

AILERONS AND FLAPS

CONSTRUCTION OF THE AILERONS

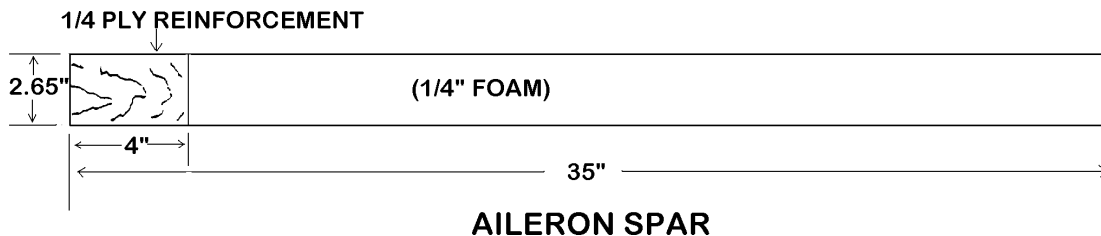
The ailerons are constructed much like the stabilizer. You will lay out the upper skin inverted on the bench and build upside down. If you have adequate bench space the two ailerons may be built at the same time. **DO NOT TRIM PARTS UNTIL INSTRUCTED.**

The aileron skins are as follows:

K19TR aileron top skin - right
K19TL aileron top skin - left
K 19BR aileron bottom skin - right
K19BL aileron bottom skin - left

CAUTION: Don't forget to remove peel ply from all factory pre-molded composite parts.

Cut out the ¼ foam and ¼ plywood pieces for the spar. Use the dimensions shown. Butt glue the pieces together with 5-minute epoxy.

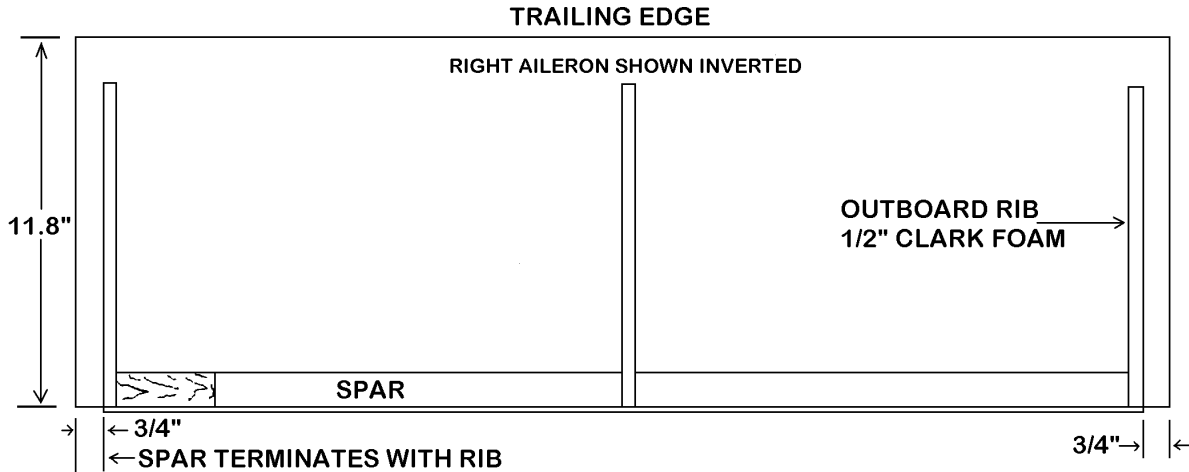


Using the aileron rib templates cut the ribs for both ailerons. Make 2 inboard and 2 center ribs from the ¼ inch foam board using the templates provided. In a similar manner make 2 outboard ribs of ½ inch high density Clark foam. Use magic marker to assign the ribs to locations.

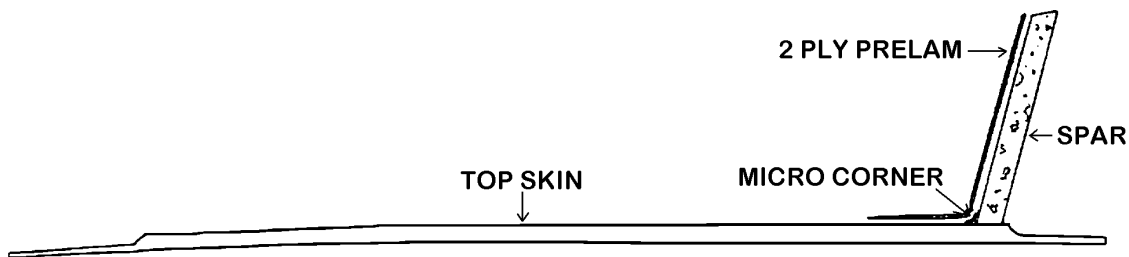
Remove the peel ply from the top skin. Examine it to determine which edge will go forward on the aircraft. On kits SN112 and subsequent a "V" or arrow may be seen scribed at one end of the center mold line on the outer surface; this indicates forward on the aileron. On pre SN112 kits the forward edge must be defined by determining which edge has the least glass-to-glass between the untrimmed edge and the foam core. Use a felt tip marker and clearly identify this edge as forward. It is now time to trim the leading edge (but not the trailing edge) to the mold scribe line on the outer surface.

Be sure that your workbench or building board surface is straight and not twisted. Lay the upper skin inverted on the bench with the aft edge towards you. Tack it in place with a little bondo or a hot glue gun. Measure 11.8 inches forward (i.e. towards you) from the untrimmed trailing edge and draw a spanwise line for the aft face of the aileron spar web.

Place the spar and ribs temporarily in place and mark the skin. Bevel the edges of the spar so that it will sit in place at the angle shown on the cross-section drawing; note the position of the spar relative to the foam core of the skin. Use the ribs to check the angle of the bevel. Sand the areas two inches each side of the spar and sand the ribs for surface adhesion. Also make sure that the skin is well sanded where it will contact the other skin along the trailing edge.



Using 5-minute epoxy, bond the spar into position. Temporarily put the ribs in place to help hold the spar at the correct angle while the epoxy cures. Micro slurry the aft face of the spar web to fill the pores. Run a micro/flox fillet along the bottom corner. Bias cut some BID and make up a 2 ply PreLam about 4½ inches wide and 40 inches long. Lay this full span along the aft face of the spar. It should cover the entire spar face, go around the corner and out onto the upper skin about 2 inches. Trim it after cure so that it neatly terminates at the spar edges.



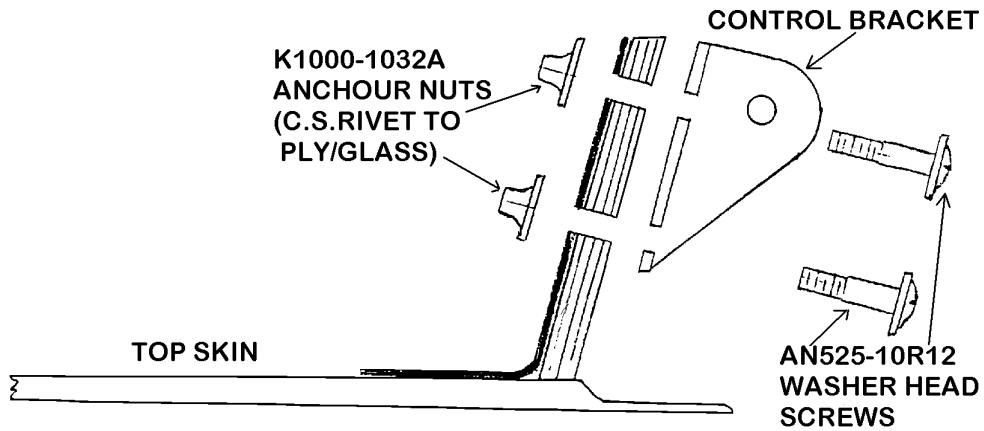
Now place the foam ribs in position. The outboard and inboard ribs are located ¾ inch in from the skin ends; the center rib is located half way between the outboard and inboard ribs. Trim all the ribs to fit properly before bonding in place with some 5-minute epoxy. Micro slurry and cover both sides of the center rib with one layer of BID. Have the BID cover the rib and extend an inch or so onto the skin. In a similar fashion micro slurry and apply 2 ply BID to the inside of both the inboard and outboard ribs (i.e. apply the glass to the outboard side of the inboard rib and to the inboard side of the outboard rib.) When the epoxy has cured the glass can be trimmed.

It is now time to make a fit check of the aileron to the wing. This is necessitated by the fact that our building method causes slight variations in structural dimensions. Remove the aileron structure from the building board and place the bottom skin temporarily in place. While holding the parts together place the aileron into position in the wing trailing edge channel where it will be hinged. The thickness of the aileron must be such that it will have clearance to move without interfering with the wing structure. If it is too tight remove some height from the ribs and spar and try again until the thickness is correct.

Now hold the aileron exactly where it will be spanwise. (The outboard aileron end will be 1¼ inches in from the end of the wing skin.) Mark where the aileron control bracket must be placed spanwise to align with the push rod coming from the bellcrank. It should theoretically be located 2½ inches from the inboard end of the aileron skin.

Again place the upper skin/spar/rib assembly inverted on the bench and tack it down with bondo. The aileron control bracket (KS-4) can be temporarily attached to the spar about 1/8 inch down from the edge as shown

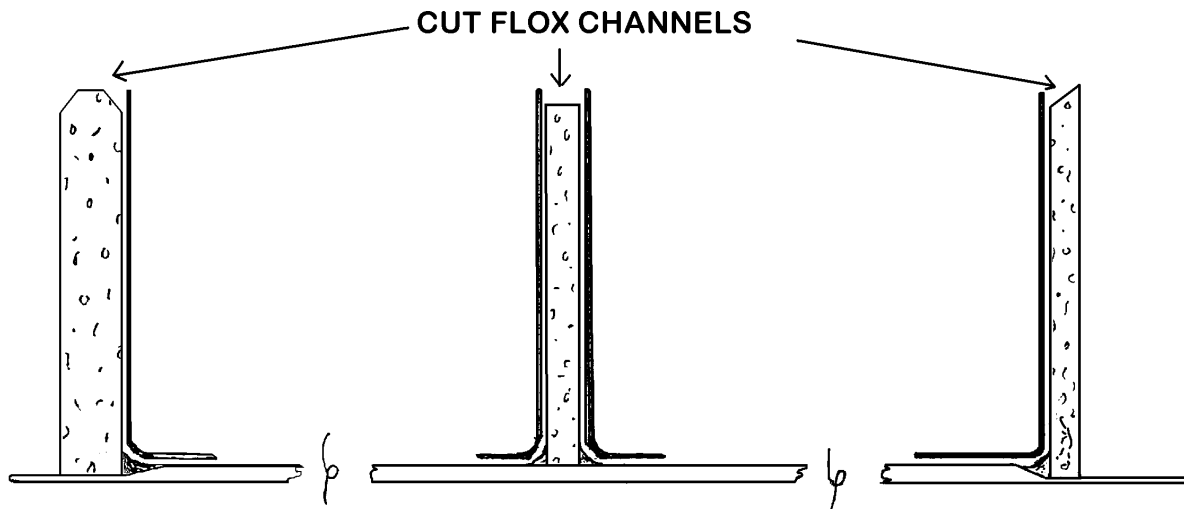
in the drawing. This allows for glassing radius and bottom skin clearance. Place the bottom skin in place and double check. During installation the bracket will sit directly on the plywood; the K1000 anchor nuts are installed on the back face of the spar. The bracket will subsequently be removed until the aileron is closed and the spar face is glassed.



Before drilling any holes through the plywood and inner BID layers look things over and recheck bracket location. Jig drill two 3/16 holes and temporarily attach the bracket with AN525-10R12 Washer Head Screws and K1000-3 anchor nuts. Rivet the K1000s to the spar with countersunk rivets. Remove the bolts and bracket. Plug the holes and the threads of the K1000 with modeling clay.

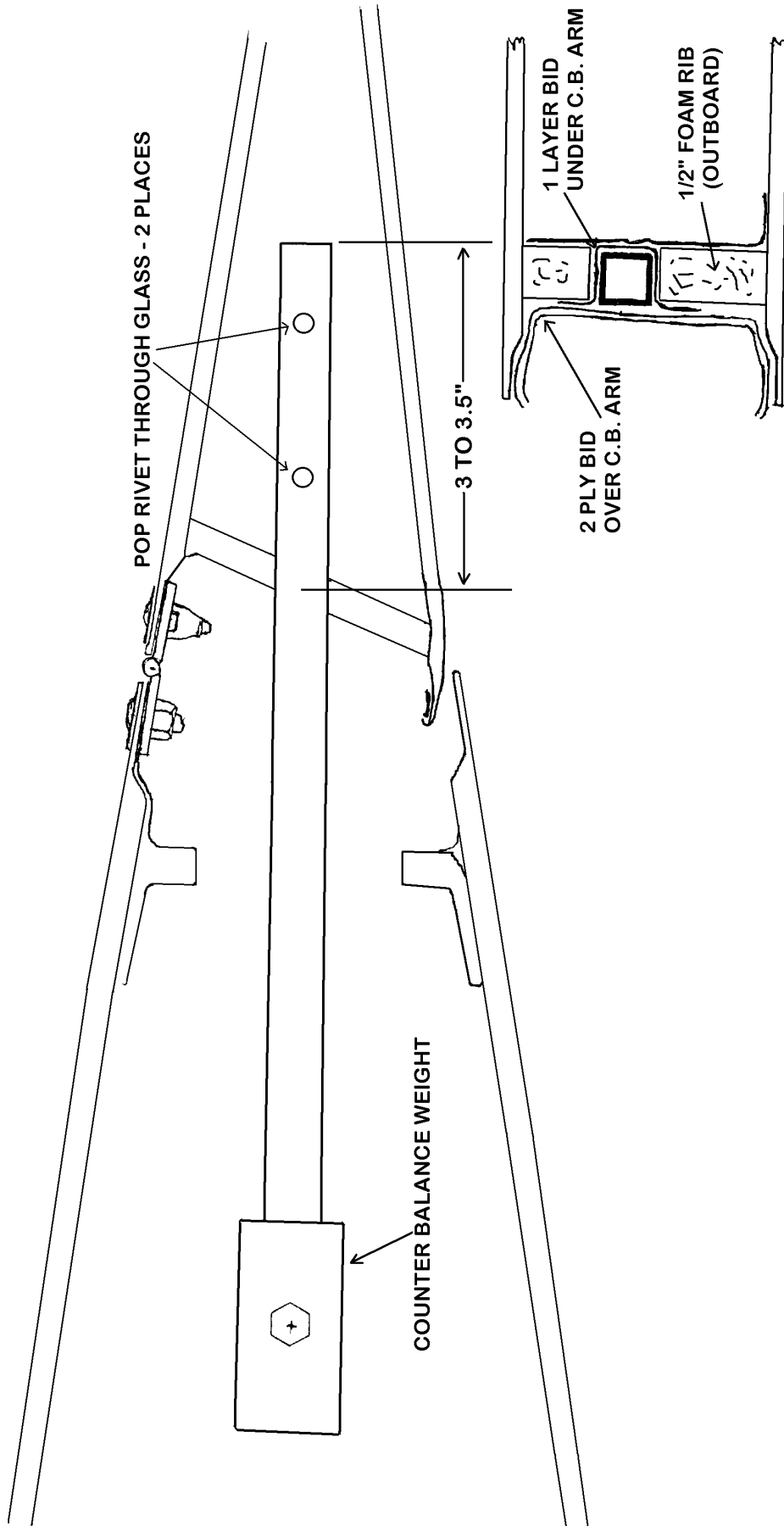
You are now ready to close the aileron. Prepare the lower skin by removing the peel ply and sanding the areas where the spars and ribs will be bonded. Fit check the skin and assure that good contact will be had between the mating surfaces. Relieve any interfering surfaces.

Remove about 1/8-inch foam to form a channel for floc in the edge of the middle rib. Bevel the end ribs as shown in preparation for floc. Also put a bevel on the spar. Remember that the object is to tie the internal glass to the skin. Later a micro/floc fillet will help tie the external glass to the skin.



Fill the channel in the center rib with excess micro/floc (pile it about 1/4 inch above the rib). Put plenty along the bevels of the two end ribs to tie the inside rib glass to the skin. Put resin with just a little floc in it on the trailing edge mating surfaces. Carefully lower the bottom aileron skin into position and add some weights until cure is complete.

Assemble the aileron counterbalance and arm. Cut a $\frac{1}{2}$ x $\frac{1}{2}$ steel tube 11 inches long and slide the lead counterbalance KS-5 over one end so that it is flush with the end. Drill $\frac{3}{16}$ and attach it permanently with a $\frac{3}{16}$ bolt and elastic stop nut.



You must make two of these.

The structure may now be removed from the bench for easy working. Cut a ½ inch slot out of the outboard rib to accept the counter balance arm. (Be sure that the centerline of the arm is centered on the center line of the rib for proper alignment. Radius the corners of the slot slightly. Add micro/flox fillets at the corners of this rib. Micro slurry the rib surface to fill the pores. Put some flox in the slot. Place a piece of BID about 4 inches square centered over the slot. Roughen the balance arm with sand paper and press it into the ½ inch slot so that it pushes the glass to the bottom of the slot. Approximately 3 to 3½ inches of the arm should be in the rib as shown in the drawing. Turn the protruding glass onto the rib surface and trim to size. Now resin two more layers of glass onto the rib. Make the glass large enough that it can go around all the corners and onto the skins and spar. This forms a strong contoured glass end rib that is well tied into the rest of the structure.

After cure drill 1/8 through the outer rib glass and into one side of the steel tube and pop rivet through one side of the tube and glass just to insure that the tube cannot slide in event that should ever become loose in the glass.

Micro slurry the exposed face of the inboard rib. Build micro/flox fillets in the top and bottom corners. Lay two layers of BID onto the rib with the edges wrapped onto the skins and spar. Micro slurry the spar. Put some dry micro fillets in the corners of the skin/spar intersection. Make up a 2 layer 45 degree PreLam 6 x 37 and lay it into the “C” channel thereby covering the spar, both top and bottom skin, and strengthening the section.

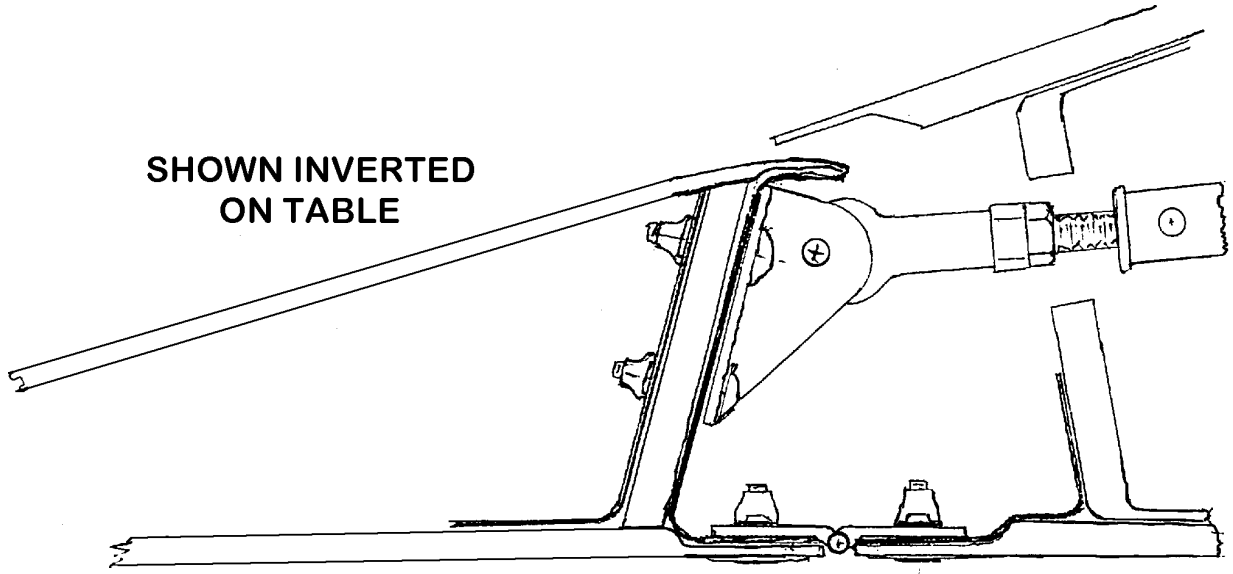
Hinge attach reinforce pad are now prepared and put in place. Prepare four five-layer BID PreLams 3 inches in width and 10 inches in length. These pads should be located at the outboard and inboard ends of the ailerons corresponding to the wing reinforce positions. Position them such that they wrap up onto the spar about 1 inch to help carry the bending load to the spar.

Take a sharp pointed knife or 3/16 drill and clear the glass from the aileron bracket holes in the plywood. Install the aileron control bracket permanently.

The aileron may now be mounted on the wing. Place it so that its end is at BL126.875 (i.e. 1.125 from the end of the wing skin). Mark where the hinges fall spanwise. Relieve the trailing edge by 3/32 inch in these areas. Mark where the hinge holes go on the aileron. Drill and install with AN507- 832R8 c.s. machine screws, A3135-017-24A Tinnermans, and K1000-8 anchor nuts. Rivet the anchor nuts to the aileron hinge to capture them.

The trailing edges of the ailerons will be trimmed after the flaps are installed.

SHOWN INVERTED
ON TABLE



CONSTRUCTION OF THE FLAPS

The flaps are constructed slightly differently from the elevators. They will be built right side up. Also more custom fitting will be required with the partially built flap installed on the wing. This is primarily to fit the inboard hinge which is different from the piano-type hinges used everywhere else on the aircraft. As with the ailerons if you have adequate bench space the two flaps may again be built at the same time.

The flap skins are as follows:

K2OTR flap top skin - right.

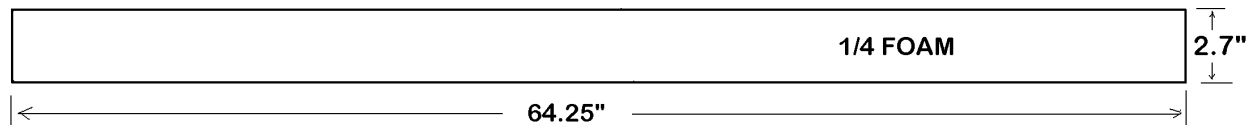
K2OTL flap top skin - left.

K2OBR flap bottom skin - right.

K2OBL flap bottom skin - left.

CAUTION: Don't forget to remove peel ply from all factory pre-molded parts!

Cut out the ¼ foam for the spar core. Use the dimensions shown.



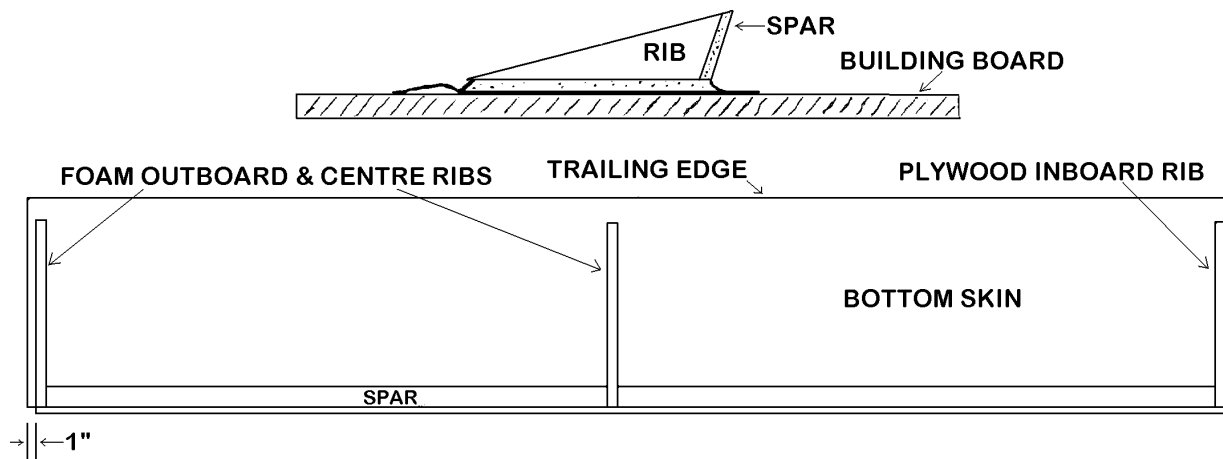
FLAP SPAR

Using the flap rib templates cut the ribs for both flaps. Cut 2 outboard and 2 center ribs from ¼ inch foam board. Cut 2 inboard ribs from ¼ plywood. Note that the plywood inboard ribs and foam outboard ribs are slightly different from the center rib. Drill the two 3/16 and one 3/32 holes shown in the plywood ribs only.

Be sure that your workbench or building board surface is straight and not twisted. Remove the peel ply from the top skin and lay it inverted on the bench. The leading edge should be facing you at the edge of the bench. Lightly tack it in place with a little bondo or a hot glue gun.

Measure 1¼ and 1½ inches aft from the leading edge and draw spanwise lines for the spar. Position the ribs. The outboard rib will be ¾ inch in from the skin end. The inboard plywood rib will be located flush with the inboard edge of the skin. The center rib will be located half way between the outboard and inboard ribs. Mark their locations.

Place the spar and ribs temporarily in place and pencil mark the skin. Use the ribs to check the angle of the spar and bevel the upper and lower spar edges accordingly.



RIGHT FLAP SHOWN UPRIGHT ON BENCH

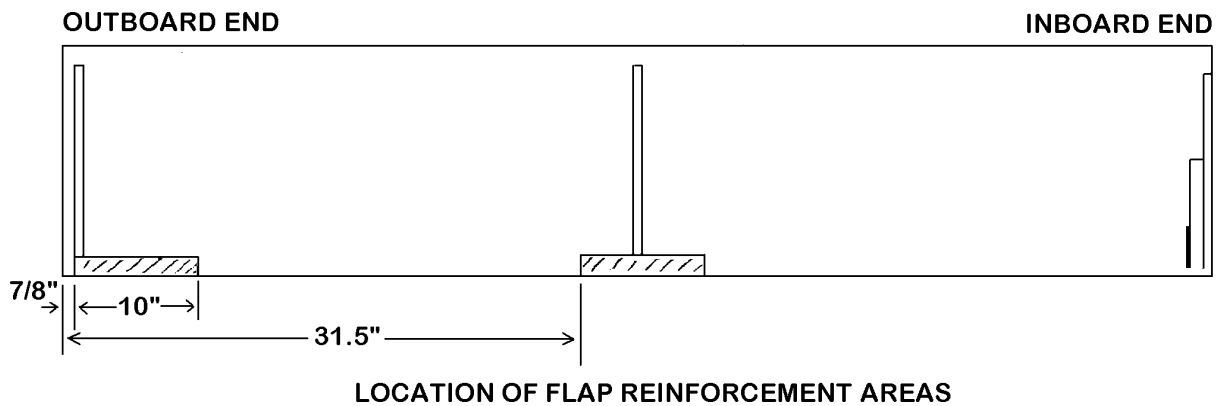
Sand the skin areas 2 inches each side of the spar and each side of the ribs for surface adhesion. Also make sure that each skin is well sanded where it will contact the other skin along the trailing edge.

Using 5-minute epoxy, bond the spar into position. Temporarily put the ribs in place to help hold the spar at the correct angle while the epoxy cures.

Remove the ribs and micro slurry the aft (inside) face of the spar web to fill the pores. Run a micro/flox fillet along the bottom corner. Bias cut (45 degree) some BID and make up a 2ply PreLam about 4½ inches wide and 70 inches long. Lay 60 inches of this full span along the aft face of the spar. It should cover the entire spar face, go around the corner and then about 2 inches onto the lower skin. Use the excess prelam to double the inboard 4 inches of spar. This makes the inboard 4 inches 4 ply thick for extra strength where the spar will be cut for the inboard hinge.

While the glass is wet place the ribs permanently into position anchoring them on the dry surfaces with 5 minute epoxy. Continue by adding micro slurry and 2 ply of BID to both sides of the center rib. Have the BID cover the rib and extend an inch or so onto the skin. In a similar fashion micro slurry and apply 2 ply BID to the inside of both the inboard and outboard ribs (i.e. apply the glass to the outboard side of the inboard rib and to the inboard side of the outboard rib.) When the epoxy is “green” trim the overhang from the ribs and redrill the 3/16 and 3/32 holes in the plywood rib.

Reinforce the outboard and midspan hinge areas. Make two 5ply prelams approximately 2½ inches wide and 10 inches long. Apply these to the areas shown on the drawing. Trim the glass flush after cure. Remove the flap(s) from the bench.

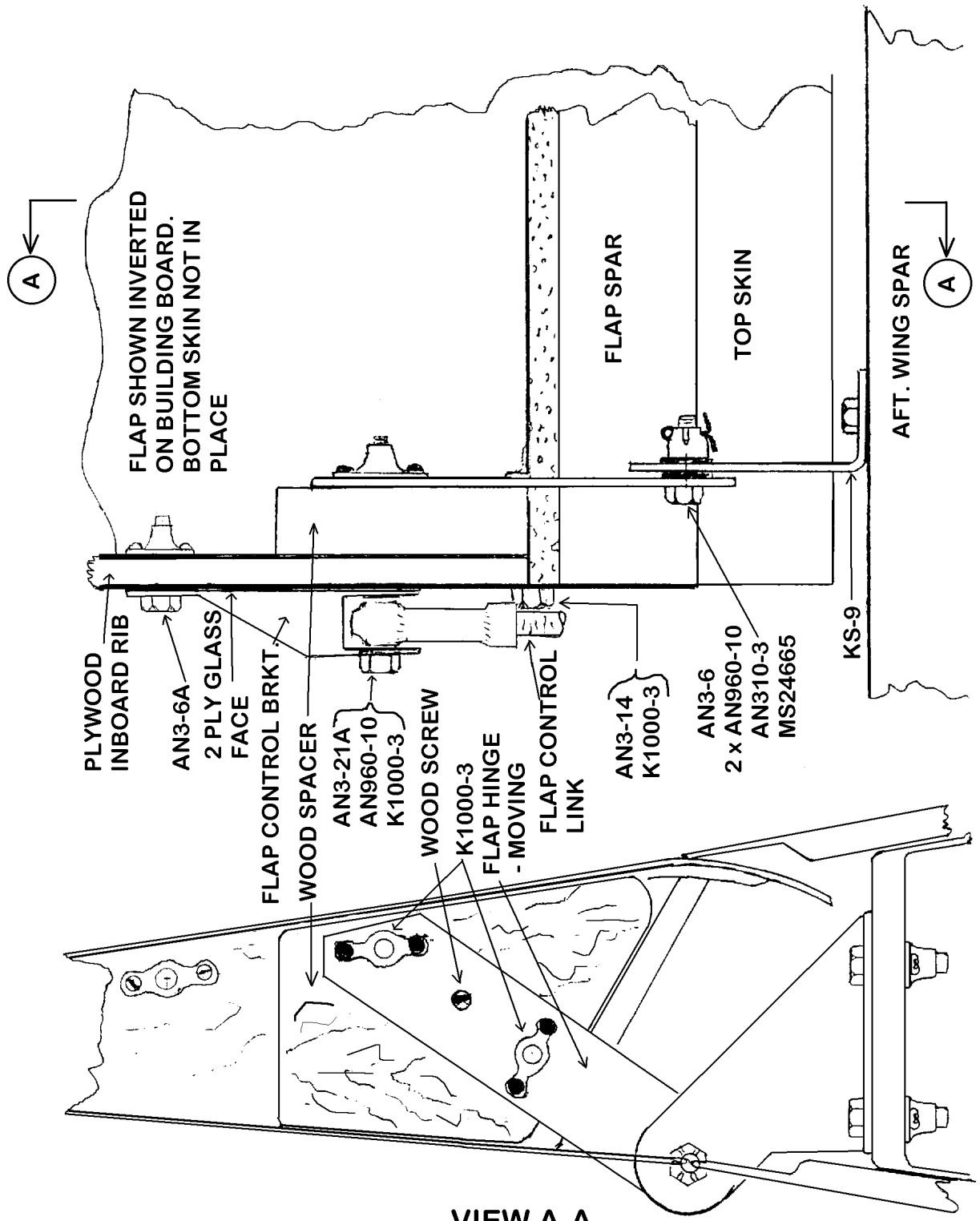


The next step involves fitting the flap to the wing. The ailerons must be in place on the wing while fitting the flaps. Position the flaps such that they have about a 1/8-inch gap between them and the ailerons. During this fit-up installation the lower flap skin will have to be slotted where the stationary inboard hinge KS-9 interferes.

Mark the exact location of the two piano hinges. Relieve the trailing edge by 3/32 for these hinges just as you did on the other surfaces. Drill the flap lower skin reinforced area for the outboard and center (piano type) hinge bolts. Hang the flap. Two or 4 bolts per hinge should be enough for the fit-up process.

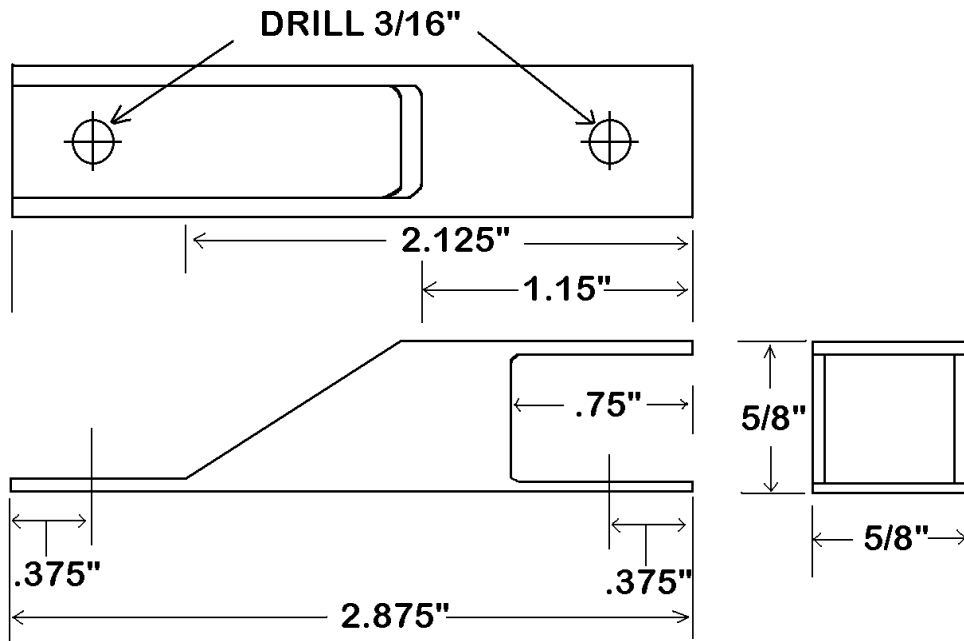
With the flap then hinged in place on the wing you can mark the exact spanwise location for the moving hinge. It will be installed in the flap just inboard from the fixed hinge. Allow space for one washer. The whole objective is to be sure that the spanwise location for the moving hinge is accurately marked on the flap spar.

Study the flap inboard rib assembly drawing to understand how that hinge is assembled and operates. Note that the moving hinge is spaced with a hardwood block against the plywood inboard rib and bolted to that rib. This block must be custom made to just the correct thickness to place the moving hinge piece at the correct BL based on your marks on the spar.



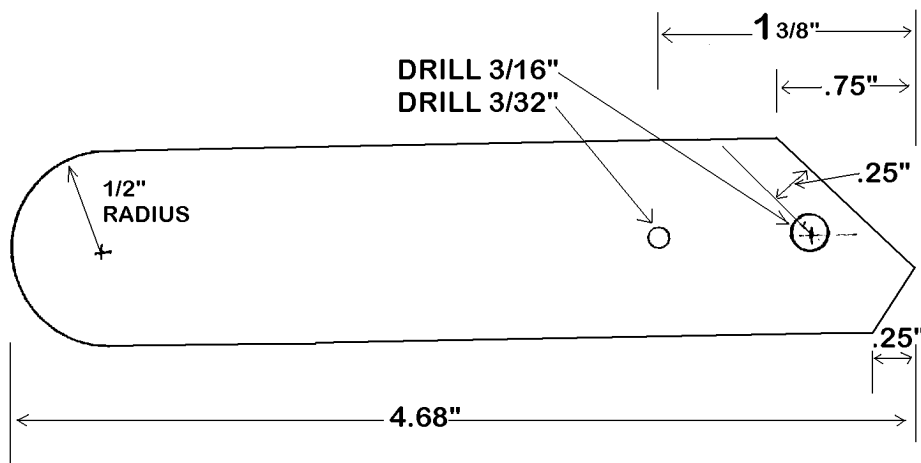
**VIEW A-A
(LOOKING INBOARD)**

FLAP CONTROL BRACKET (MAKE 2)

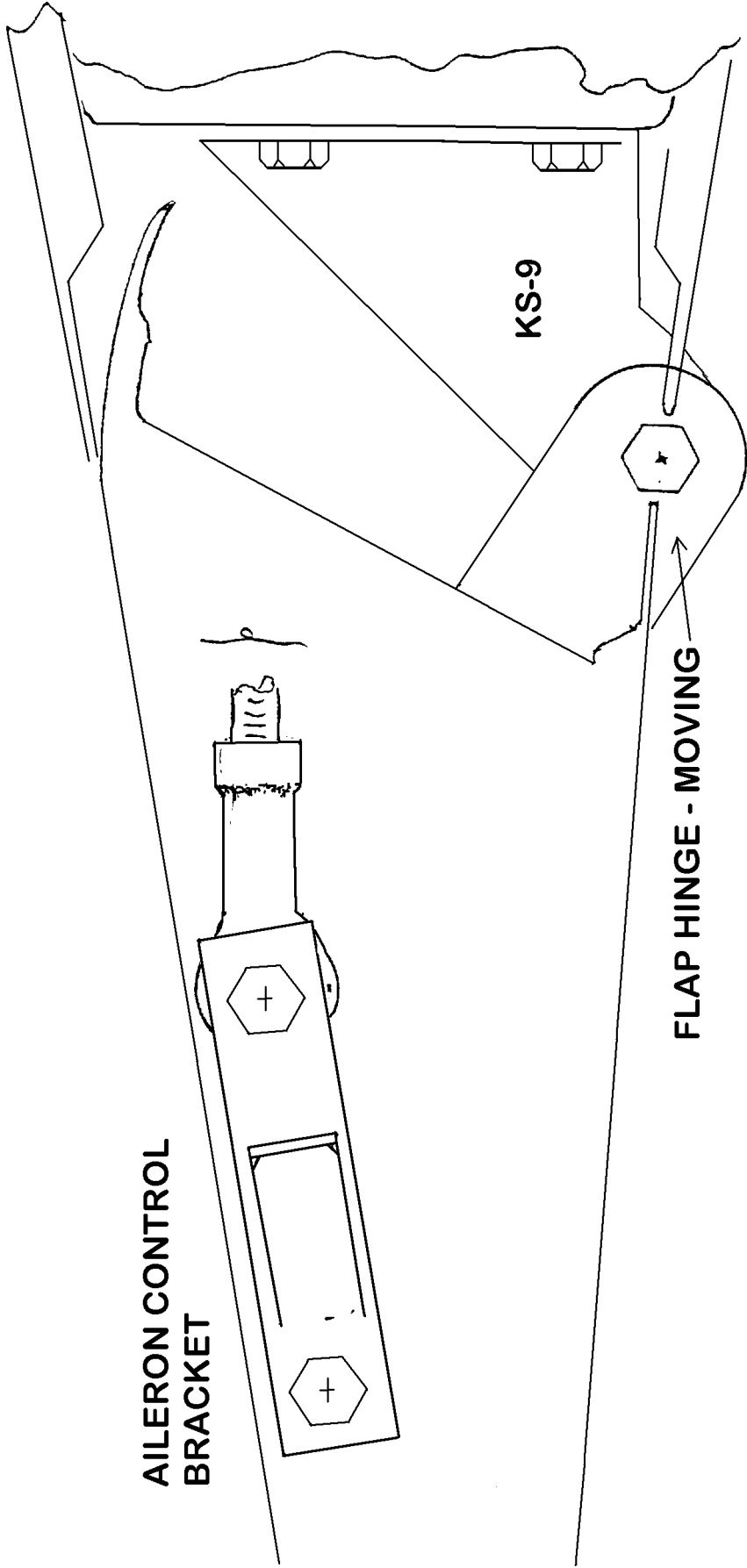


**MATERIAL: .049 x 5/8" x 5/8"
SQ. STEEL TUBE (4130)**

FLAP HINGE - MOVING



MATERIAL: 4130 STEEL .050 THICK



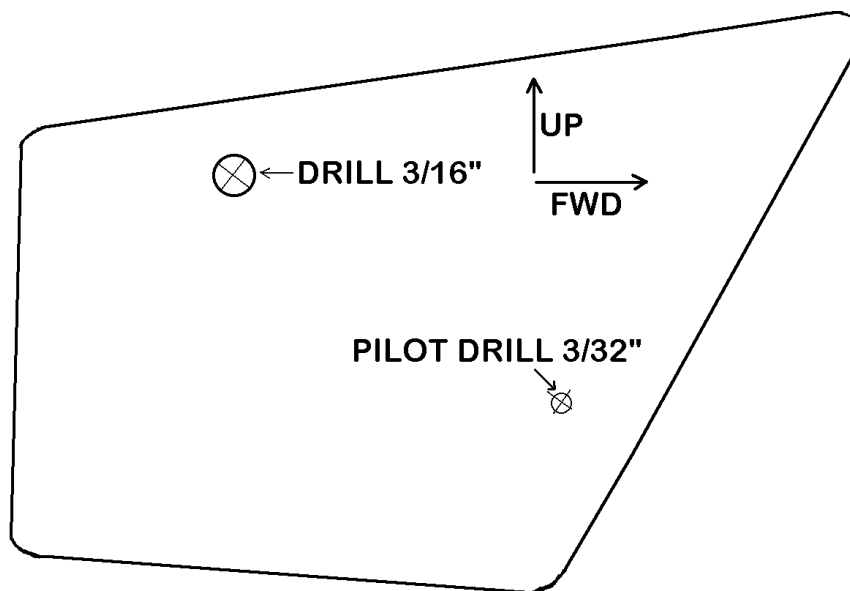
AILERON CONTROL
BRACKET

KS-9

FLAP HINGE - MOVING

FLAP
VIEW LOOKING OUTBOARD

Remove the flap from the wing. Cut a slot in the spar where the moving hinge piece will go through. This can be done by making numerous 3/32 drill holes through the spar and then cleaning the cut up with a small knife or saw blade. Sand the inside of the inboard rib. Cut a hardwood block the correct thickness and install it with flox. (Actually two or more laminates of 1/4 ply may work fine instead of a one-piece block; sand to the exact required thickness.) Drill the 2 x 3/16 holes through the rib and block.



FILLER BLOCK TEMPLATE (FULL SIZE)

Make two flap inboard moving hinge pieces from .050 steel strap as detailed in the drawing. Also make two flap control brackets from .049 x 5/8 x 5/8 square tubing as detailed in the drawing.

The flap moving hinge and the flap control bracket can now be temporarily attached to the inboard rib and spacer block. Use two bolts and K1000 anchor nuts as shown. This leaves the moving hinge piece slightly loose at the bottom for alignment.

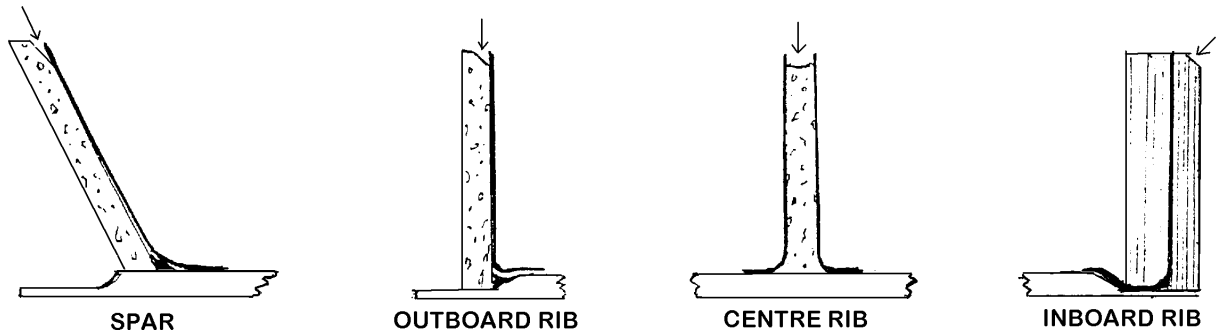
Mount the flap back on the wing for another fit check. The fixed and moving hinge pieces should now be side-by-side. Make sure there are no alignment problems. Locate and drill the remaining hinge attach bolt-hole through the 3/32 hole in the rib and through the moving hinge. Open it to 3/16 and add the lower bolt. The pivot bolt-hole can now be precisely scribed on the moving hinge. If the fixed hinge was located properly this hinge bolt will be centered on the part and exactly on the flap line of rotation. Remove the hinge piece from the flap for this drilling. While it is off rivet the K1000 nuts so they cannot fall off when removed. Also secure the K1000 at the rear of the control bracket. It can be attached to the rib with very small wood screws and/or some small pieces of BID, resin, and flox. It is important that these K1000s be well secured and it is also wise to grease the bolt threads. They will be removed and replaced after flap closure.

Screw a short #6 wood screw through the small hole in the center of the flap moving hinge and into the wood spacer block. This will capture the hinge piece later when it is necessary to temporarily remove the AN3 bolts for facing the rib with glass.

With all the parts assembled swing the flap through its 28 degrees of rotation. As part of this check the upper flap skin should be held in place to assure that there is sufficient clearance with the wing skin. If additional clearance is required take a little material off the ribs and spar and recheck.

The flap may now be removed from the wing for final closure. Place it on the bench and make a last minute check of fits between the mating surfaces. Prepare the ribs and spar for floc joints.

Remove about ¼ inch of foam to form a channel for floc in the top of the middle rib. A small “V” groove against the glass in the outboard rib is also good. Also put a bevel on the spar. Remember that the object is to tie the internal glass to the skin.



Put some thin floc/resin mixture along the trailing edge. (Make sure it is sanded first.) Pile thick floc on the ribs and spar. Place the upper skin in place and apply weights all over until cured.

Micro-slurry the spar. Put dry micro fillets in the corners of the spar and upper skin and spar and lower skin. Make a PreLam of 2 layers 45 degree cloth 6 inches wide and 70 inches long. Lay it into the “C” channel thereby covering the spar and wrapping onto the skins.

The outboard rib and the two skins form a three-sided channel. Run a micro/floc fillet around the corners and lay two layers of BID in place to reinforce the rib. After cure clean out the hinge bolt holes.

Next is the inboard end of the flap. Temporarily remove the three bolts and control bracket. Make a ¼ inch floc channel all the way around the rib by carefully removing sandwich core from the ends of the skins and spar. Put plenty of floc in the channel formed and lay 2 layers of BID over the entire end of the flap forming a face. When cured and trimmed, take a sharp pointed knife or 3/16 drill and clear the glass from the control bracket and hinge bracket holes in the spar and rib plywood. Bolt these brackets on permanently.

The flaps are complete.