identify the edges of this solid block, and mark the center). The center of this block is to be located at buttline 22 where it will be drilled for the rear spar bolt. Lay the rear spar in place along the aft section of the wing skin with the open face pointing forward. Carefully locate the rear spar with it's aft face 1.75 inches forward of the rear trimmed edge. Establish the proper butt line location relationship between the spar and skin by lining up the inner edge of the skin with the previously marked buttline 22 on the spar. Fixture the spar in place with several clecos or small screws. Fit the rear rib sections into this rear spar at their appropriate butt line stations, and mark areas where bonding will take place as reference for subsequent surface preparation. The innermost rib (buttline 26.5) on either side may have to be vigorously sanded in the area where the aft spar flange fits. The rear flange of the rib must sit against the rear spar inner/forward face without clearance for proper chord wise stack up of wing assembly components.

where + how to align

4PWINGRSP

REAR SPAR PREPARATION and FUEL VENT – REVISION 1 JAN 1998
INSERT AFTER PAGE 7 IN 4PWINGA DATED JULY 1 1997 AND STRIKE OUT CORRESPONDING ORIGINAL SECTIONS

## REAR SPAR PREPARATION

The wing rear spars are identical and interchangeable. Select a rear spar for the wing section that you are building at this time. Trim away any surplus edge material and remove all peel ply and other non structural manufacturing materials. Sand the edges of the fiberglass parts to make them safe for handling (potential slivers and cuts from these sharp edges can be very nasty - perform this operation as a matter of course when selecting premolded parts for assembly)

Locate the inner end of the selected rear spar. This is accomplished by identifying the end of the spar where the core material for the web is made from a 4 inch long section of Phenolic (hold the spar up to a bright light to identify the edges of this solid block, and mark the center). The center of this block will establish the location of buttline 22. This will be the location of the edge of the wing skin when assembled.

The rear spar bolthole will be drilled at BL-21 at a later time. Assure that the insert block will have sufficient edge distance at that time. DO NOT DRILL THE REAR SPAR BOLTHOLE AT THIS TIME.

Lay the rear spar in place along the aft section of the wing skin with the open face pointing forward. Carefully locate the rear spar with it's aft face 1.75 inches forward of the rear trimmed edge. Establish the proper butt line location relationship between the spar and skin by lining up the inner edge of the skin with the previously marked buttline 22 on the spar. Fixture the spar in place with several clecos or small screws. Fit the rear rib sections into this rear spar at their appropriate butt line stations, and mark areas where bonding will take place as reference for subsequent surface preparation. The innermost rib (buttline 26.5) on either side may have to be vigorously sanded in the area where the aft spar flange fits. The rear flange of the rib must sit against the rear spar inner/forward face without clearance for proper chord wise stack up of wing assembly components.

## FUEL TANK VENT – INNER CHAMBER

Provisions for venting the air from the inner fuel chamber have been overlooked in the assembly manual. If not vented, this inner tank chamber will trap air above the fuel and limit the filling of this section by about 3 gallons per side. While not a safety issue, this condition will limit the possible fuel capacity, and probably

should be corrected. If you have not progressed beyond this point, insert a short section of tubing through the rib just beneath the upper flange (this is the rib which has the anti slosh flapper valve). Position it such that it will be in the upper rear corner of the inner tank compartment which is shortened by a panel for the spar "pocket". The tube is to assure that the hole does not get plugged in the bonding operation and is the easiest way to seal the edges of the foam core. However, this foam core is fuel proof, and this might actually be a bit of overkill.

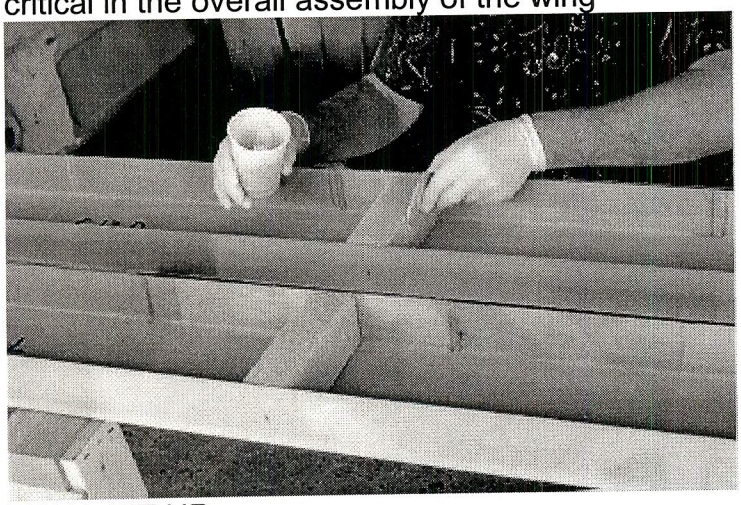
If your wing has been assembled , this vent may still be provided by a less elegant fashion. Probably the best and easiest soloution is to pierce a small hole up in this region of the rib web. A rod can be sharpened with a slender point and inserted through one of the supply ports in the inner rib. Only a small hole is required, and this method will result in minimum debris.

MAIN SPAR

Select the proper main outer spar for the wing side you have selected for first assembly, and strip all peel ply etc., and prepare it in the same fashion as the rear spar. Lay it in place on the upper skin, and locate and mark all bonding surfaces including the rib positions. Make sure that all these surfaces are cleaned of any peel ply and parting agent, and roughen surfaces for bonding with coarse sandpaper.

SPAR BLOCKS

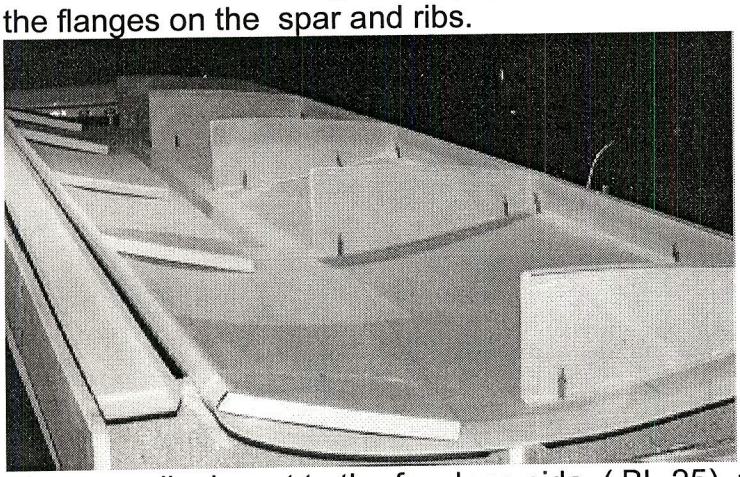
SPAR FILLER BLOCKS - In the outboard areas of the main spar where it is not boxed in by the spar close-outs, the installation of filler blocks to provide a surface for bonding the aft rib sections will be required . Make up blocks of blue foam to fill these areas (note that the spar flange thickness is varied, so individually fit these blocks in their proper areas). Verify that the spar flange will not be distorted as these blocks are bonded into place. Bond these blocks into the spar with a bit of micro slurry, and close out the exposed foam surfaces with two plys of wet BID with about 1 inch overlap to the spar around the perimeter (do not overlap the top or bottom surface of the spar since these surfaces are at their final dimension, and bulk in theses areas will prevent proper fit up . Also keep these inserts flush with the edges of the spar flanges since this face is critical in the overall assembly of the wing



TRIAL FIT UP

Select the ribs for this assembly (there are no right and left side ribs so just set out the required number of pieces). Again remove all peel ply and sand edges for personal safety in handling. Prepare the flanged bonding areas of the ribs in the same fashion as the other bonding areas - roughen with sand paper and clean. Do a trial assembly with the spars and ribs to assure yourself how they will interface with each other, and mark critical locations for future reference. Rib

butt line dimensions are to be set at the centerline of the rib web sandwich panel section. Pay particular attention to the orientation of the ribs. Some of the rib sections are easy to confuse up from down, and remember that you are building the wing upside down. Again, note that there are no left and right rib sections. The rib flanges will point away from the fuselage in the right side wing, and toward the fuselage in the left side wing ( photo and sketches show a left side wing). Clean and scuff areas of the upper skin (based on these marks) which will be bonded with 80 grit sandpaper in a similar fashion that you had prepared the flanges on the spar and ribs.



The nose rib closest to the fuselage side ( BL-25), must be cut short to provide for the insertion of the center stub spar section during mounting the wings. This cut should be made 3.5 inches in front of the spar forward face, carefully parallel with this face. The section in front of this line is a portion of the fuel tankage system, so a panel should be cut from the supplied honeycomb "standard panel" to close out this area out to the next rib. Fit this part carefully since the joints will be potential fuel leaks. The back face of this panel is flush with the cut edge of the rib and it will have constant height out to the next rib (The photo shows a board clamped in place for forming a flange on this part for bonding to the lower skin, which will be done in a later operation).

The nose rib in the center of the fuel tank bay should have it's corners notched per the attached sketch to permit fuel to pass between sections and avoid any bonding conflicts with the perimeter of the tank area.

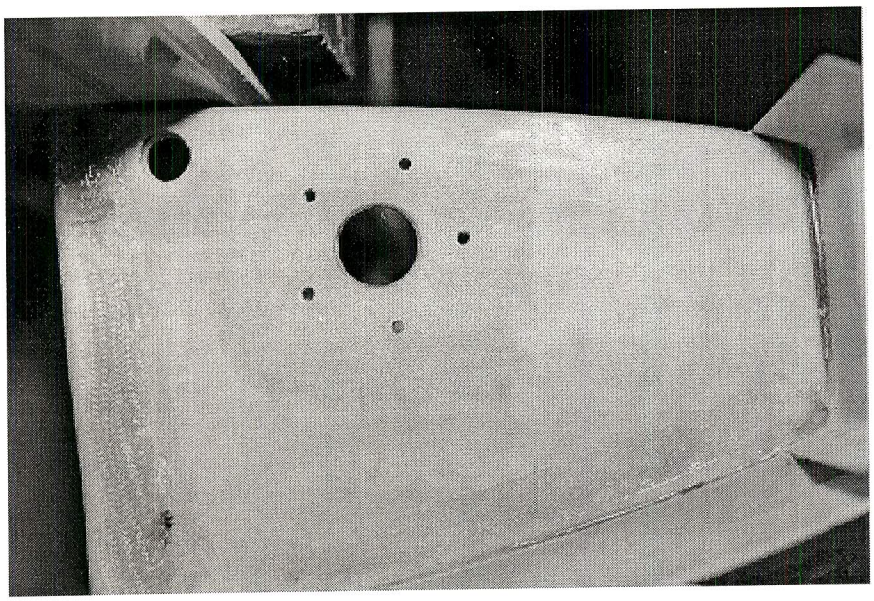
no sketch

Note that there is an extra nose rib added for carrying the mounting point for the aileron bell crank, and that the nose internal close out channel ends at the end of the tank bays. The open area at the nose of the wing is for the aileron control rod coming out from the fuselage, and the bell crank will be mounted in this short "bay" to transfer this motion back to the aileron.

Clecos or small sheet metal screws can be used to secure these components prior to and during bonding, and will be useful for reinstalling the parts accurately in place with the bonding materials for the final assembly .

While the assembly is in the trial stage this would be a good time to review mounting of vent lines, fuel level sensors, and the anti slosh valve. Drilling holes and other preparations are best done on local components which have been identified, and keyed into the selected location

FUEL OUTLET - The fuel outlet uses a finger strainer located at the lower aft corner of the first rib. It may be easiest to install this plumbing in the loose rib before bonding into place. Reference picture as to the location and procedure for installing the fuel outlet. If an injected engine is to be used, verify whether a fuel return line should be provided for. If this is the case, this rib is also the appropriate location for for this line.



The first rib out from the inboard section of the wing on each side is shortened per instructions elsewhere in the manual, to permit a "pocket" for installation of the wing assembly on the stub spar protruding from each side of the fuselage. This rib also requires hard points for both the fuel outlet, and any other penetrations for devices such as fuel level measurement or others. The suggested insert material for these locations is 1/4 inch aluminum plate to provide a rigid non porous material for bolts and fittings. The fuel outlet is the supplied finger strainer, and a section of aluminum about 1.5 inch square is suggested, located at the aft lower corner of the rib (double check location - you are building the wing upside down).

Deburr all sharp corners and edges and clean and roughen all surfaces completely . Drilling and tapping for the finger strainer before installation is a

10A

4PWINGFR

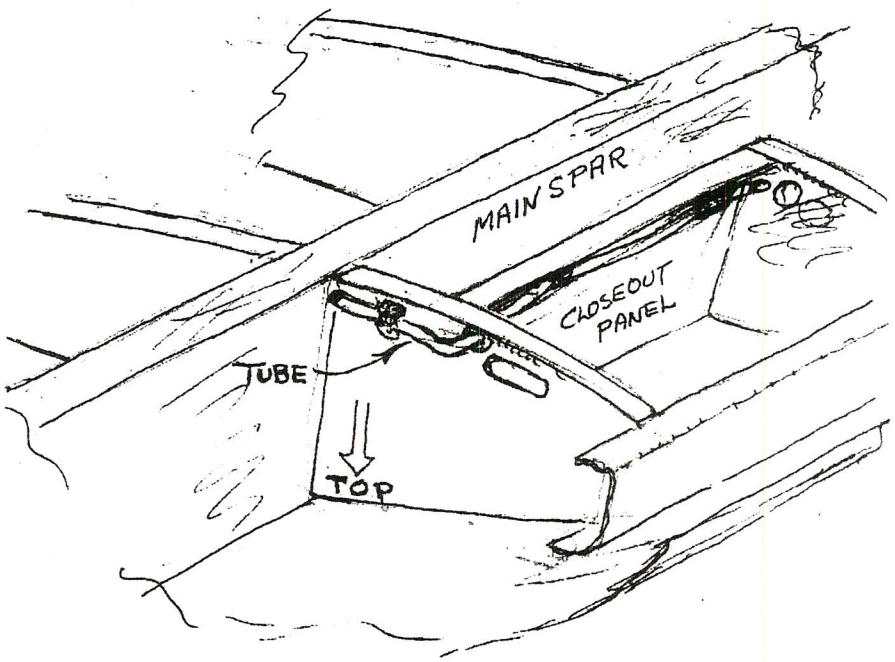
PART OF REVISION 1 FEB 1998 4 PLACE WING – FUEL RAMP – INSERT BEFORE PAGE 11 IN 4PWINGA DATED JULY 1 1997 AND NOTE IN CORRESPONDING ORIGINAL SECTIONS

FUEL RAMP

The original document shows a photo of a fuel ramp designed to avoid a trapped false sump in the second fuel bay just beyond the flapper valve. Several builders have pointed out that when this volume is sealed, there is a potential problem of trapped air pressure in this volume stressing and possibly failing the bond joints of the ramp. The expected forces are not large, but flexing this panel could be a problem. It would be well to use a sandwich panel section for this ramp when it is installed,

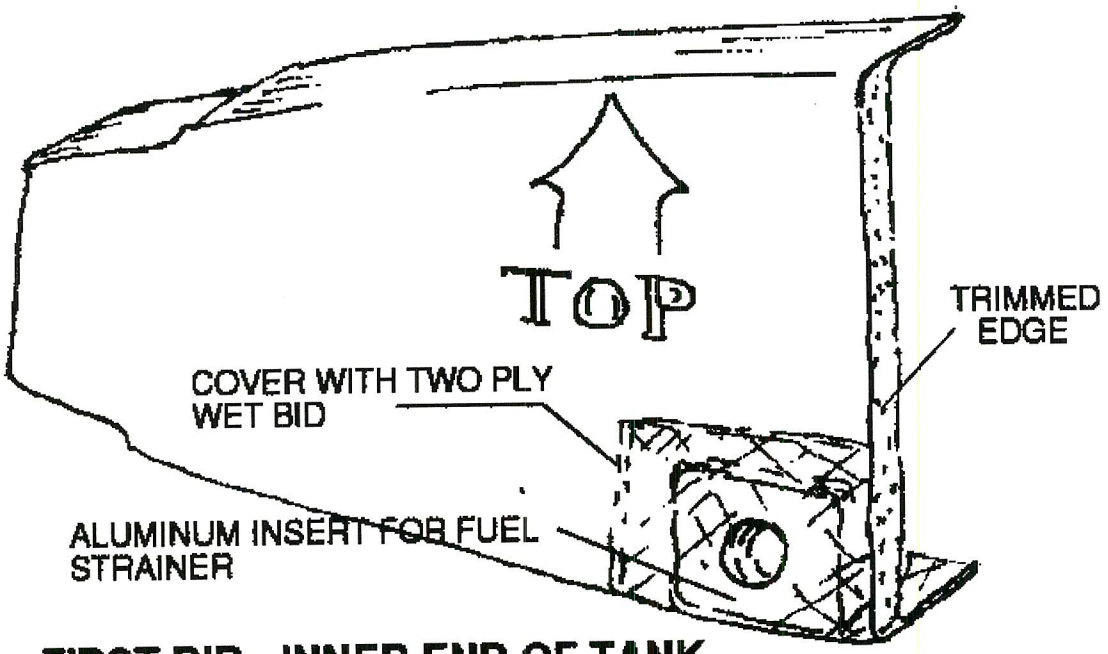
There are two possible treatments for this problem – those of you that have "closed out" this area should drill a small hole (about 1/8 in dia,) in the lower skin to vent this volume, and verify that it is clear in frequent inspections.

Another solution proposed by one of the builders was to leave this ramp out, and install a small diameter tube ducting this corner around the spar pocket divider to the inner low point. This would "siphon" this corner of any water or residual fuel. Secure the tube with patches of FLOX (clean and roughen both surfaces). Be sure in routing this tube such that it will not interfere with bonding the bottom skin in place.



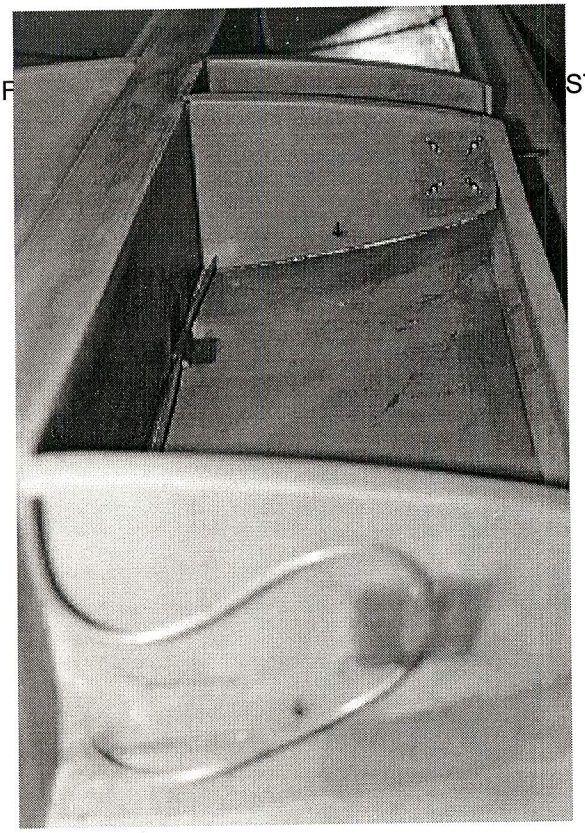
good idea to avoid breaking any bonding after installation. Tape both open ends to avoid filling with resin. Cut away one side of the sandwich panel as for any hard point, and clean away the core material. Bond in place, and fill end voids with a fairly wet MICRO slurry, and cover with 2 ply wet BID. Trim glass to clear openings after the patch is cured.

Any other fuel penetrations into the tank area through this rib, or other locations should employ a similar technique with sufficient aluminum insert to take the local bolting forces. The phenolic, or plywood inserts used for structural hard points elsewhere in the assembly, would probably weep a small amount of fuel because of porosity



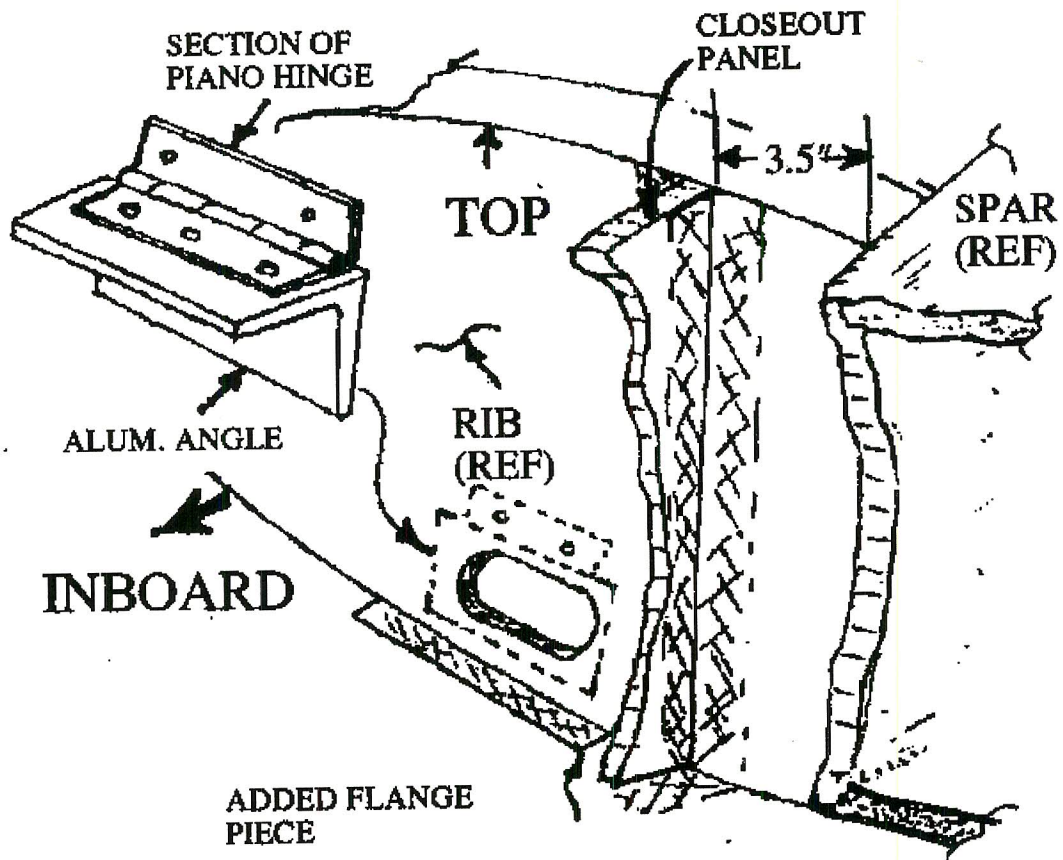

**FIRST RIB - INNER END OF TANK**

FUEL VENT LINES - The fuel tanks must be vented to permit the entrance of, or exit of, air equivalent to the fuel flow . the upper rear corner of the outermost rib of the tank bays, is the preferred location of this vent . The lines are 1/4 inch aluminum tubing furnished with the kit. Route this vent line out to the tip of the wing and out what will become the lower surface as shown in the drawing. Fit this line in place with the temporally mounted wing structural components, cut away any local areas required for this line positioning prior to bonding.



FUEL MEASURING PROVISION - This same first rib is the logical place for installation of a fuel level sensing device. No fuel level measuring system is provided in the kit, although the tubular capacitive sensors are one of the most popular devices. For this type, and/or many other fuel level sensors, the most logical installation is through a prepared hard point in the web of this inner rib for the mounting flange. Also locate the path for the length of this sensor element, and mark any next rib sections where they must be penetrated, and remove and modify these ribs. Any hole through the rib core which will be exposed to liquid fuel shall have the core forced down in the raw edge, and filled with a MICRO/Flox paste. Carefully follow the sensor manufacture's instructions for any bending that might be required to implement the desired level measurements.

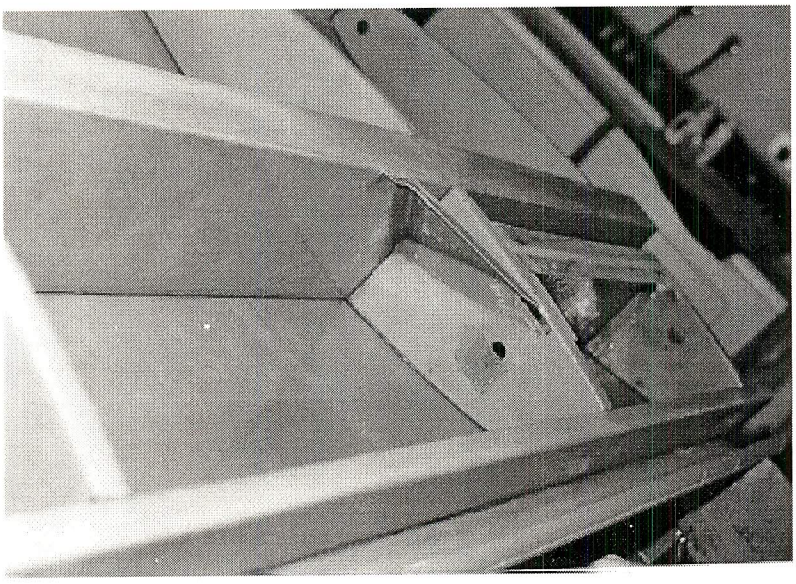
ANTI-SLOSH VALVE - The anti slosh valve system is installed in the lower section of the second rib outboard . This rudimentary check valve will keep this inner "header" tank relatively full during the agitation due to rough weather or enthusiastic maneuvering. This valve is a flapper configuration which is built in place , using a 3 inch length of hinge section and a 3 inch section of 1 X 1 X 1/8 inch aluminum angle. Install the aluminum angle on to the hinge section with 2 or more pull rivets (see sketch). Position the flapper valve assembly along the lowest point on this rib, near the rear joint to the spar pocket. Make sure that there is sufficient clearance for the flapper to open and close. On the rib where the flapper valve will be mounted on the side with no flange, local strip of precured 2 ply may be added as a flange to keep final assembly bonding material from jamming the flapper..




FUEL TANK FLAPPER VALVE - PLACE FWD. OF FUEL TANK CLOSE OUT PANEL

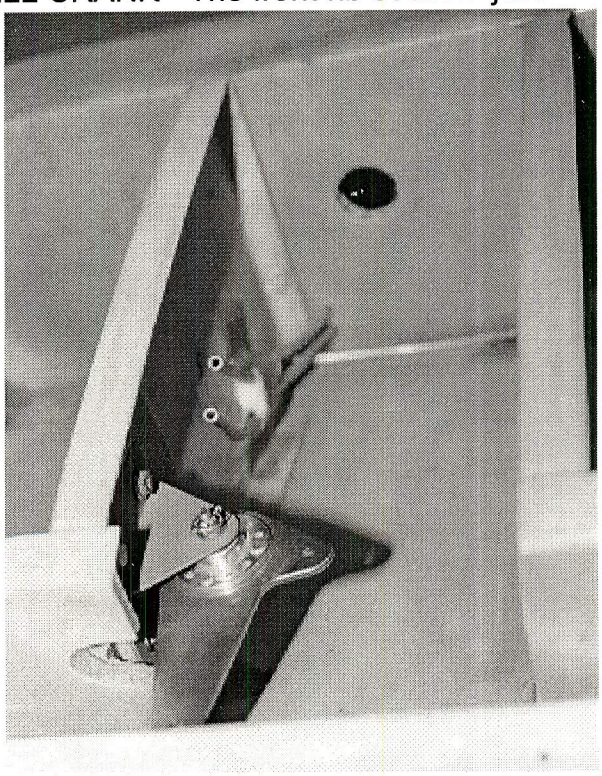
Mark the overlapped area covered by the flapper in the closed position, and mark the mounting holes in the top part of the hinge assembly. Make sure that the valve is clear to swing when mounted at that location. drill and cut out an opening ( or multiple openings) for the fuel to flow through that is well within the flapper area. Crush the core material around this new opening and "butter" on a protective layer of FLOX around the edges. clean up the edges and the surface after the flox has cured, and install the flapper covering this opening with good overlap all around it.

Again, check for freedom of movement, and the coverage of the opening, and total flat seating of the flapper surface.



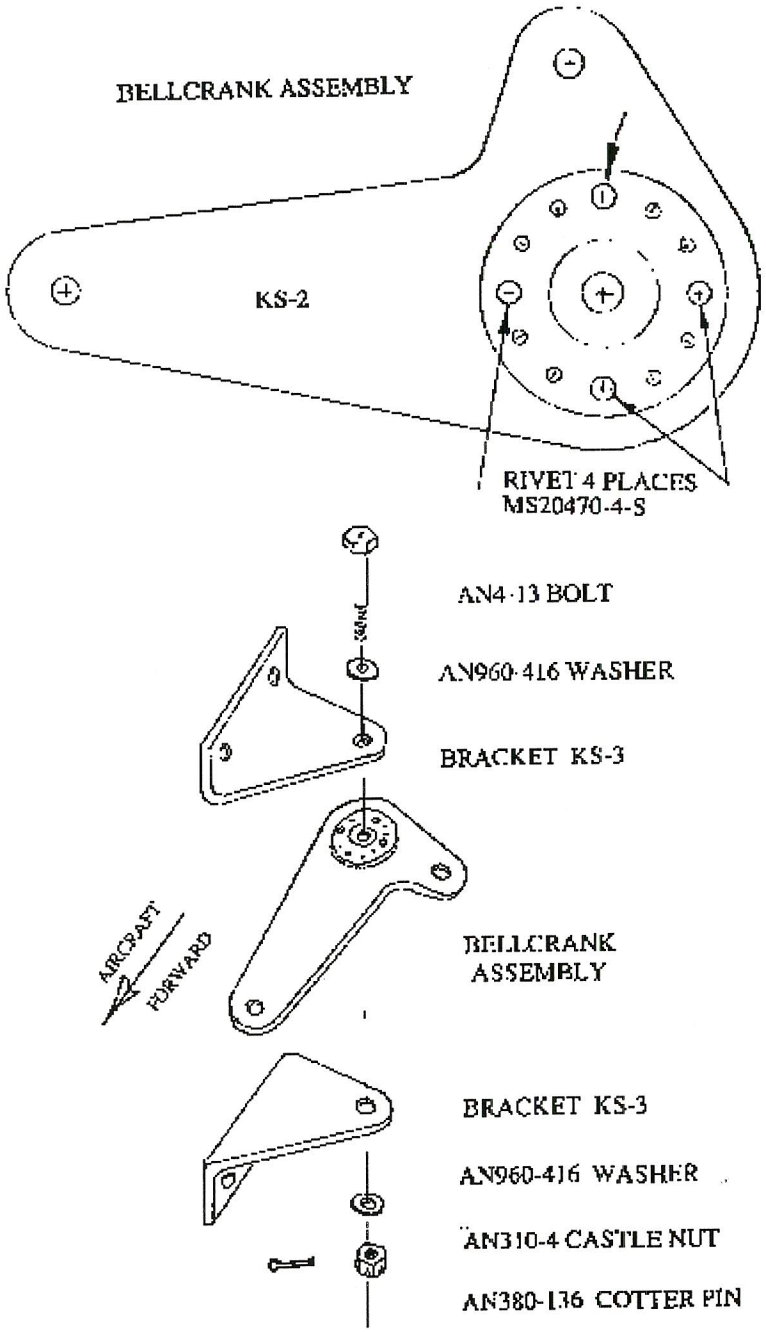
This view shows the sort of fuel ramp feeding into the flapper valve. Remember we are upside down, and this close out will prevent the collrection of unavailable fuel, or a false sump for water to collect.

HARD POINT FOR THE AILERON BELL CRANK- The front rib section just beyond the last nose rib of the fuel tank, is where the aileron bellcrank will be mounted. The "hard point" for mounting this bell crank can be installed most easily prior to the assembly process. Make up a pre-assembly of the bell crank with its bearing, riveting the bearing in place with a minimum of 4 AN 470 AP 4-12 rivets. Make a partial assembly of the bell crank (KS-2), and the two mounting angle brackets (KS-3) using the appropriate bolt, nut and washers. Cut a piece of 1/4 in. plywood, about 2 3/4 by 2 3/4 inches. (see also earlier figure of modified nose ribs). Position this piece of plywood on the rib, and the bell crank assembly such that the aileron actuating rod end extending outward from the fuselage will be centered in the nose open area when mounted to the top surface of the bell crank (note again that we are building the wing upside down). Mark the outline of the wood insert piece on the inner surface of the rib, Cut away the skin within this outline and remove core in this area. Clean the remaining outer skin and



insert the wood with FLOX adhesive, and close out the hole with 2 plies of prewetted BID.

Make the more complete sub assembly with the 2 KS-3 brackets per the sketch shown, and fabricate a 1/4 inch plywood spacer as shown, fitting the mounting area of the KS-3's. Locate the assembly with the leading edge of the KS-3 brackets 3/8 inch back from the front edge of the rib and center the assembly 1/4 inch below rib centerline. Drill the 4 holes for the #10 bolts through the plywood and the rib hard point. Mount the 4 1000-3 nut plates using the bolts to fixture them, and drill and install 2 rivets in each nut plate on the back (outboard) side of the rib hard point. Cut clearance areas in the plywood, and the leading edge of the rib to permit at least 30 degrees of movement in each direction (on the left wing assembly the entire local section of the front flange must be removed to permit free travel).




BONDING UPPER SKIN ASSEMBLY

Replace all the rib sections and spars following the modifications and assure that none of the previous operations create any problems with the fit up. When you are satisfied with the positioning, the bonding can be initiated. Again, this is

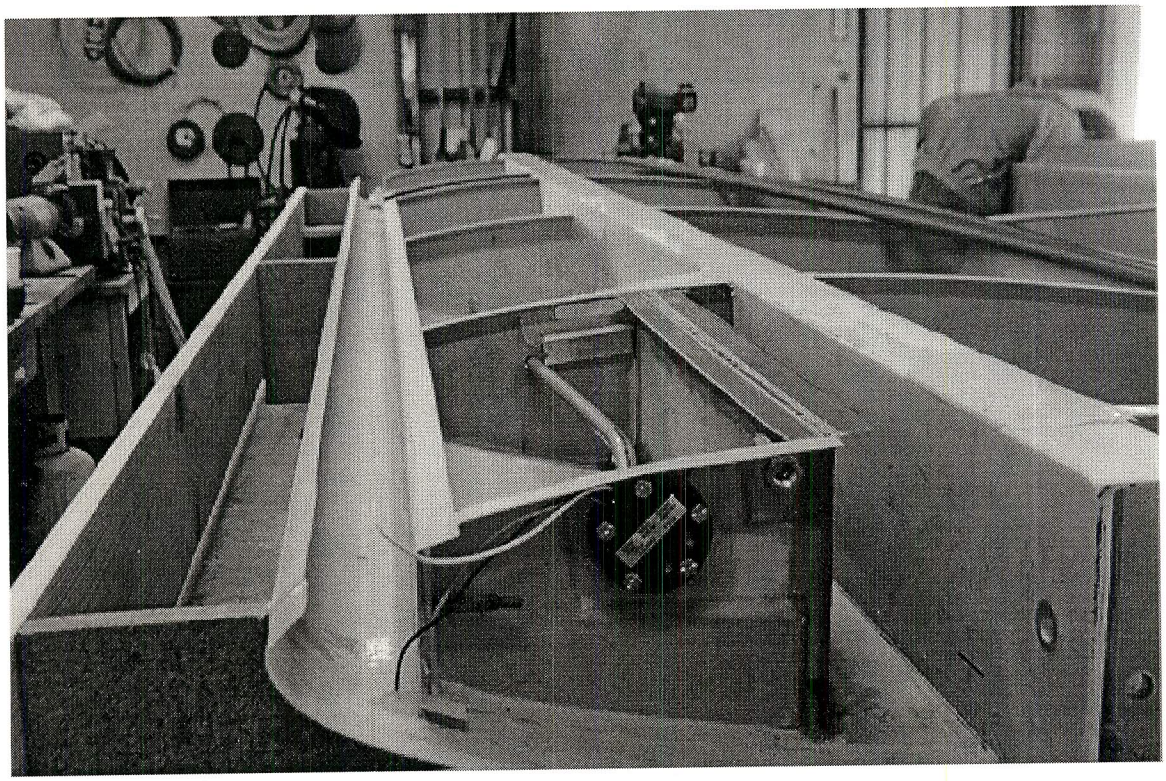
accomplished working from the rear spar forward. Mix the Hysol adhesive per the directions. and apply a bead along each joint sufficient the there will be visible squeeze out on the edges of the bonding areas (A small amount of FLOX may be added to the adhesive to thicken it and assure that it does not flow out of the joint area) , Remember to assure that the bonding surfaces are clean and clear of all debris or greases or oils which might interfere with the bonding process.. Secure and lightly clamp all bonding surfaces with weights, clecos, , or clamps until the adhesive has sufficient strength. Verify before the curing has started, that the fixture has not shifted, and the assembly is still straight with no twists.

PITOT STATIC LINES - On the left wing assembly, two lines shall be installed running just behind the main spar for the pitot and static air pressure for the flight instruments. Make an expansion loop in these lines, and route them forward to the location of the aileron bell crank area. Secure these lines so that there is no possibility of interference with the aileron push pull tube sharing this space. Terminate the aluminum tubing in the region of the bell crank bay such that the removable cover can serve both purposes of access to the bell crank and the pitot static connections.

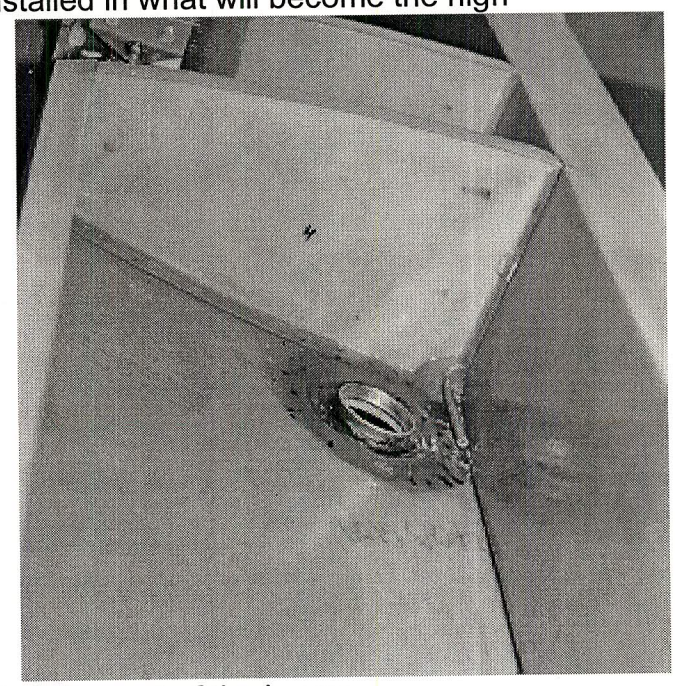
SPAR POCKET CLOSE-OUT - With the ribs and spars bonded to the upper skin, this is a good point for the installation of the honeycomb panel that was cut for the spar pocket forward close out. Fit this panel carefully since most of these joints must be fuel tight. Position the panel with it's aft surface flush with the cut edge of the first rib, and in a straight line to the face of the next nose rib. With all surfaces previously prepared and clean, bond this panel in place using 2 layer 2 inch wide wet BID strips on both sides on all three perimeters. After these joints are cured, prepare a straight flat board to span the open top face of this panel, with clear tape or other parting preparation on the face. Clamp this board in place as shown in the photo, laminate a flange on both the fore and aft edge of this panel using 2 inch wide 2 ply wetted BID strips. When these flanges are sufficiently cured, remove the board, and roughen and clean the surfaces of these flanges in preparation for bonding the bottom skin.

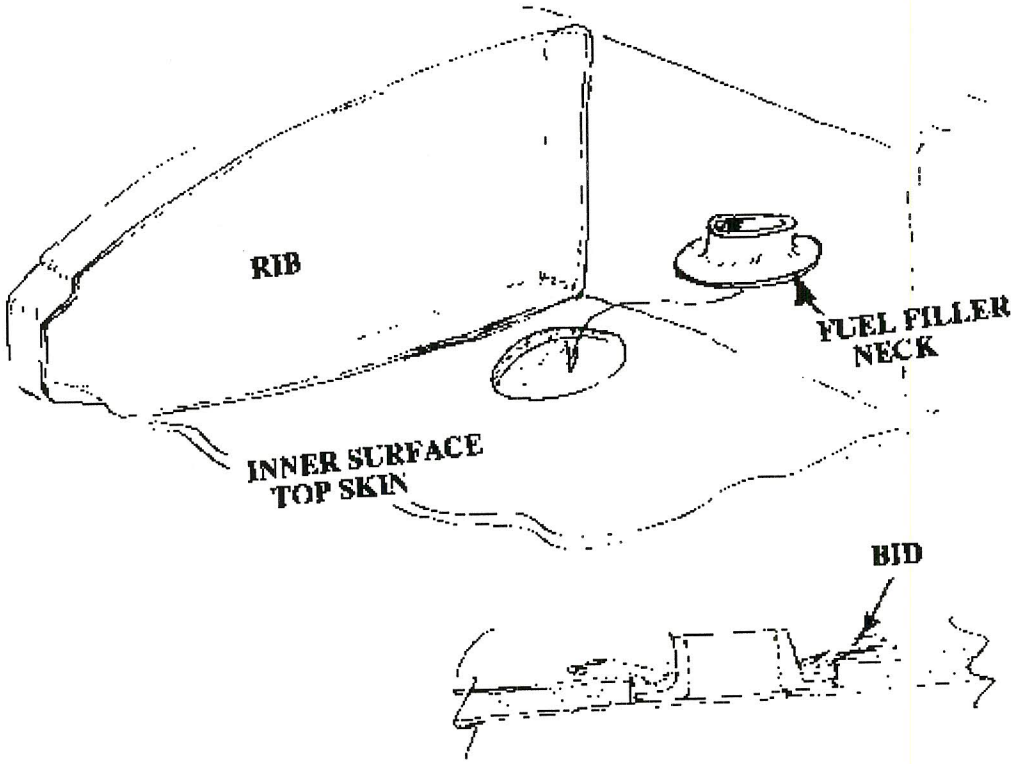
No photo

What About Access to outer Spar bolt.



GAS CAP - The gas cap neck will be installed in what will become the high corner of the wing tank area. Locate the desired position and hold the filler neck against the inner skin and draw around the perimeter. With a small electric grinder or similar tool, cut away this inner skin to the edge of the marking,, and clean away the core material without damaging any of the outer skin. Rough up the area of the skin around this cut out, and the metal surfaces of the fuel filler neck in the bonding areas, and clean any debris from the area. Smear the FLOX around in the cut out area, working it into the core material and seat the filler in place. Cut a three layer "washer" of wet BID and lay it around the filler neck. Work this BID down into all the joint areas and work all the bubbles out of the lay up.

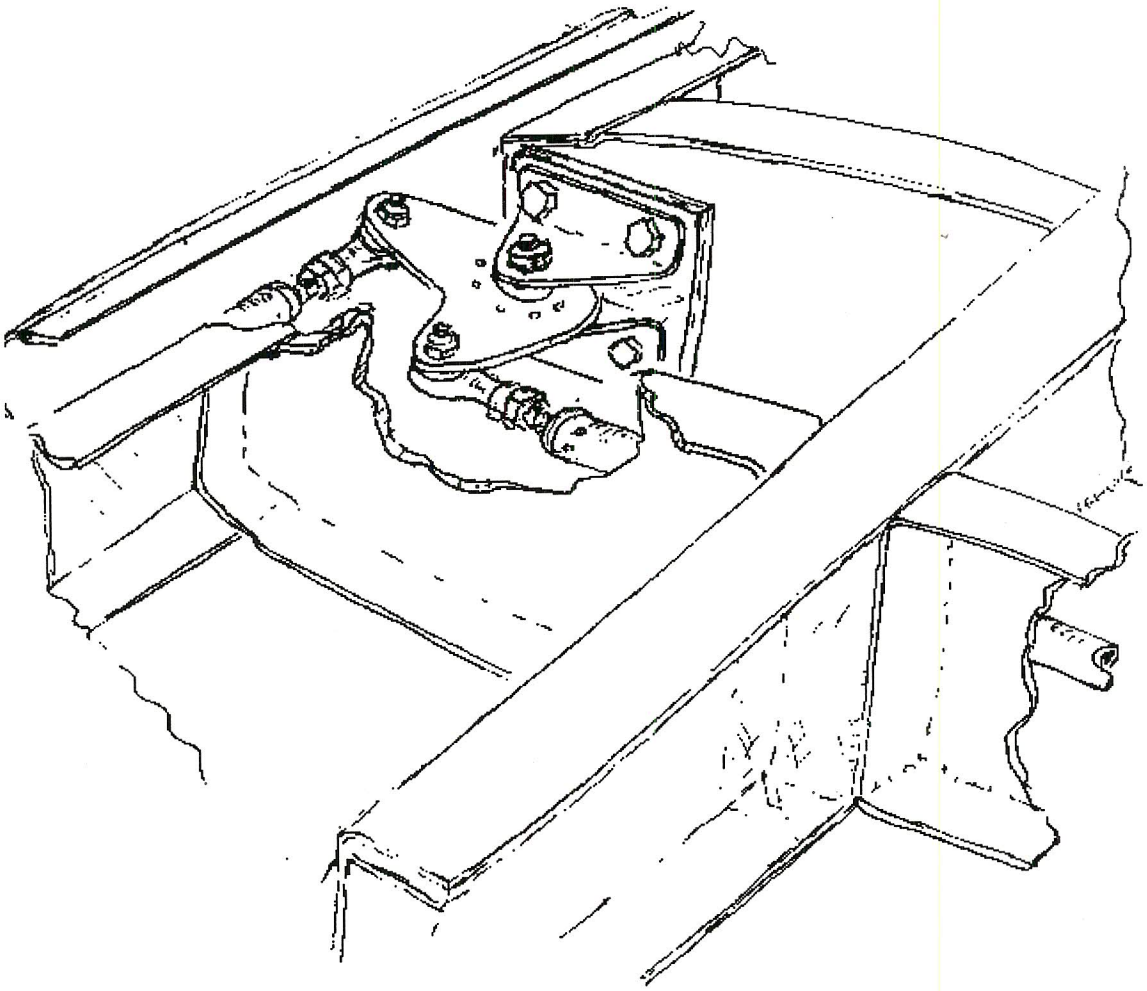





**FUEL FILLER CAP INSTALLATION**

FUEL PROOF - Now is a good time to seal all of the pin holes and any other defects in the surface and joints which will be exposed to fuel. Lightly sand all the areas which will be wetted with fuel and clean away any oils, grease, fingerprints, or loose debris. Resin the entire area using a squeegee. Press firmly, and leave an almost dry surface, paying particular attention to corners, and any areas where the cloth weave is evident. Also resin both sides of any ribs inside the tank area. In about four hours, when the surface has partially cured, repeat the operation, leaving the surface a bit wet this time. This same operation will have to be repeated on the wetted areas of the lower skin before it is assembled to the wing.

WIRING CONDUIT - Even if you are planning a "day VFR only" aircraft, it is a good idea to make provisions for wiring to go out to the wing tip. The easiest way to ensure protected access for later wiring is to purchase lengths of thin wall PVC pipe and install a conduit through the inner rib all the way out through the outer rib. Placement of this conduit is entirely optional, just assure that there is no interference with flight controls.. This might be a good time to verify that there are flow provisions to vent any of the wing compartmments in the unlikely event that they might be overpressured during altitiude changes.



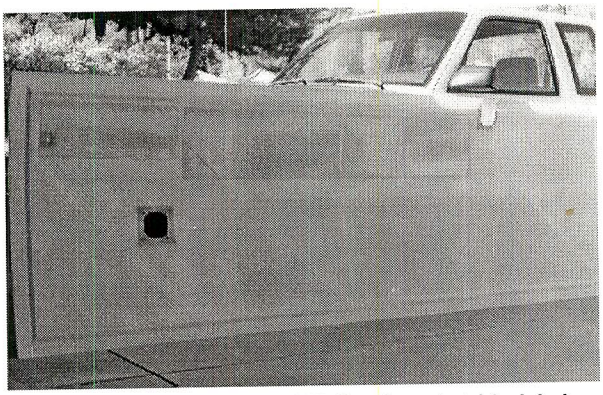
AILERON BELL CRANK - Install the aileron bell crank at the prepared location on top of the previously prepared platform using the supplied #10-32 bolts and the nut plates previously installed . .

CUT HOLE IN REAR SPAR - Note the location of the aileron bell crank, and resulting routing of the actuation rod. Cut a roughly circular hole (about 1.5 in. dia.) in the rear spar to allow passage of the actuation rod (also reference wing and aileron drawings and parts for assured location).

## PREPARATION OF LOWER WING SKIN

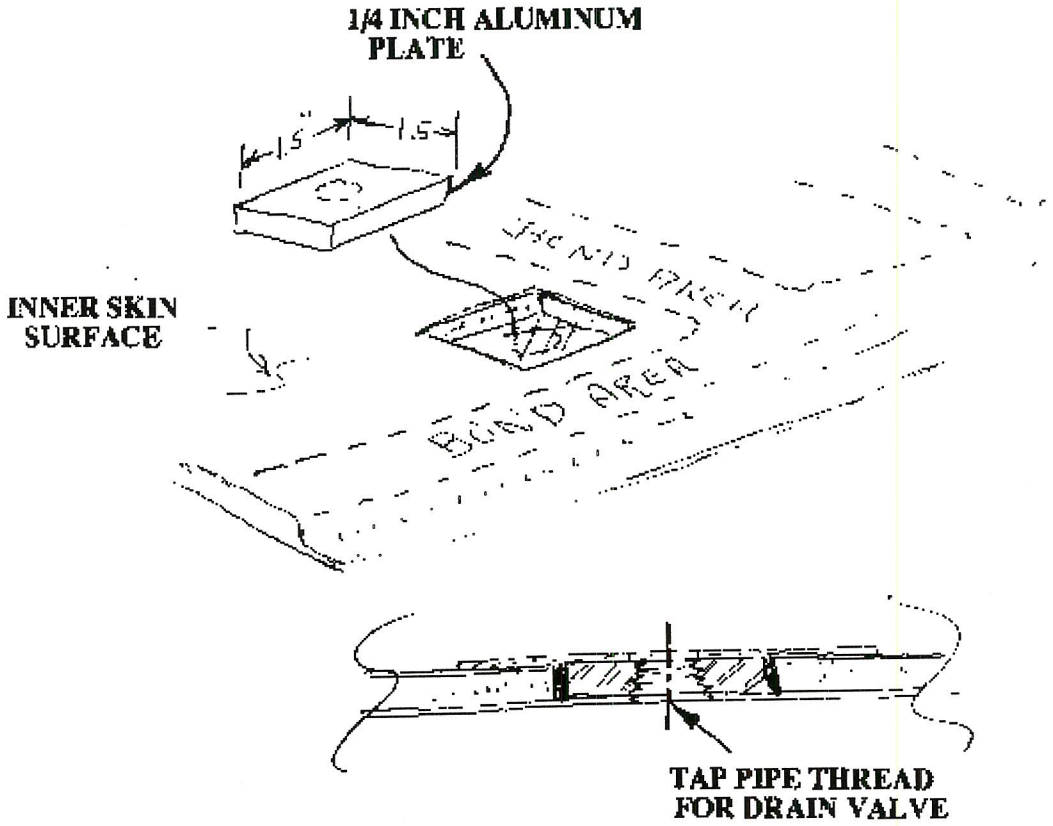
### LOWER SKIN TEST FITTING

A major portion of the bond line for the lower skin is the very critical fuel tank perimeter. A small leak due to not completely bonding all these lines can be a



major problem when the tank is filled. A test fit which transfers a surface impression is very good practice . Locate all the areas of the lower skin, which will be bonded in the assembly, and cover with wide clear tape as a parting surface (or cover the entire inner surface of the wing skin with a smoothed out and taped in place thin film pastic sheeting). Apply a bead of fairly thick FLOX/MICRO about 1/4 high on the surfaces which you wish to bond, and assemble the skin in place and weight it with the sand bags that will be used for the final joining. Allow the FLOX/MICRO to cure overnight, and separate the parts. If the fit up is proper, the FLOX/MICRO bead should be pushed down into a thin film in all the bond areas. If this is not the case, try to determine the cause of the poor fitup, and correct it, building up all low areas with FLOX/MICRO to establish a full flange width bond area. Remove the tape or plastic and all residue from the wing skin, and clean and roughen up all the areas to be bonded before the final assembly. Apply sufficient adhesive in the final bonding such that there should be visible squeeze out around the tank perimeter. The wing will be structurally sound with about 75 percent bonding with short skips of less than an inch, but such a gap would be totally unsatisfactory as a fuel leak. A "tap" test should give the builder a pretty good feel for how complete the bond is, and a low pressure or vacuum test should be used to verify fuel tank leak tight integrity (do not exceed 3 psi either direction).

FUEL DRAIN COCK - It will be required to install a fuel drain cock in the lowest section of the wing tank, to drain fuel and check for water accumulation. Locate the spot for mounting this drain as far inboard as practical, and as close to the and as far aft as the flange on the spar pocket close-out panel will allow. Stay well out of any of the bonding areas for the ribs, spars, and internal bulkheads. The overlapping tape from this insert could lead to a fuel leak if it intrudes into a flange bonding area.




## FUEL DRAIN PROVISION

Cut a 1.5 inch square from 1/4 inch thick aluminum, and lay on the inner panel skin in the selected position, and mark around it. Drill and Tap a hole centered in this pad - 21/64 through and 1/8 in pipe thread from the outside. Fill, or locally tape over this tapped hole to keep it from being filled with resin in fabrication.

Cut away the inner skin and clean away core to the inner surface of the outer skin. Bond the aluminum patch in this hole with thick MIOCRO/FLOX. cover with 2 ply BID patch at least a half inch larger on all sides for overlap with the skin. Make sure this patch is well wetted out with no pores or pin holes. When the resin is fully cured

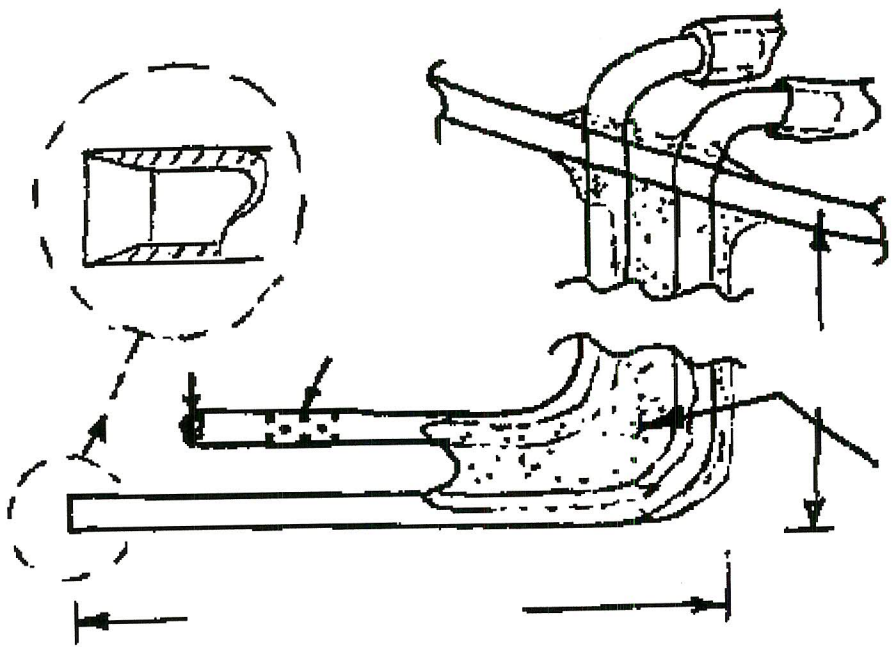
AILERON BELL CRANK INSPECTION PANEL - The aileron bell crank inspection panel is probably best installed at this point before bonding the wing skin in place. This will give you a bit more access to both sides of the skin as you work on the access panel, and will allow some added visibility inside the wing during the bonding process..

The door will be 6 inches square, and located under the aileron bell crank to provide access to both rod ends and the pivot bolts. Mark out the outline of the door and cut carefully with a fine tooth, thin kerf blade. The cut edges of both panel and hole can be "hardened" for greater durability, by cleaning back some of the core material at the edges, and filling with a thick FLOX paste. After removing and preparing the panel, coat the entire inner surface with clear plastic tape., and place it back in the hole. Tape the cover back in place on the outer surface, keeping the edges flush. Now build up a flange on the inner surface using 3 layers of wet BID. Provide extra surface under the corners of the panel, as this is where the anchor nuts will be located for securing the panel (see figure). Drill the holes through the cover and the newly made inner flanges, and prepare these locations for bolts. Cut out extra area around the holes in the cover, and fill these areas with MICRO/FLOX, and countersink for the bolts after curing. Install nut plates at the holes in the flanges for ready removal and replacement of the panel in service.

.SUGGESTED PITOT TUBE FABRICATION

The figure below shows a low cost effective way to construct your own pitot tube assembly. If you intend to set up your aircraft for full IFR we would suggest a commercial unit.

.



OTHER ACCESS COVERS

The basic wing plan form drawing enclose in this section shows where other access panels will be required. The wing assembly/disassembly procedure will require a panel to be located aft of the outer main spar bolt

## INSTALLATION OF LOWER SKIN

The lower skin must be carefully prepared for this final bonding operation, since many of these bond areas are potential fuel leaks. Rapid and complete assembly of this skin will be facilitated by having numerous tooling holes and Clecos or small screws placed along the leading edge joggle. This will assure rapid and actuate placement of the skin after placing the adhesives required for bonding.

Mark out the area of the fuel tank system, all the way to the extremities of all flanges. Wet these areas with epoxy as outlined for the upper skin to seal all pores and any small leaks in previously installed flanges. As before, squeegee out almost all of the resin for the first layer, follow this after partial curing of the first layer with a wet layer for final sealing.

Double check all flange surfaces especially in joint areas where the fit and resultant bonding may be discontinuous. Repair any suspect surfaces building them up with a dry MICRO/FLOX mix and "dressing" them for best fit after curing. Roughen all bond areas, and clean them. Have an assistant help and practice placing the skin without sliding off any bond material. Dry test the fit both by visual inspection, and by thumping along bond lined to assure contact.. Triply check all those surfaces with potential fuel leakage, and repairing all fit up problems noted.

Mix a thickened Hysol adhesive and lay a bead along all joining surfaces. Round up a good supply of sand bags or other suitable weights for clamping. Carefully lower the skin into place, avoiding any wiping motion which would smear adhesive . Place weights along all bond lines, and watch for any surplus adhesive which might plug fuel outlets or vents. Carefully observe the leading edge lap joint for gaps, and use screws or clecos to close up any gaps (it will be a lot easier filling a bunch of holes, than to correct any wavy joint after bonding is completed).

As you can see from the group above, a good crew is valuable, and dont spare the weights. The 3/8 sandwich skins on the four place are quite stiff and a significant force may be required for closure on all curved surfaces. We hope you made up the table and assembly jig with this sort of load in mind. Iin addition to the clecos you see in the view, a lot of small self tapping screws are valuable to keep a smooth leading edge (very important for good performance).

## STIFFEN TRAILING EDGE

The trailing edge of the wing skins should now be stiffened, and reinforced for flap and aileron mounting forces. Sight down the edges to see if any waviness can be seen. If any significant distortion is noted, clamp that edge to something straight and rigid. Do the upper and lower edges separately to facilitate this straightening. Apply 2 layer prewetted BID tape along the entire length of the edge, and 3 extra layers in the areas where hinges will be installed (3 places on the lower skin for flaps, 2 places on the upper skin for aileron hinges). Trim the trailing edges and cut back local areas for the hinges as noted on the figure.

## INSTALL HINGES

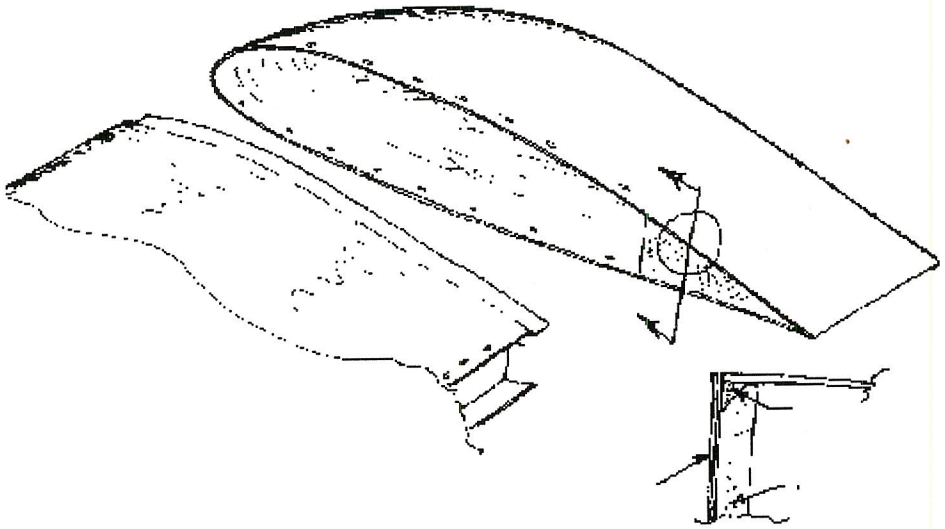
When the flap and ailerons have been completed, the hinges should be fitted and the nut plates are installed for installing and removing flaps and ailerons to their respective wing sections. Carefully fit and align the respective control surface, cleaning up the mounting surface for a secure flat mounting. Using pre drilled hinges (reference drill jig in elevator section) as guides, mark the holes in the wing trailing edge section, and carefully drill for the mounting bolts. These surfaces have sufficient access such that loose nuts can be used for this

installation. Nut plates may speed later maintenance operations, but are left to the discretion of the builder.

## INSTALLATION OF WING TIPS

The installation of the wing tips can be delayed until closer to the final assembly process, for storage and handling reasons, but this is the logical place to put it in the manual. The wing tips may be made removable by attaching them with roughly 16 8 - 32 countersunk screws and appropriate captive nuts and tinnerman washers, but this hardware is not included in the kit.

The recommended procedure is to fit up the tips, and close out the trailing edge opening, and bond them permanently in place. Fit up the tips by slipping them onto he recessed area at the outer edge of the wing skins. Some distortion or shrinkage may be present in the polyester glass tip moldings. First attempt to get out any of this by clamping them in place as best as possible and allowing the parts to set in this restrained condition for a day or two if possible. The parts may be temporarily joined and clamped using clecos or sheet metal screws - the holes can be easily filled in the finishing process. If this does not cure the problem a few judicious saw cuts can be used to flatten stubborn wrinkles, and a trailing edge cut can aid in stubborn twist cases.



With the wing tip in this temporary attachment position you will note that there is an opening into the tip interior outboard of the aileron. Make a trailing rib section to fill this opening from 1/4 inch foam. Tack this in place with temporary adhesive and chamfer back the edge of the foam through most of it's thickness. Fill this chamfer with dry FLOX and close out the surface with two ply wet BID. Knife trim to the tip molding edge and flush in the surface neatly. This will close out the opening and add significant stiffness to the tip (be sure you did your fit up first).

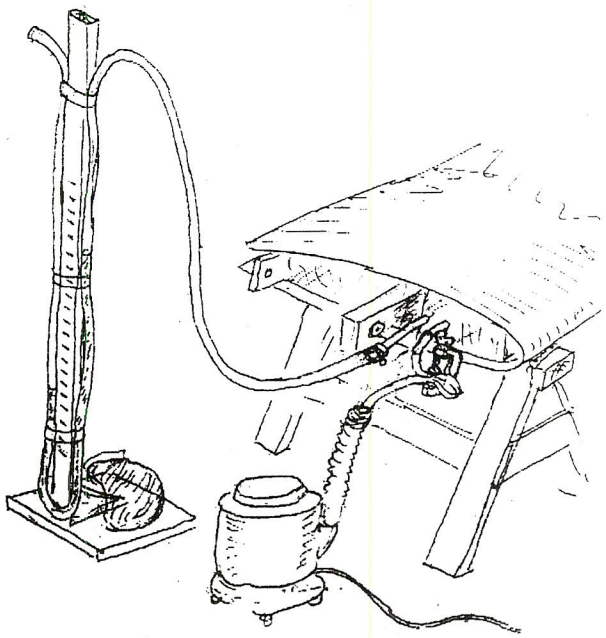
Remove the temporary fasteners, and roughen and clean the overlap bonding area. Mix some thick MICRO/FLOX, coat both surfaces and reinstall the wing tip. Again use the clecos or screws to hold position and clamp the joint, removing them as the bonding material becomes rubbery.

4PWINGLT

PART OF REVISION 1 - FEB 1998 WING ASSEMBLY SUPPLEMENT - FUEL TANK LEAK TESTS

INSERT AT END OF 4PWINGA MANUAL SECTION DATED JULY 1, 1997

It has been brought to my attention that we do not address the procedures for fuel tank leak tests in the assembly manual, and that this omission has led to some hazardous procedures being used. The maximum lifting force that can be imagined on the upper wing skin would be about 78 pounds per square foot at 4.4 G's and max gross weight. Dividing this by 144 gives us just a tad over ½ a pi. We have heard of leak tests at only ?? about 3 psi. Bad news guys, this is about 6 times worst design forces. Figuring the average tank bay on the four place as 3 foot by 1 ½ ft that is close to a ton of force trying to blow that panel off the tops of those ribs. We would like to suggest that you use a water tube manometer to measure the pressure, and monitor the leak down. A partial vacuum from a vacuum cleaner is suggested, limited to a couple of feet water column. If you use pressure, one foot (about ½ psi differential) is the suggested maximum using either a vacuum cleaner or lung power to set the pressure. If you lose control with your faithful Craftsman compressor, those wing skins may leave you on their way through the roof on their way back to Oxnard. Using vacuum with a water manometer, you should exercise a bit of care to avoid sucking the water into the tank, it can take a long time to dry out.



With all vents closed off, and the vacuum/pressure source sealed off, observe the water level for leakage rate. If you can see the column move you need to try resealing all vents and fittings and try again. Gasoline will wick through a very small leak path, so you should try to get below one inch drop per minute. Avoid using water or soap solution on the joint areas since you may have to apply epoxy for sealing. Visual or audio clues can often help you localize the source of a leak if it occurs. A partial vacuum can help draw epoxy from an external surface into the leak (remove the pressure during cure). A couple of 1 inch diameter round holes can be made through the center of the rear spar web for visual checking or adding sealing resin. Close the holes afterwards with a couple of BID plies to keep varmints out.