

CHAPTER 7

REVISION LIST

The following list of revisions will allow you to update the Lancair ES construction manual chapter listed above.

Under the "Action" column, "R&R" directs you to remove and replace the pages affect by the revision. "Add" directs you to insert the pages shown and "R" to remove the pages.

Page(s) affected	Current Rev.#	Action	Description
7-1 thru 7-12	None		
7-13	A2	R&R	Moved figure to 7-22, removed step B2.
7-14	A2	R&R	Moved B2 & B3 to previous page.
7-15 thru 7-17	None		
7-18	A2	R&R	Re-labeled elevator ribs.
7-19	None		
7-20	A2	R&R	Edited step C2 (#4).
7-21	None		
7-22	A2	R&R	Moved figure from page 7-13.
7-23 thru 7-32	None		
7-33	A2	R&R	Relabeled elevator ribs, changed dia. vents
7-34	A2	R&R	Relabeled elevator ribs.
7-35 & 7-36	None		
7-37	A2	R&R	Edited text in paragraph below figure
7-38 thru 7-44	None		
7-45	A2	R&R	Added text to figure.
7-46 & 7-47	None		
7-48	A2	R&R	Flipped hinge.
7-49 thru 7-58	None		
7-59	A2	R&R	Added text to step J4.
7-38 thru end	0	None	

CHAPTER 7

HORIZ. STAB AND ELEVATOR

(SECTION A - HORIZ STAB)

REVISIONS

From time to time, revisions to this assembly manual may be deemed necessary. When such revisions are made, you should immediately replace all outdated pages with the revised pages. Discard the outdated pages. Note that on the lower right corner of each page is a "revision date". Initial printings will have the number "0" printed and the printing date. All subsequent revisions will have the revision number followed by the date of that revision. When such revisions are made, a "table of revisions" page will also be issued. This page (or pages) should be inserted in front of the opening page (this page) of each affected chapter. A new "table of revisions" page will accompany any revision made to a chapter.

Arrows

Most drawings will have arrows to show which direction the parts are facing, unless the drawing itself makes that very obvious. "A/C UP" refers to the direction that would be up if the part were installed in a plane sitting in the upright position. In most cases the part shown will be oriented in the same position as the part itself will be placed during that particular assembly step. However, time goes on and changes are made, so careful attention should be paid to the orientation arrows. That old cartoon of the guy agonizing over the plans for his canoe, built one end up, one end down, should not happen in real life. Especially to you.

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Chapter 7 REV. 0705-10-98
Horizontal Stab and Elevator



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Horizontal Stab and Elevator

1. INTRODUCTION

The horizontal stabilizer (H. Stab.) is comprised of two structural skins (top and bottom), and an internal structure consisting of spars and ribs. This is a symmetrical airfoil so top and bottom are the same. You'll notice that there is a 1" L.E. joggle that does make the two halves look different. The half that has the wrap around L.E. with joggle is the half that must be first laid into the assembly cradle that you'll be making and for the sake of discussion, we will call this half the bottom skin.

The H. Stab. is also tapered, which means that the thickness will vary. The thickest part is at the center line and the thinnest is at the tip. A straight line will exist from any relative % of chord at the root to the same % of chord at the tip. For example, the points along the 25% chord will form a straight line along the entire airfoil. With this fully symmetrical stabilizer, either the upper or the lower skin will be flat (spanwise) from tip to tip.

The elevator consists of a left and right half. The internal structure is completed except for the installation of the trim tab and the counterweights.



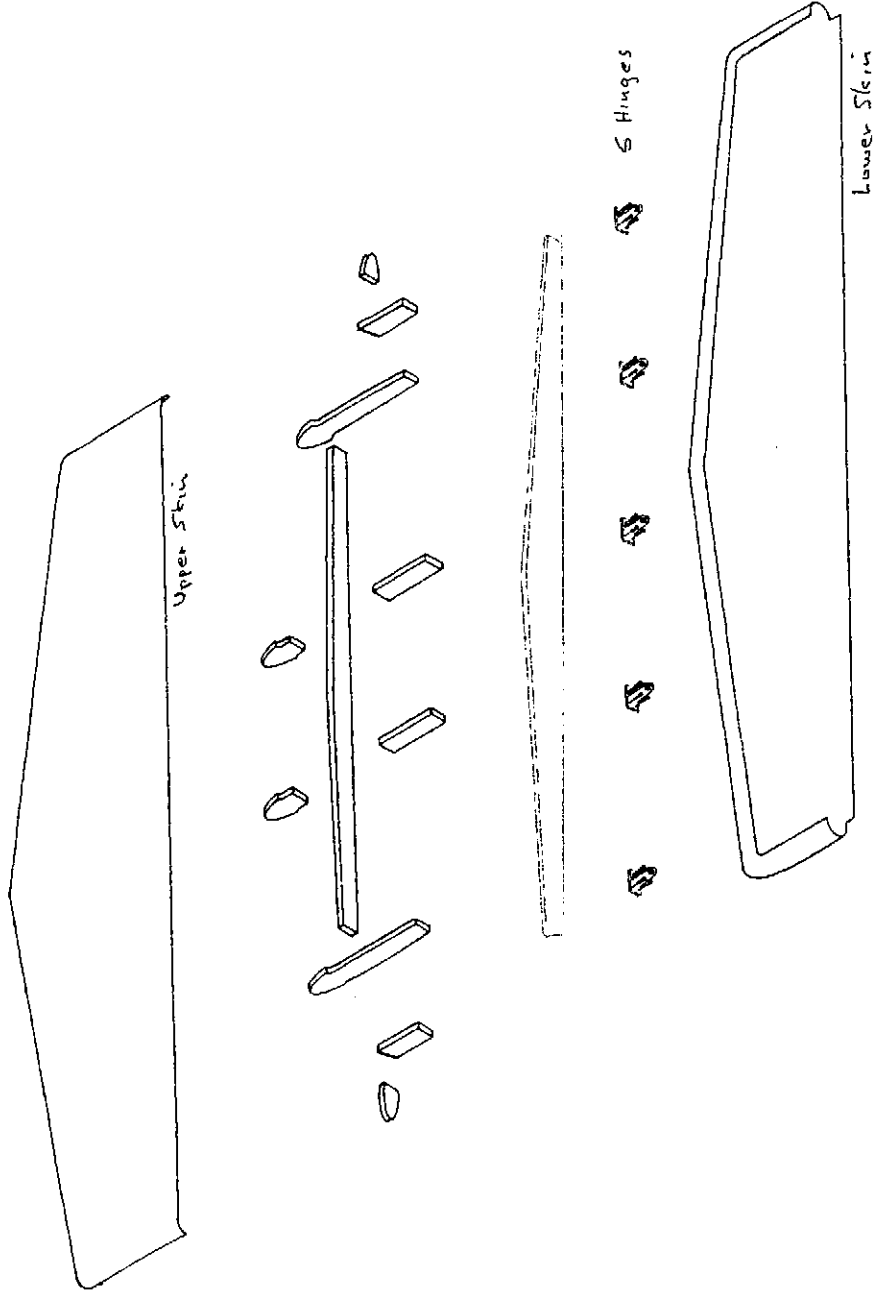
2. SPECIAL PARTS, TOOLS, AND SUPPLIES LISTS

A. PARTS

#	P/N	QTY	DESCRIPTION
1)	5-010025	1	Upper H. Stab. Skin
2)	5-010010	1	Lower H. Stab. Skin with Premolded Structure
3)	EL053-T	5	H. Stab. Hinges
(Not shown: (20) K1000-3 nutplates and (40) AN426A3-4, (20) AN3-6A bolts, and (20) AN960-10 washers used to secure the hinges to the H. Stab.)			
4)	5-020075	1	Upper Left Elevator Skin
5)	5-020085	1	Upper Right Elevator Skin
6)	5-020050	1	Lower Left Elevator Skin with Premolded Structure
7)	5-020060	1	Lower Right Elevator Structure with Premolded Structure
8)	EL-055-02	1	Elevator Weldment
Note: refer to the following figure for mounting hardware			
9)	EL-053-U	4	Elevator Hinges (Elevator)
(Not shown: (8) K1000-3 nutplates and (40) AN426A3-4 rivets, (8) AN3-5A bolts, and (20) AN960-10 washers used to secure hinges to elevator.			
10)	5-020096	2	Premolded Counterweights
11)	S4A	1	Trim Tab Servo
(Not shown: (5) MS24693-S28 screws, (5) K2000-06 nutplates, and (10) AN426A3-4 rivets to secure it)			
12)	5-020016	1	Trim Tab Cover
13)	5-002045	1	Upper Trim Tab Skin
14)	5-020035	1	Lower Trim Tab Skin
15)	MS20001	2	Trim Tab Hinge
(Not shown: Trim tab activator arm, (4) hard rivets to secure it.)			

Horizontal Stabilizer Breakdown

Fig. S 2-1.



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B. TOOLS

- 1 Rivet squeezer or bucking bar
- a/r Shot bags (10 lbs. - 25 lbs. assorted weights are great)
- 1 Sabre or band saw
- 1 Level, flat table top, approximately 11' long and 30-36" wide
- a/r nails or wood screws
- 1 hammer or screwdriver
- 1 6' level
- 1 Drill motor
- 1 Drill bit, 1/8"
- 1 Drill bit, #12
- 1 Drill bit, #40
- 1 100° countersink
- 1 Cleco tool and about a dozen Clecoes (a real handy tool for this project, but not mandatory).
- 1 Dremel tool with a ball grinder bit
- 1 Heat gun
- 1 Roller blade cutter (Looks like a Pizza cutter, but a pizza cutter WILL NOT WORK), available through Lancair.
- 1 set Bondo™ Plastic spreader set- available from auto parts stores, contains 3 spreaders of varying sizes.
- 1 3" wide roller for wetting out BID tapes. Metal ones are easiest to clean.

C. SUPPLIES

- 130 #6 x 3/8" pan head sheet metal screws
- 10 1" x 2" x 6' wood strips (straight) for cradle
- a/r Instant glue
- 5 pcs. of wood (about 3" x 3" x 1/2") to brace aft spar during bonding
- a/r Release tape (clear, thin packaging tape, 2" or 3" wide is good)
- a/r Artist's spray adhesive or similar
- a/r Wood glue
- a/r Bondo™
- 1 Plastic spreader (for the Bondo™)
- a/r Nails or wood screws for fabrication of cradles
- a/r Sandpaper, #40 grit
- 1 Red felt tip marking pen
- a/r MC (Methylene Chloride) cleaner
- a/r Hysol structural adhesive
- a/r Tongue depressors/ mixing sticks
- a/r Acetone (a one pint can from the hardware store should see you through the whole aircraft construction, if used sparingly)
- a/r Microballoons
- a/r Flox
- a/r Epoxy
- a/r Plastic sheet for preparing BID tapes (2 or 3 mil thick (maximum 3 mil)) painter's drop cloths work great.
- 1 Tape measure
- 1 pcs. 10-1/2" x 34" for BL0 cradle
- 2 pcs. 10-1/2" x 29-1/2" for BL 21 cradle
- 2 pcs. 10-1/2" x 24-1/2" for BL 46.75 cradle
- 6 pcs. 50" 1-1/2" x 2" x 1/8" (thick) 90° angle iron
- 2 pcs. 21" 1-1/2" x 2" x 1/8" (thick) 90° angle iron

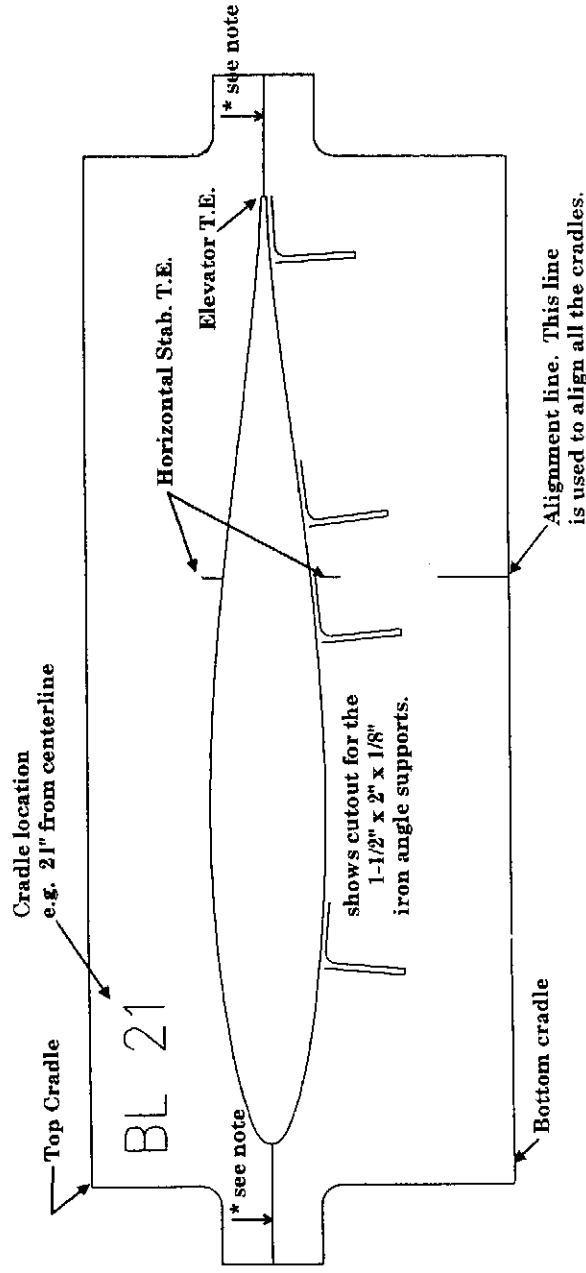
3. CONSTRUCTION PROCEDURE

A. BUILDING THE H. STAB ASSEMBLY CRADLE

The assembly cradle is needed to insure that a "true" H. Stab. with no twists or warps is the result of your work. You'll make the simple airfoil section cradles that must be aligned with each other. Using a level, flat table top is ideal, but not essential. What is essential is that the chord line references on the airfoil cradles be properly aligned with each other and that good straight lines be established between these three airfoil section cradles.

H. Stab. Cradle Patterns

Fig. 7:A:1.



* Note: This tab should be in the same level (horizontal) plane for all cradles.

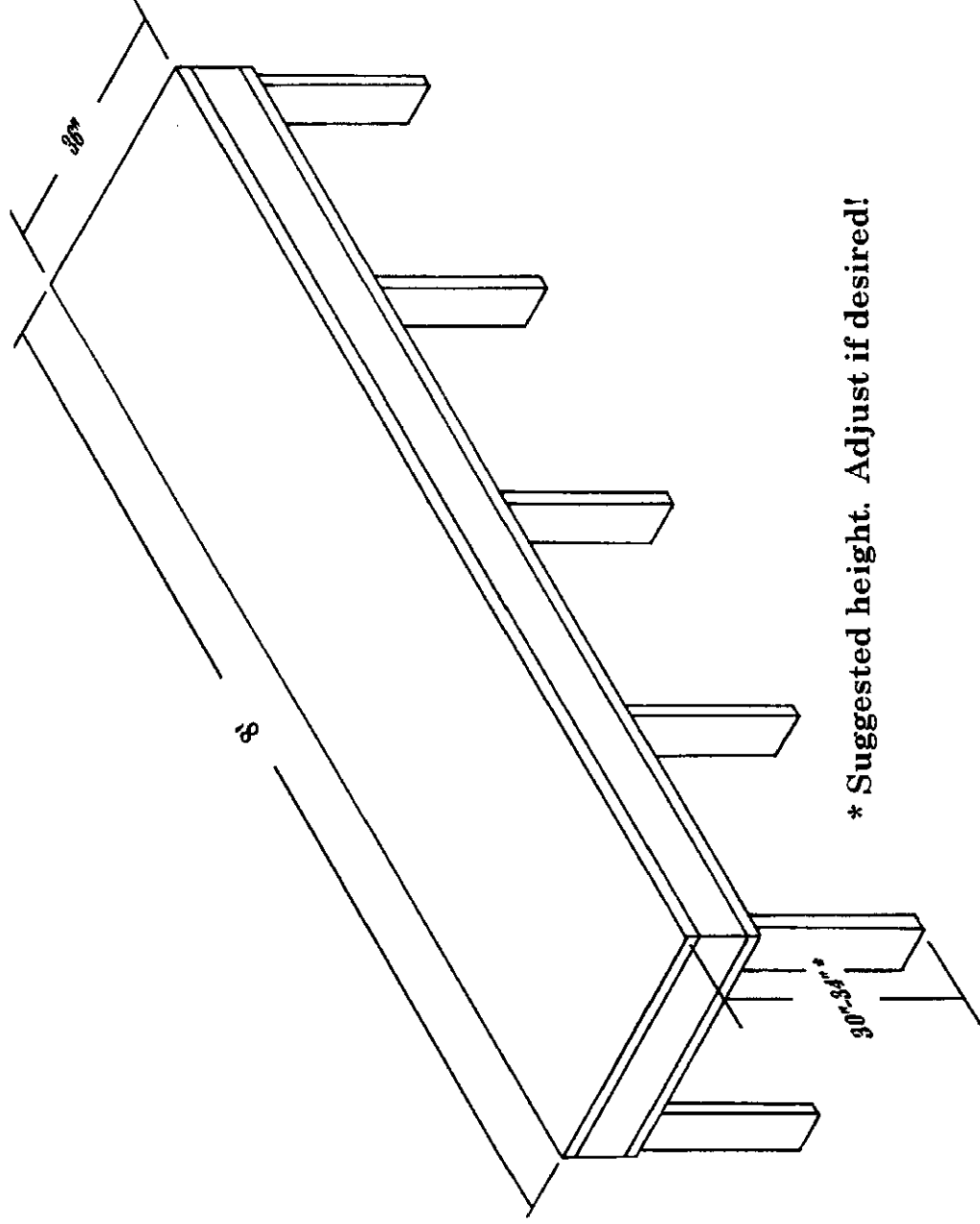
- A1. Locate the three patterns for the H. Stab airfoil sections- blueprint numbers 5-020101, 5-020111, and 5-020121. You'll be making two of the BL 21 and BL 46.75 cradles and one from the root pattern. Using spray adhesive or similar, glue them to the 1/2" thick particle board. You've been supplied with two copies of this blueprint so that one copy can always remain intact as a reference. At this time check the blueprints for scale:

Chord lengths			
Station	Chord length	Tolerance	t
BL0	28.00	$\pm 1/8"$	$\frac{1}{2}$
BL21	23.55	$\pm 1/8"$.1205
BL 46.75	18.00	$\pm 1/8"$.1244
			.122

- A2. Cut the patterns out using a sabre or band saw. Cut just along the inside of the line and then sand up to it.

MK-II H. Stab. Table

Fig. 7:A:2.

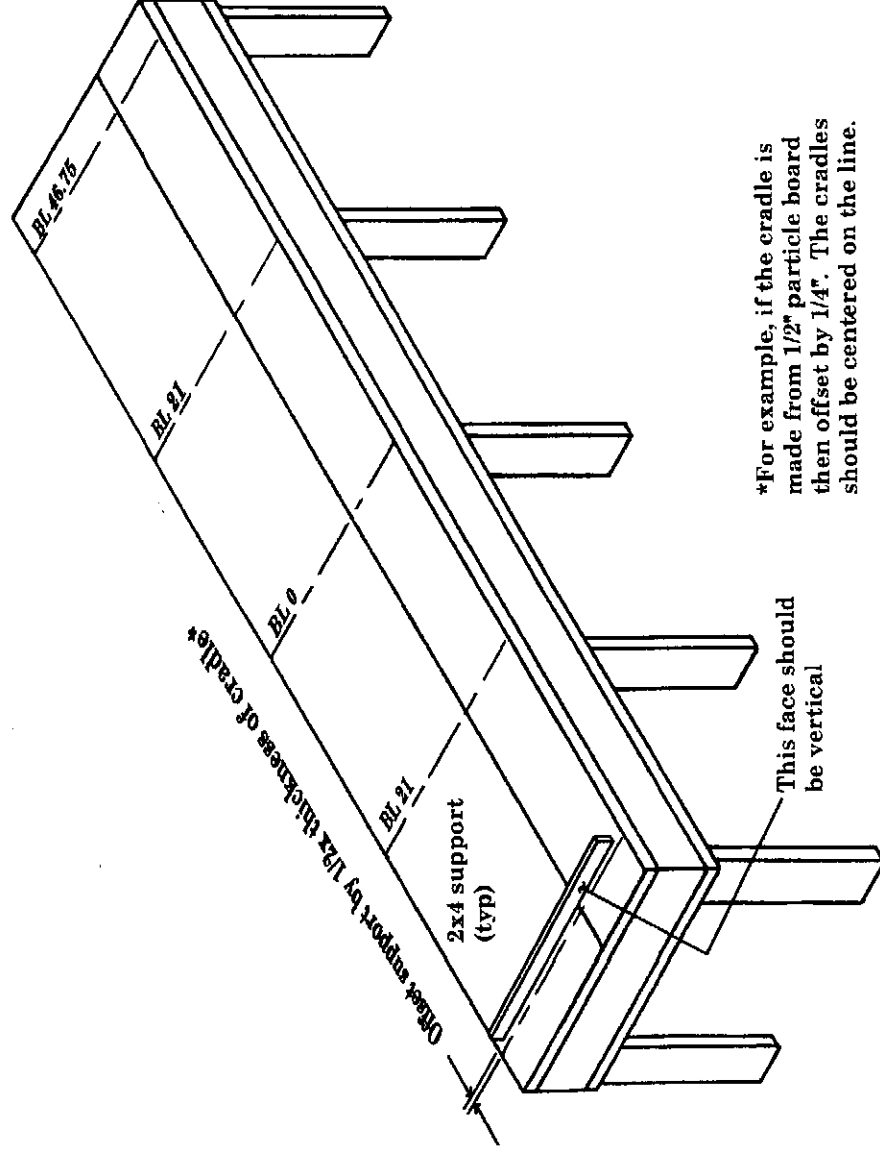


* Suggested height. Adjust if desired!

- A3. Construct a table for your jig. We suggest a box-frame structure as shown in the above figure.
- A4. Draw a straight line 14" from the aft end of the table. Draw perpendicular lines to this at BL 0, BL 21, and BL 46.75 (the cradles will be centered on these lines).

Installing the Support Braces

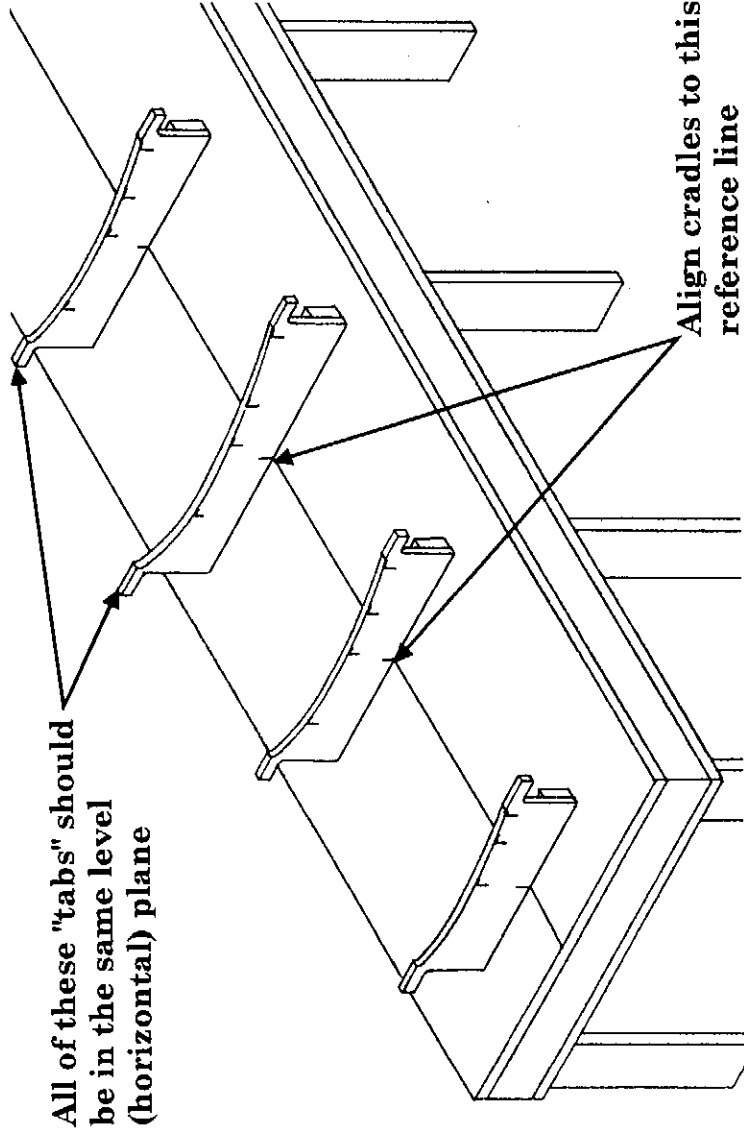
Fig. 7:A:3



- A5. Install the cradle supports. Use 2 x 4's or equivalent. Screw to table.

Leveling the Cradles

Fig. 7.A:4.



A6. Install and align cradles. Following is the criteria for aligning cradles:

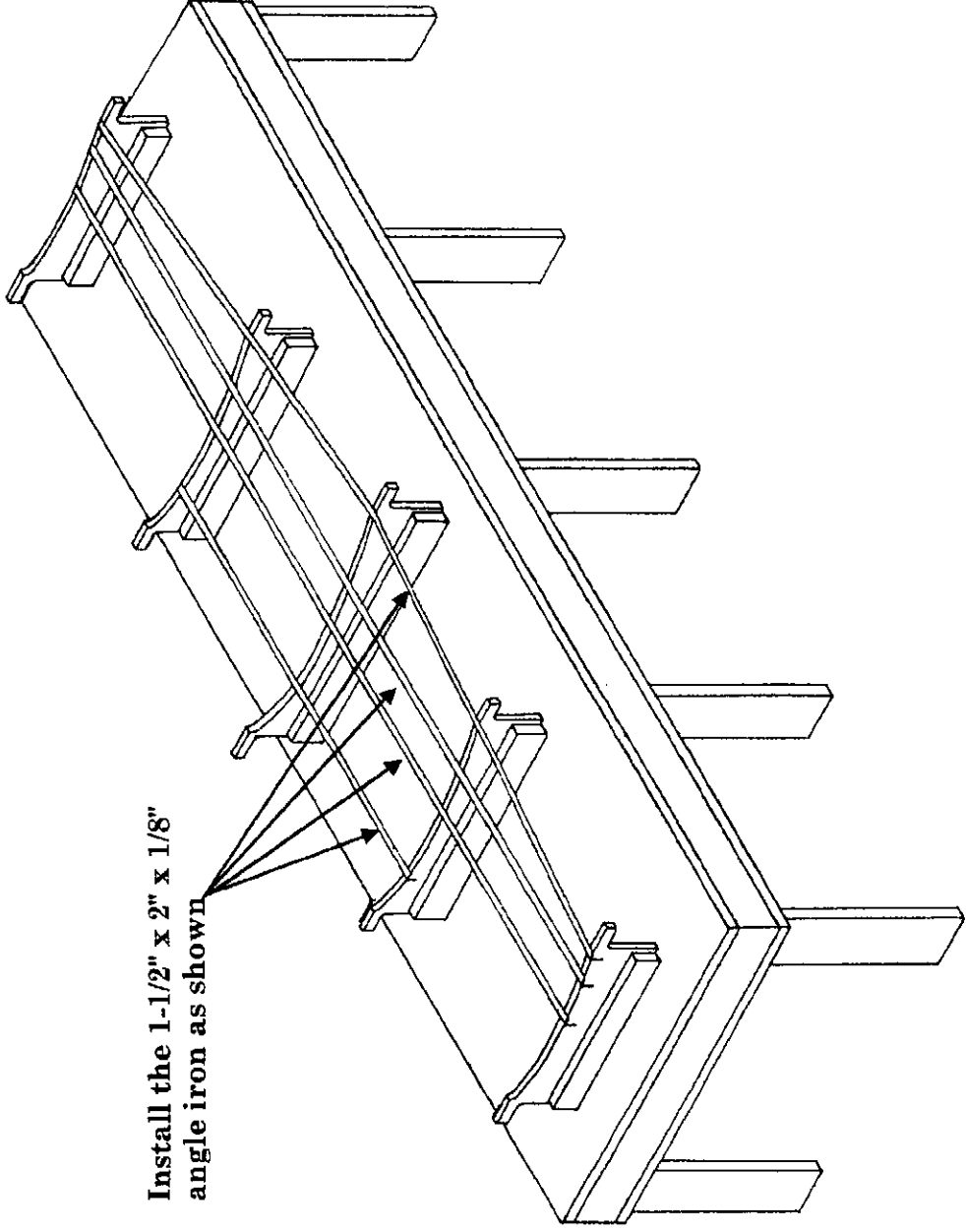
1. Align fore/aft by using the alignment mark on all the cradles.
 2. All cradles should be set heightwise by leveling the tabs to the same horizontal plane- see figure A1. We suggest using a water level for this step.
- Hint: Start by placing a shim underneath all the cradles- this allows you to bring cradles down as necessary to align.

↳ P 7-8

A7. Once level, secure all the cradles to the cradle supports with wood screws.

Installing the Angle Iron

Fig. 7:A:5.



B. H. STAB. HINGE BRACKETS

With the cradle complete, you can now begin building the H. Stab. The first step is to position the H. Stab. in the cradle.

B1. Position the H. Stab. in the cradle.

In summary:

1. The H. Stab. should be centered.
2. The H. Stab. should be pushed forward and fit well in the cradles. Look underneath to check the fit. It is acceptable to use some weight in order to conform the H. Stab. to the cradle.

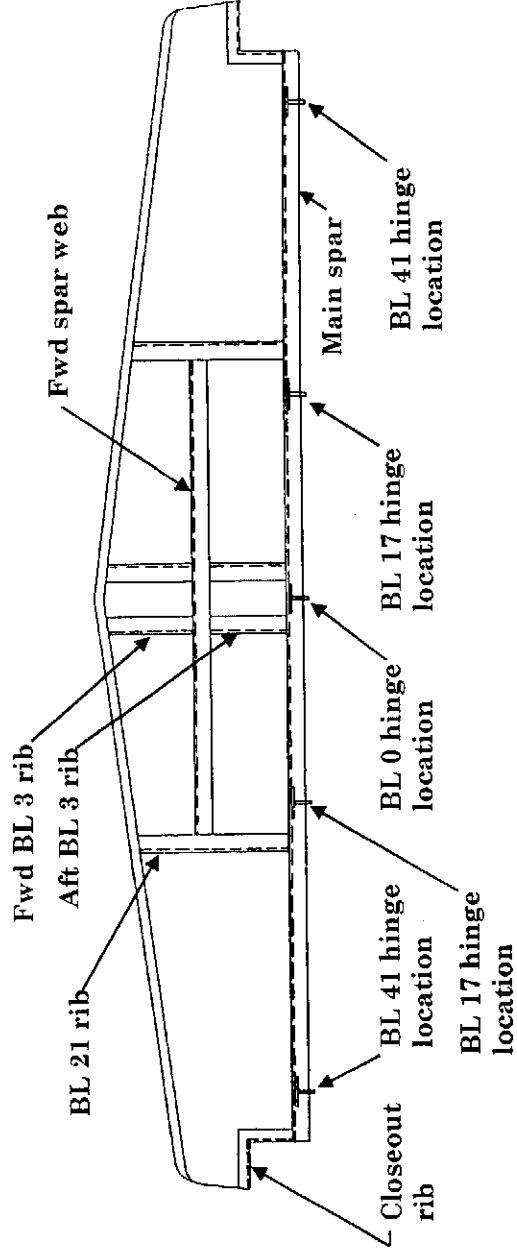
B2. This step has been eliminated.

B3. Now use Bondo or similar to temporarily secure the H. Stab to the cradles. Use 25lb. shot bags to help hold the stab down in the cradle and eliminate any warping.



Horizontal Stabilizer Top View

Fig. 7:B:2.

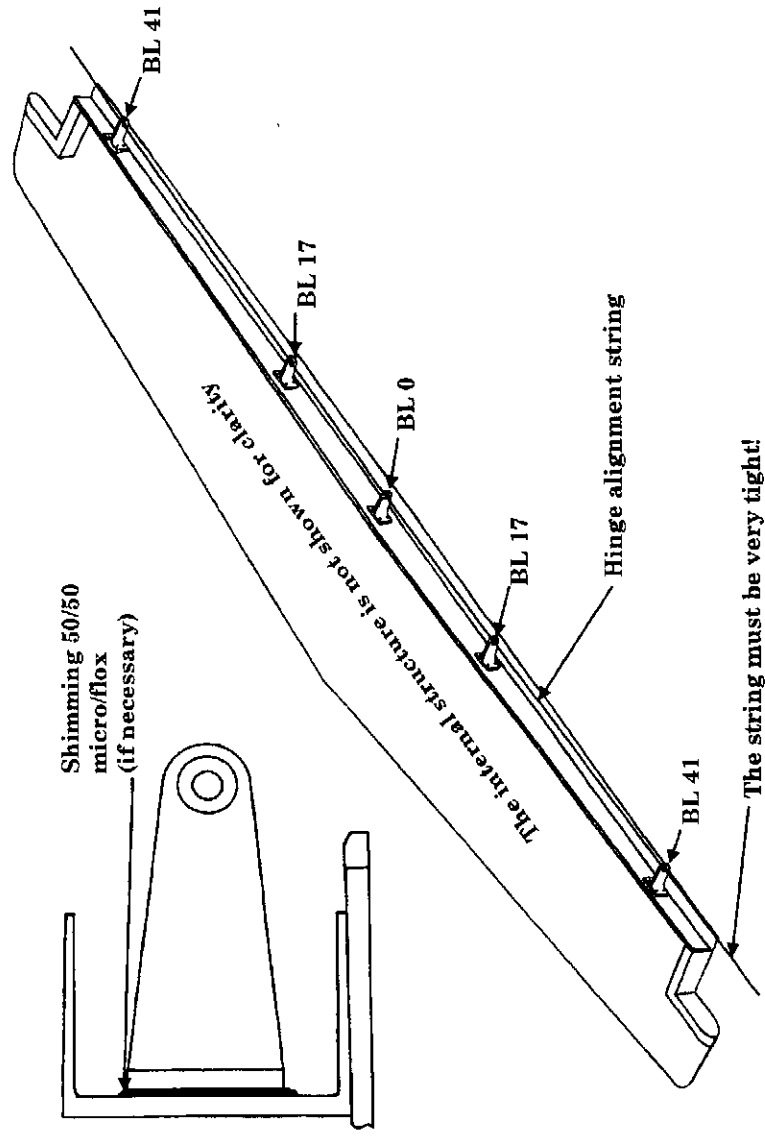


- B4. Remove all peelply from the inner surfaces of both upper and lower H. Stab. skins. Be sure all of it is removed (most of it probably already is).

WARNING: Structural bonds can NOT be made over peelply. Be sure to remove all peelply from bonding areas. Failure to do so will result in structural failure of the component.

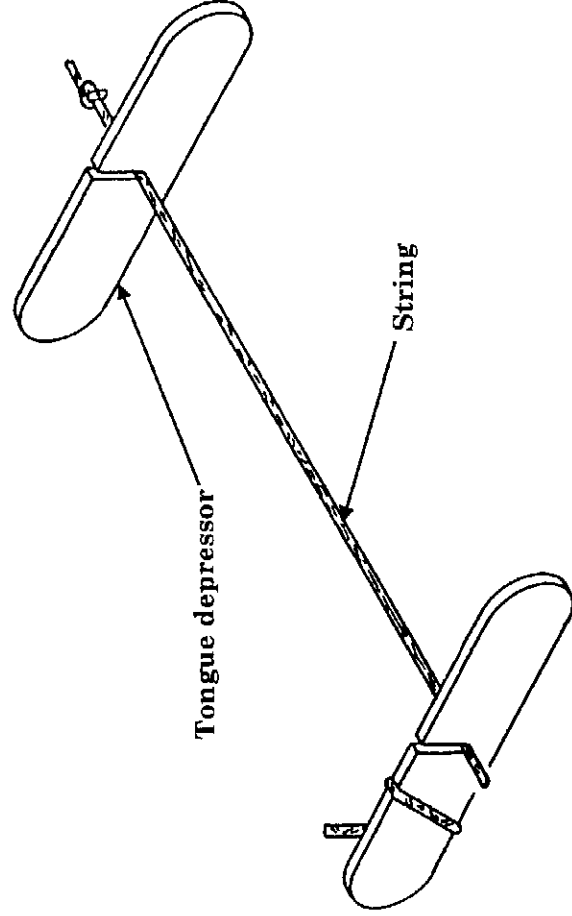
Checking Hinge Alignment

Fig. 7:B:3.



Holding String With Tongue Depressor

Fig. 7:B:4.



B5. The hinges must all be centered between top and bottom aft-stab skins. They can be clamped or super glued in place. Pull a string through the center of the bearings. The string should be centered on the outboard bearings and must be tight. Perhaps the easiest way to hold the string in place is to use a tongue depressor with a small slot cut into the side. Tie a knot in the end of the string and slide the string through the slot.

The best way of making small adjustments away from the web is to apply a layer of micro/flox (use about 50/50 micro and flox) between web and bracket (see Fig. 7:B:3). Be sure to apply enough layers of release tape to the hinges to simulate the 3 BID that will be applied to the web after closeout. You'll have to allow this to cure before rechecking the alignments.

see
Fig. 7-39

B6. With the hinge brackets properly aligned, drill the pilot holes for the four attach bolts in each bracket. This is a 1/8" pilot hole. You can then use Clecoes to hold the brackets in position.

With the pilot holes drilled first (instead of just going for the final size hole right away), you will have one last opportunity to make any small adjustments in the bracket placements to assure bearing concentricity.

B7. Now, when you are convinced that everything lines up, go ahead and drill for the attach bolts. Pull out only one Cleco at a time and drill for the bolt hole final size. Use a #12 drill bit and try to make the holes as straight as possible with the hand drill.

Provided that your bolt holes through the fiberglass spar web are nice and clean (not wobbled out), you can use them alone to align the anchor nuts.

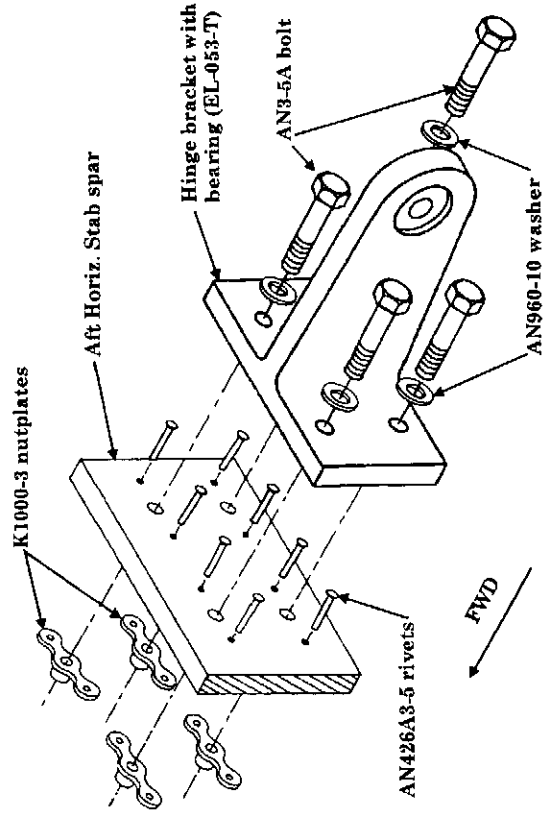
If, however, your holes are a bit loose (but they really shouldn't be), you could simply leave the hinge brackets on the web and screw the anchor nuts on, then back drill for each anchor nut's two attach rivets using a #40 drill bit. This will assure a perfect alignment of the bolts and, most importantly, the hinge brackets. If you choose to use this approach, be very careful not to drill into the hinge brackets themselves. A very small drill "tip" divot in the back of the hinge bracket is, however, acceptable.

B8. Install the nutplates for the hinges.
Method #1.

Method number one requires a bucking bar and a pneumatic rivet squeezer. With this method the rivets are secured directly to the spar. Using the existing 3/16" holes in the spar set the nutplate. Use the nutplate as a guide to drill the #40 holes for the rivets.

Installing the Nutplates, Method #1.

Fig. 7:B:5.

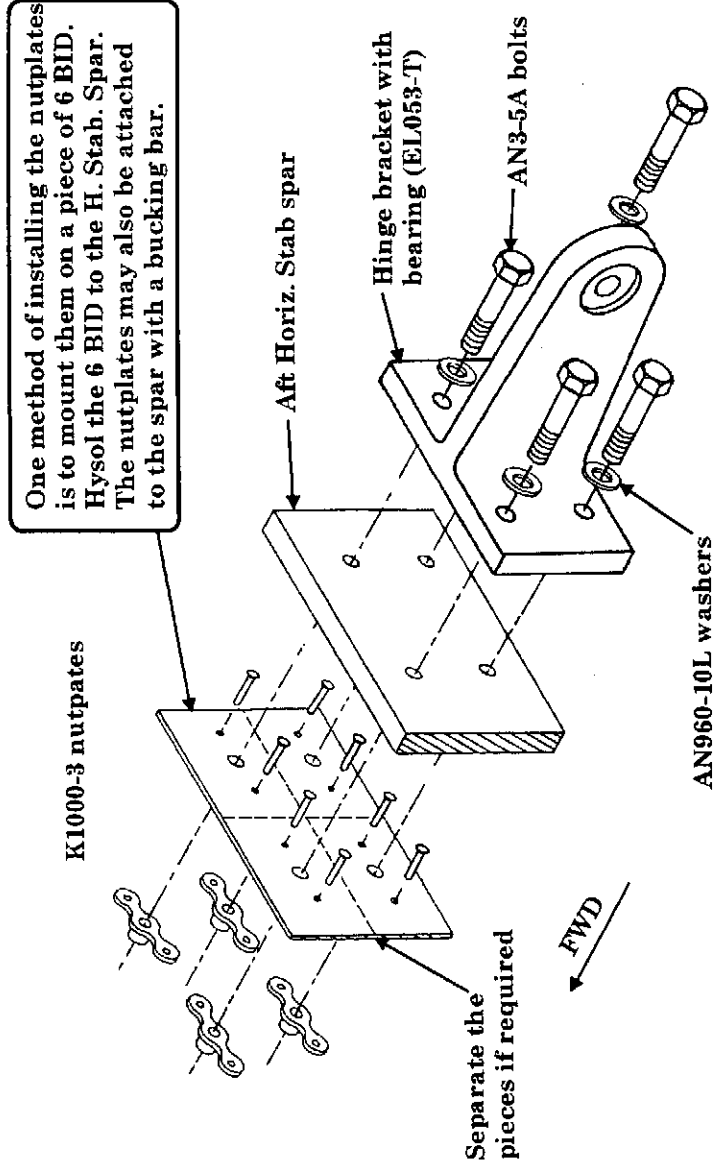


Method #2.

Method number two does not require any special tools other than a rivet squeezer. First layup a six BID on a flat surface and let cure. Mount the nutplates on the 6 BID and bond the 6 BID in place.

Installing the Nutplates, Method #2.

Fig. 7:B:6.

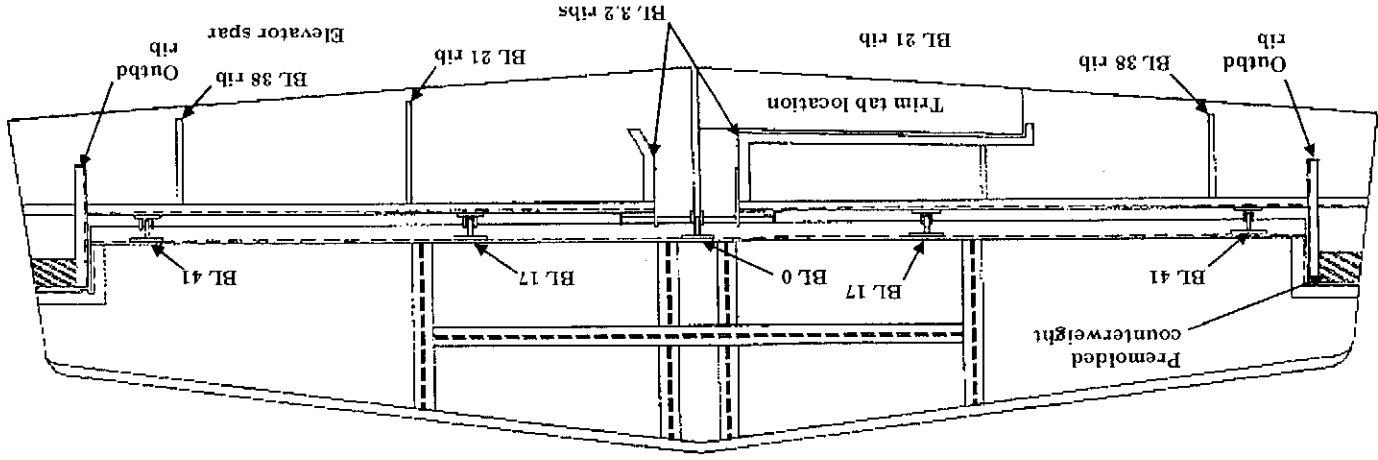


C. ELEVATOR HINGE INSTALLATION

The hinge halves that install into the H. Stab must be installed to set the elevators.
The elevator weldment should also be installed for this step.

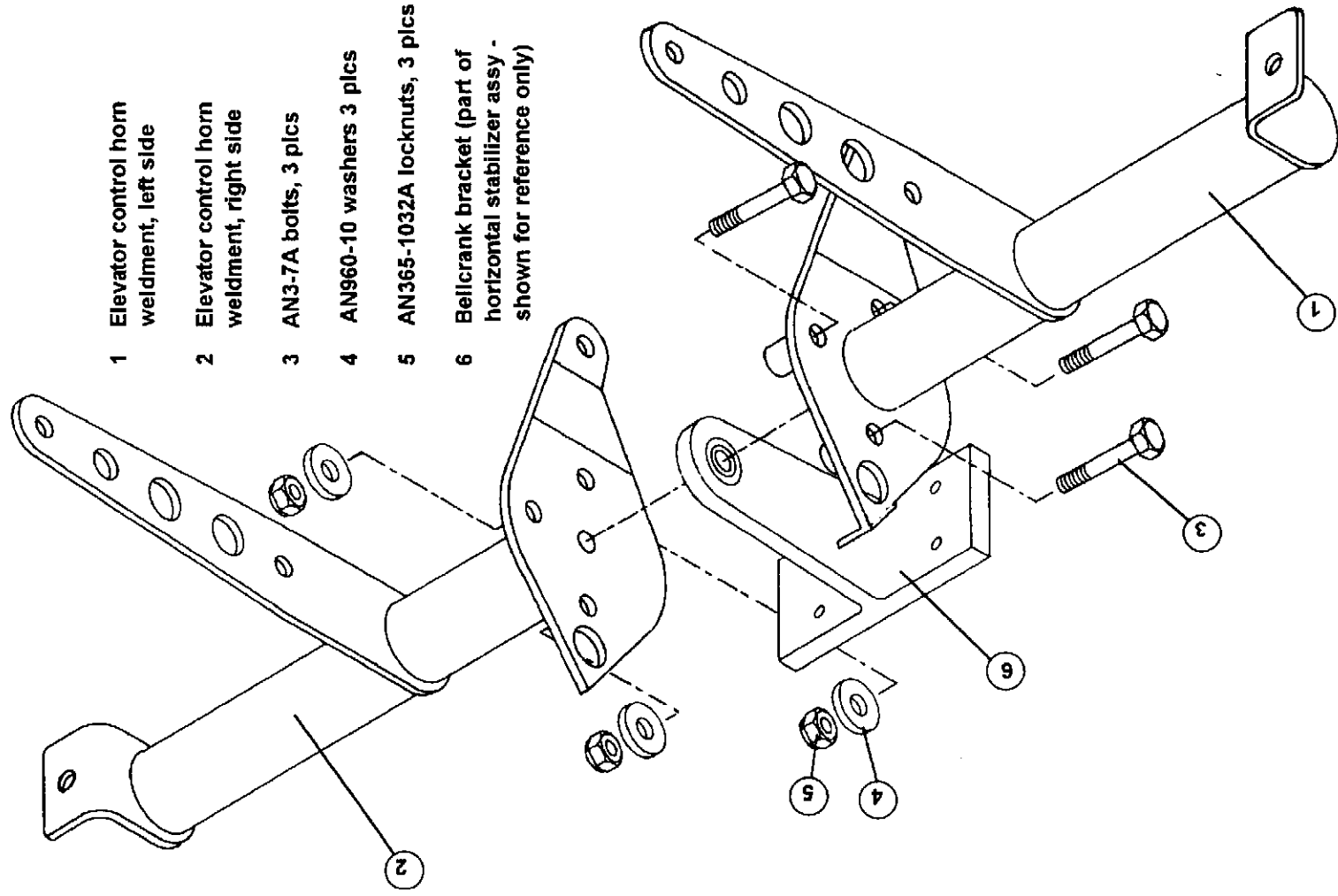
Top View, Elevator/ Horizontal Stabilizer

Fig. 7:C:1.



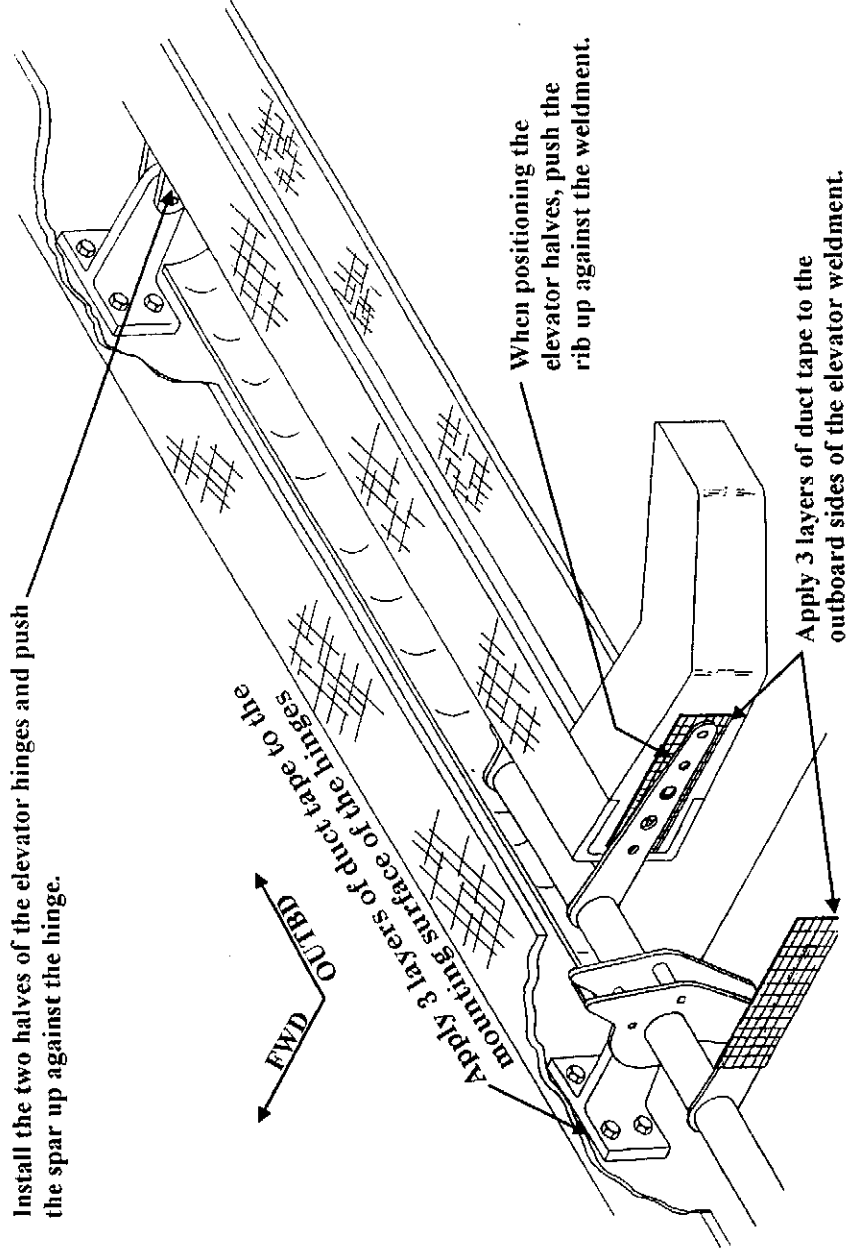
Elevator Hinge Weldment

Fig. 7.C:2.



Center Elevator Hinge Weldment

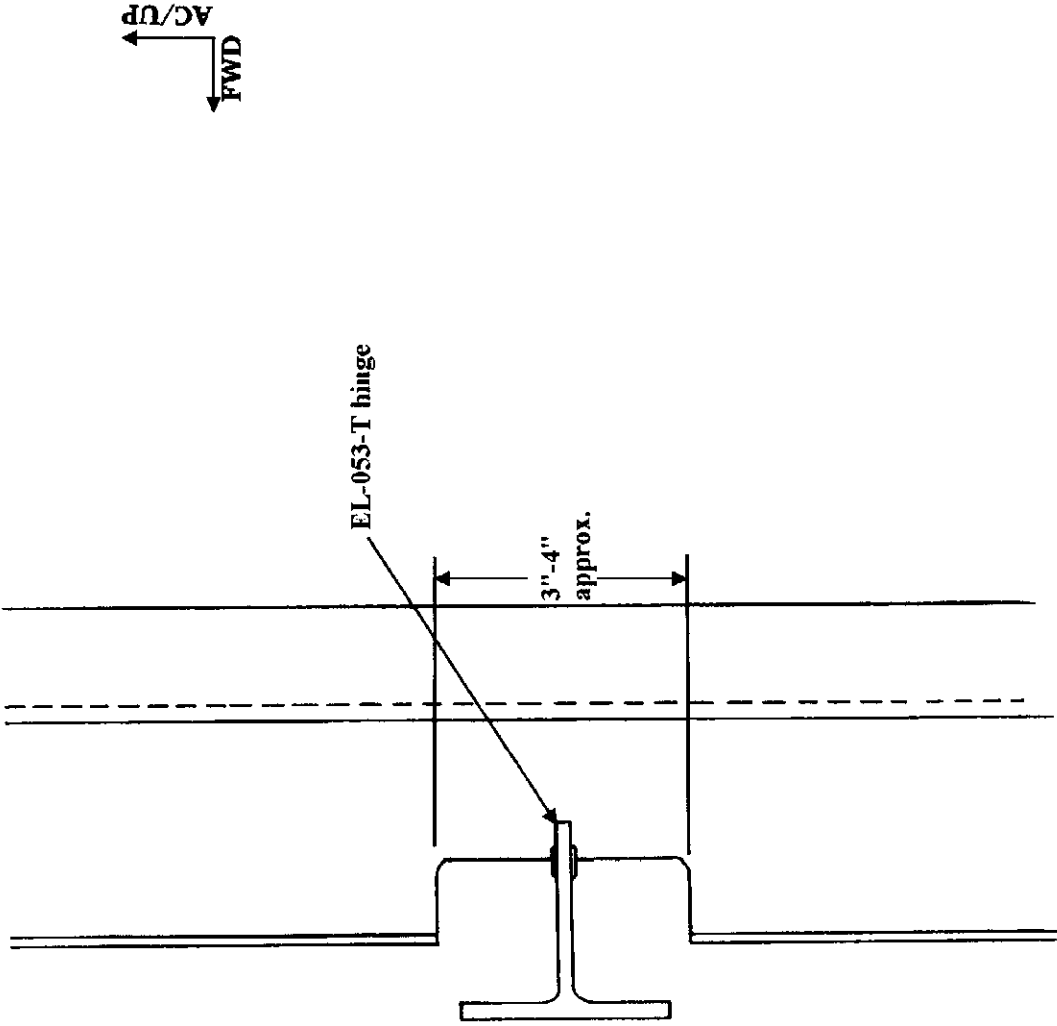
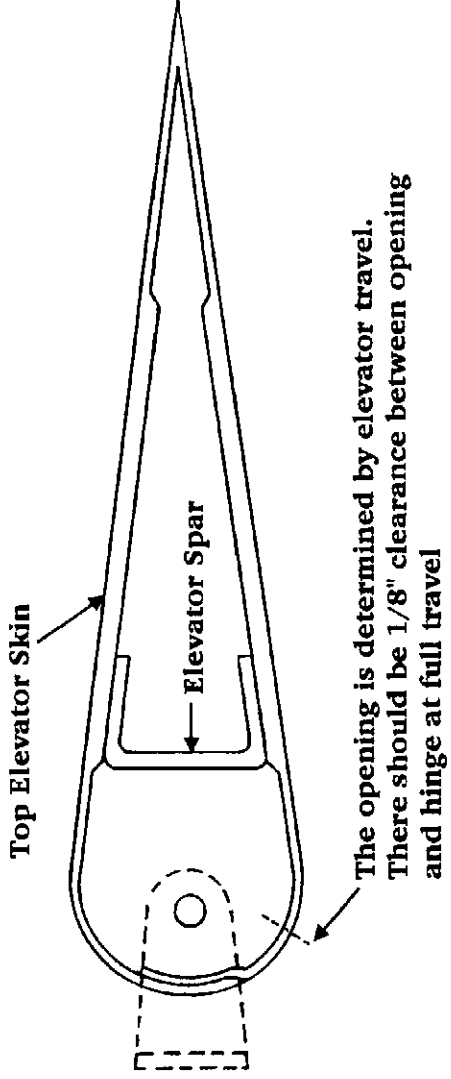
Fig. 7:C:3.



- C1. Install the center elevator hinge weldment. For this step, it is necessary to cut a slot in the center cradle to fit the weldment.
- C2. Position the elevators. In summary:
 1. The inboard rib should be up against the weldment.
 2. Trim the outboard end of the H. Stab. main spar for elevator counterweight clearance.
 3. The spar should be forward up against the elevator hinges with 3 layers of duct tape under the horizontal at hinges. The duct tape simulates the three BID that will be applied after closeout.
 4. Trim the H. Stab. skin for elevator clearance along the horizontal trailing edge and in the counterweight area (Fig. 7:C:5 & 7:C:6). For now, just trim for clearance.
 5. The elevator should be weighted down into the cradle. Once aligned, temporarily secure the elevator hinges with superglue.
 6. Cut the holes for the hinges (Fig. 7:C:4).

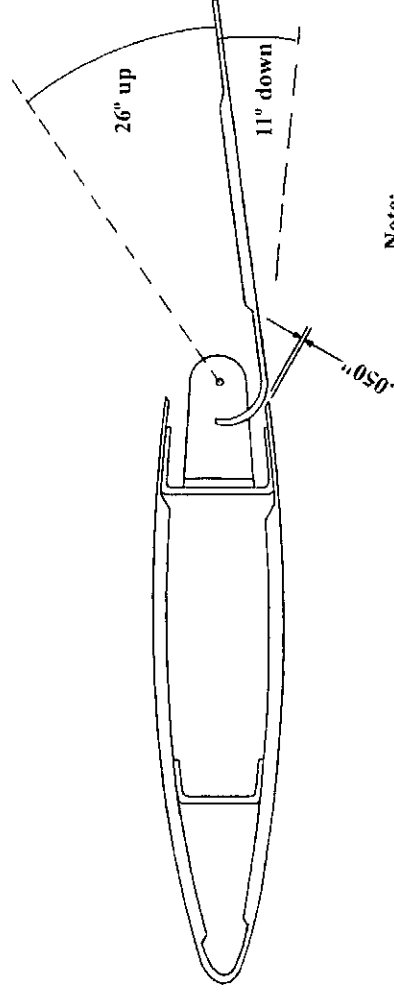
Cutting Holes for Hinges in Elevator

Fig. 7:C:4



H. Stab./ Elevator Gap

Fig. 7:C:5.

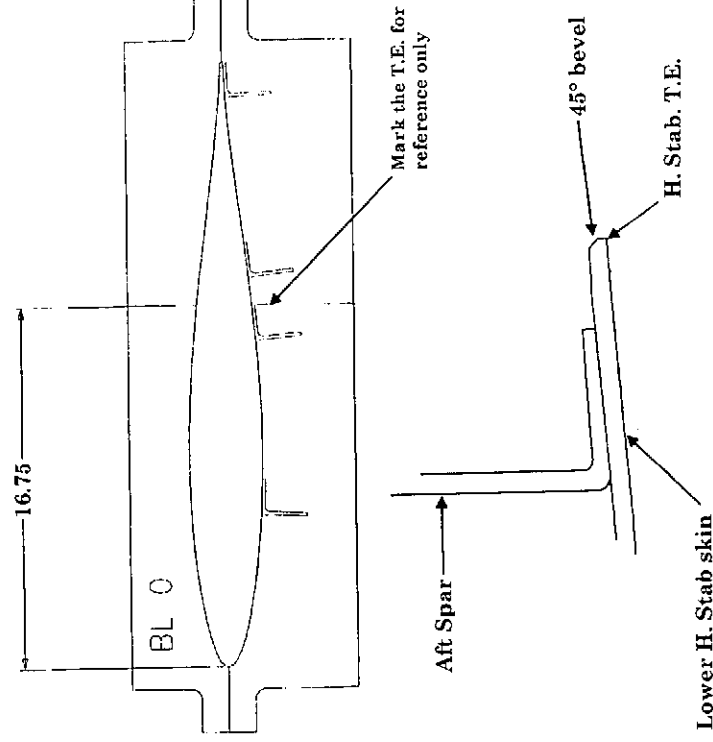


Note:
The .05" gap should
be constant through the
entire travel range

- C3. Recheck the H. Stab. elevator gap. Ideally there should be .05" between the H. Stab. and elevator as shown in Fig. 7:C:5. Most likely some body work will be required to get a constant gap through the entire travel range (this is normally done after the H. Stab. and elevators are closed). For now, simply trim the horizontal trailing edge so that it clears the front of the elevator and fine tune it later.

Trimming the H. Stab. T.E.

Fig. 7:C:5.a.



Lower H. Stab skin

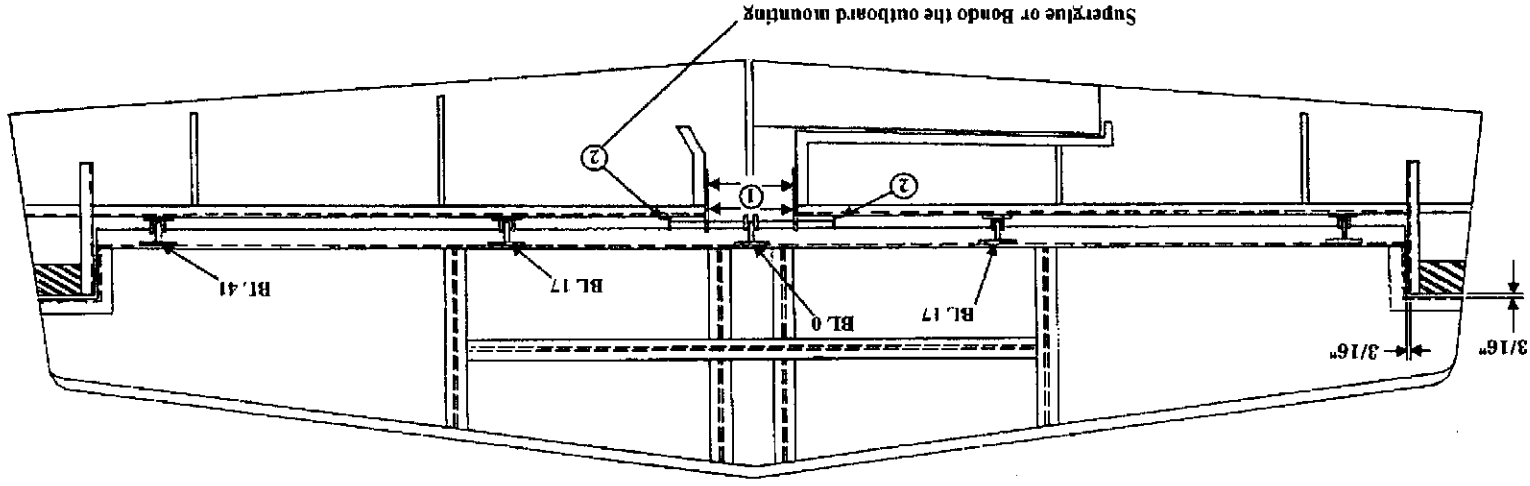
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Horizontal Stab and Elevator

Drilling Holes for Elevator Hinges and Horizontal Stabilizer

Fig. 7:C:6.



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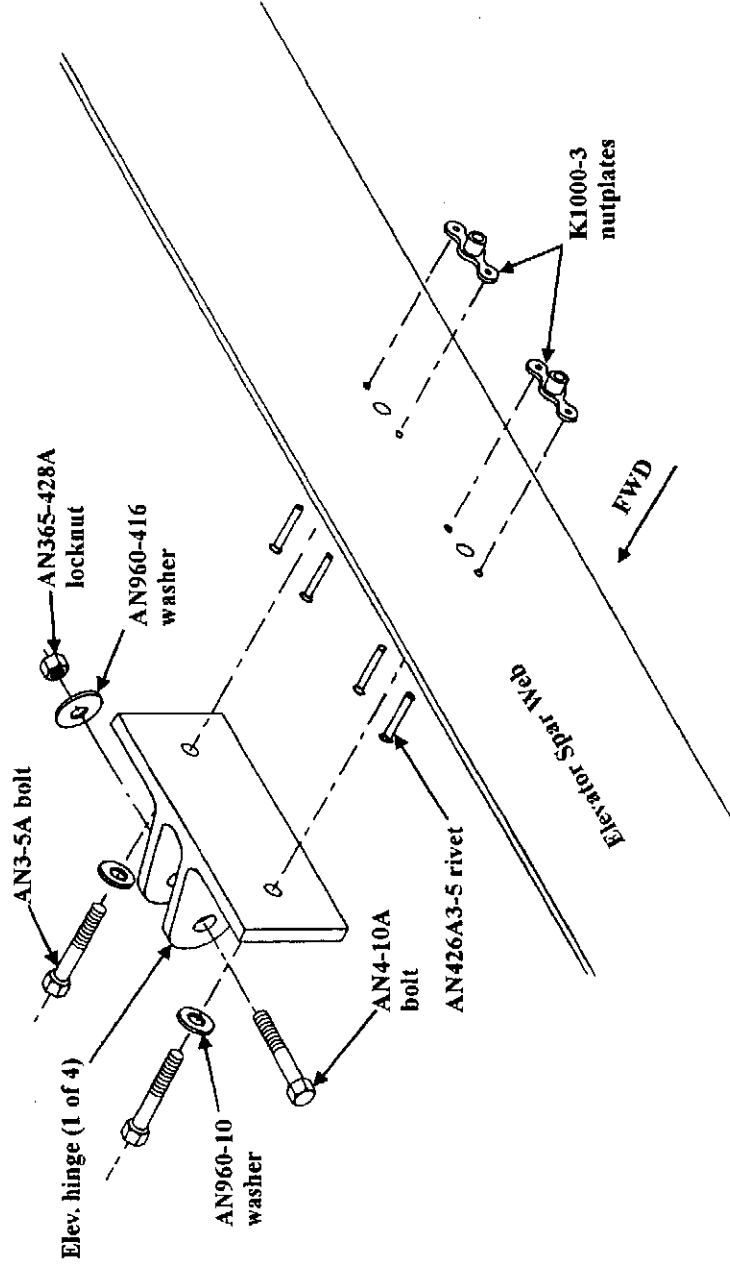
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- C4. Remove the elevator. Drill the holes for the elevator hinges and the elevator weldment. The weldment should be centered heightwise on the inbd rib.

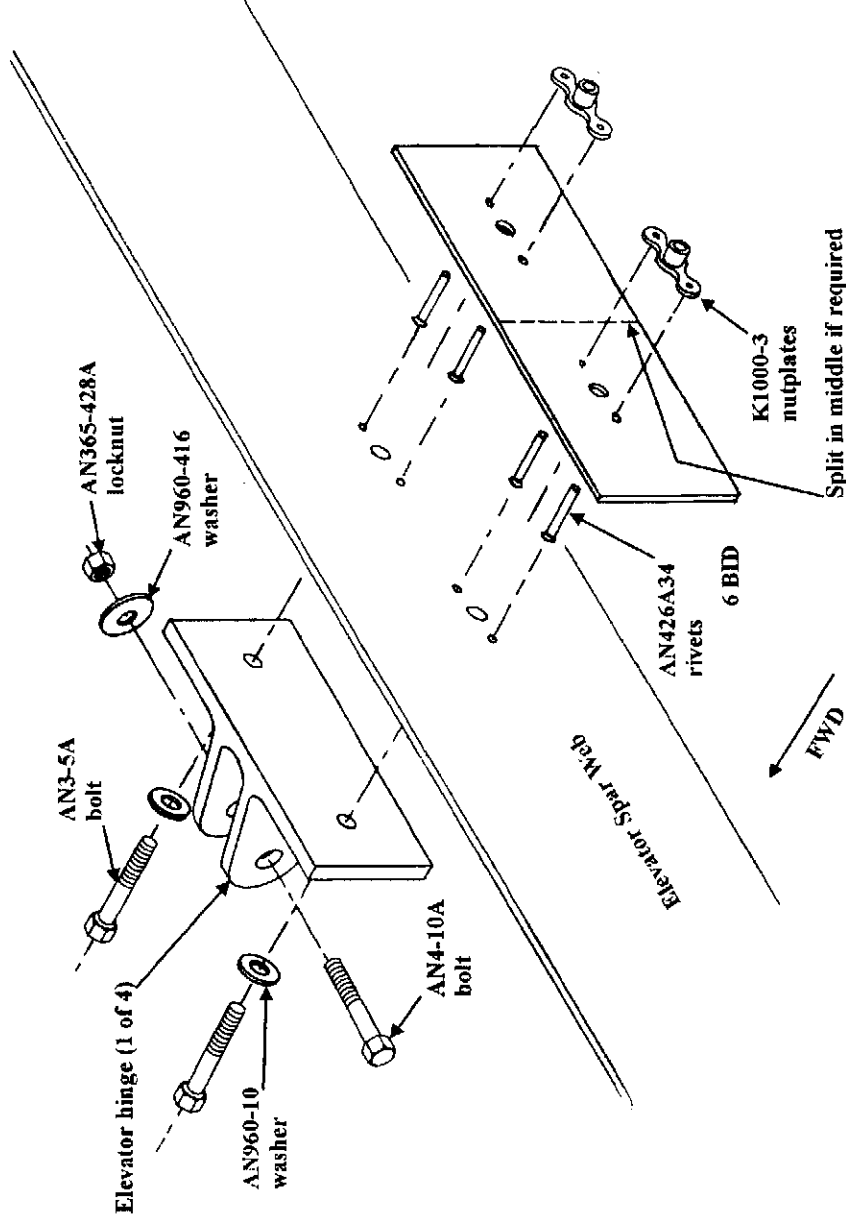
Installing the Elevator Hinges, Method #1

Fig. 7:C:7:a



Installing the Elevator Hinges. Method #2.

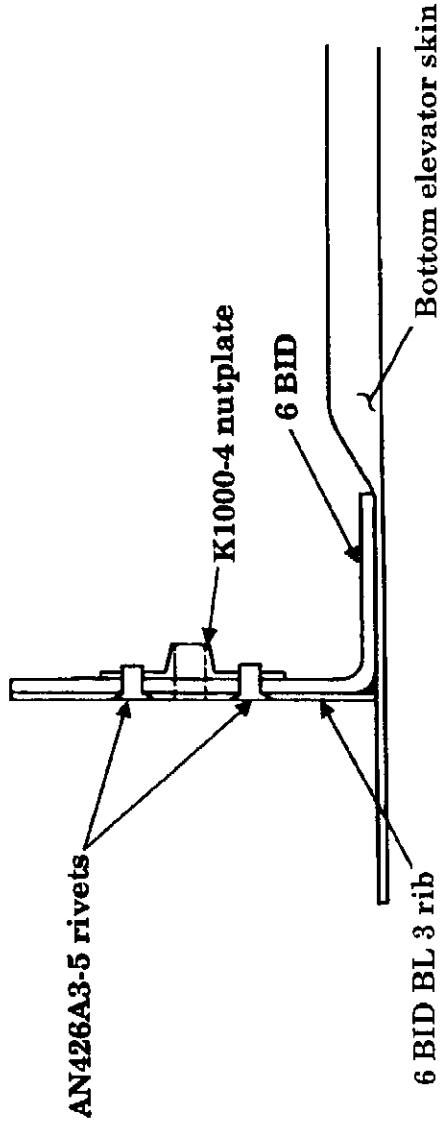
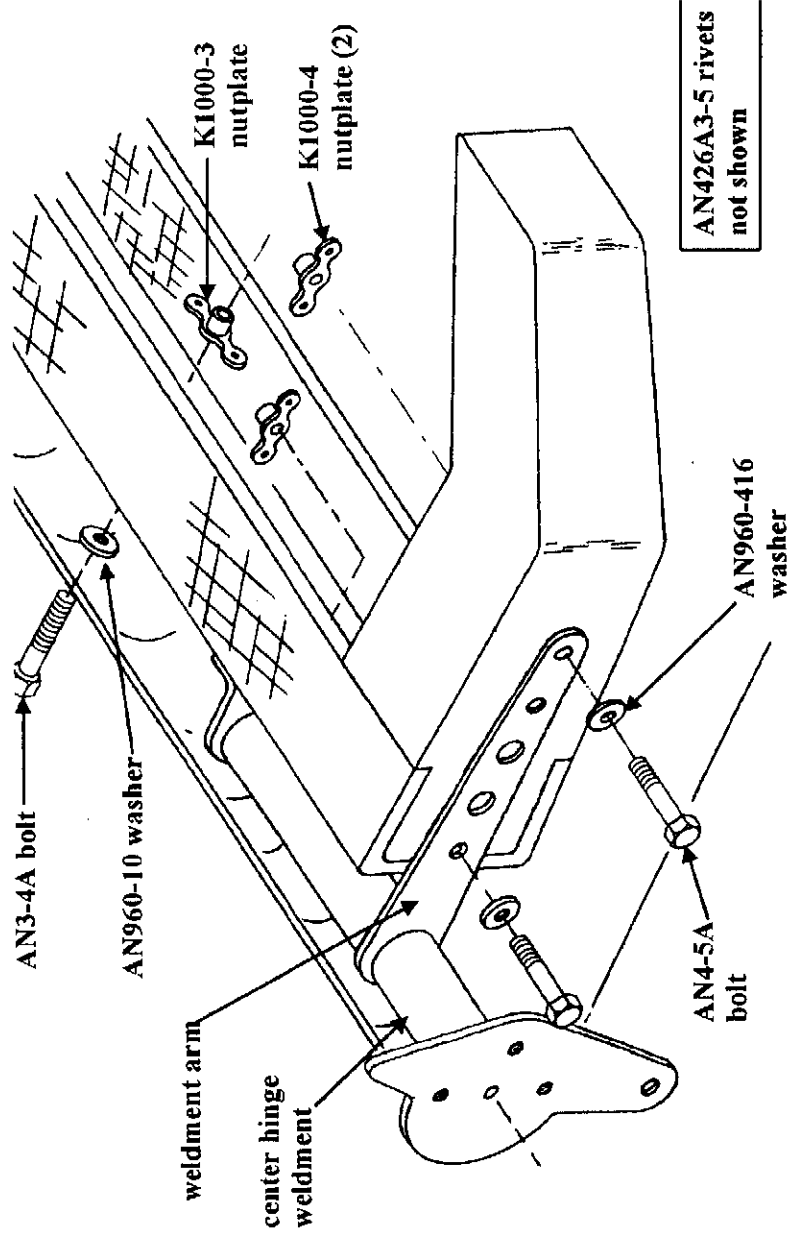
Fig. 7:C:7.b.



C5. Install the elevator hinges using either of the above methods.

Installing Nutplates for Elevator Weldment

Fig. 7:C:8.



C6. Install the nutplates securing the elevator weldment.

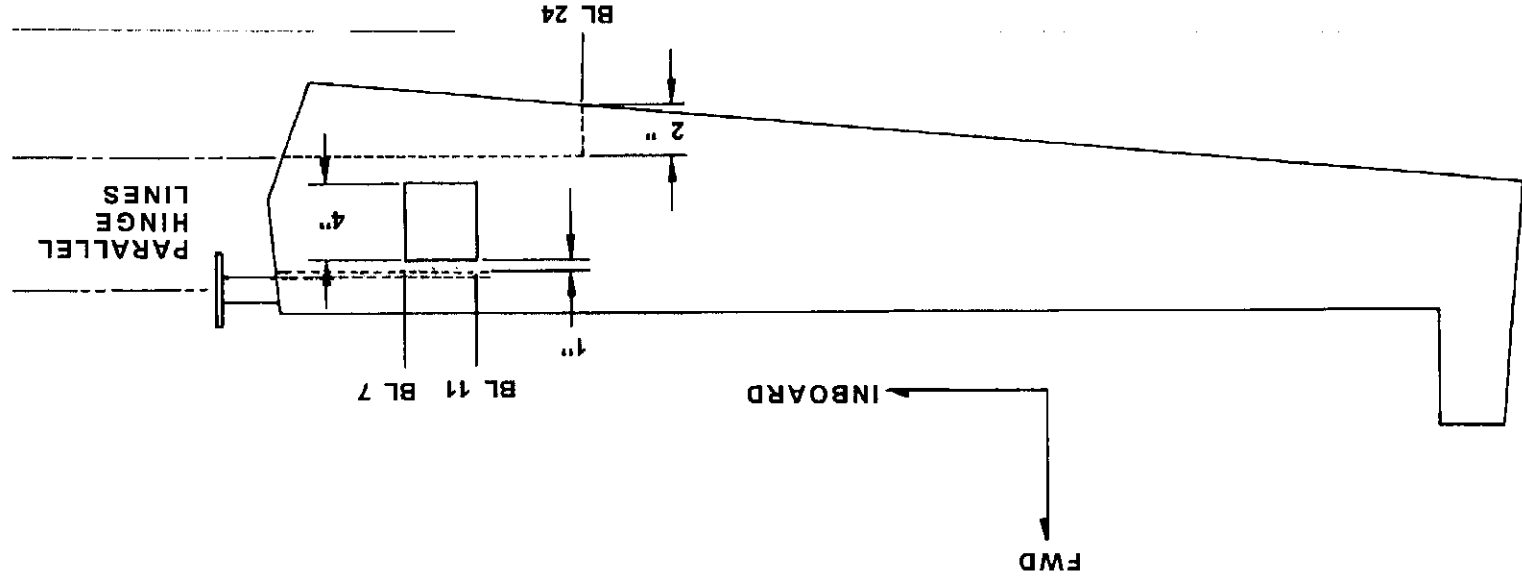
D. TRIM MOTOR INSPECTION PANEL

The Lancair uses a MAC servo to adjust a standard trim tab on the elevator, thus providing pitch trim. There is a glass to glass area on the bottom elevator skin from which the inspection panel will be cut. For panels that are not glass to glass, core the area out and apply a glass 2 BID with an overlap of 1" onto the carbon. To find the proper angle of the inspection panel you will first mark the location of the trim tab.

- D1. Mark out the location of the trim tab on the bottom elevator skin from the dimensions given in Fig. 7:D:1.
- D2. Drill #40 reference holes at the corners of the trim tab. Don't cut the tab out yet, you will use the reference holes to cut the tab out after the elevator is closed.
- D3. Center your inspection panel at BL 9 at a right angle to the trim tab hinge line designated by the reference holes. The forward edge of the panel should be about 1" aft of the elevator spar. Mark the 4" x 4" outline of the inspection panel onto the inside of the bottom skin.
- D4. Do a segmented cut around the inspection panel. In other words, cut through the bottom skin on the panel outline, but leave 1/4" carbon at the corners uncut. The panel will stay in position while you lay up its mounting flange. A little bit of patience, a Dremel tool and their #426 fiberglass reinforced cut-off wheels (see your local hobby shop) will make a very nice, thin cut you can be proud of later.
- D5. Sand the area 1" around the panel with 40 grit to prepare it for the flange. Clean with MC.
- D6. Apply a 4" X 4" release to the inspection panel. Clear tape or packing tape will work well for a release here.

Trim Tab and Inspection Panel Locations

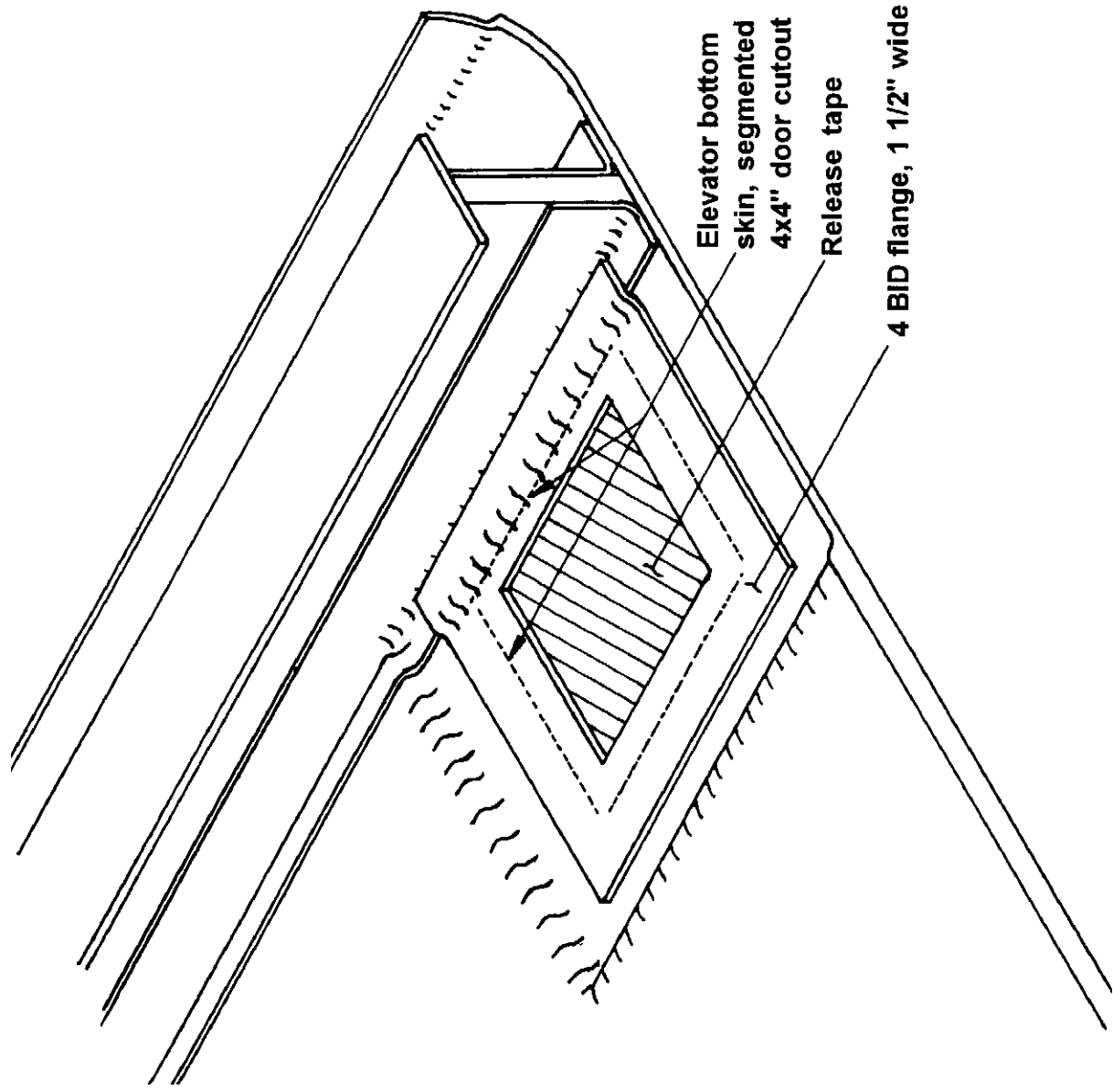
Fig. 7:D:1.



- D7. Apply a 4 BID, 1-1/2" wide flange around the inspection panel, centered on the segmented cut (see figure 7:D:2).

Inspection Panel Flange

Fig. 7:D:2.



- D8. Temporarily close the elevators, using enough clecoes in strategic locations to keep the skins aligned.

- ✓
- D9. Carefully finish the segmented cut of the servo inspection panel. Use a sharp mat knife or carefully cut with a Dremel rotary blade. The panel should pop off the flange.
- D10. Trim the inspection panel flange to 5/16" .
- D11. Drill four #29 holes through the panel and the flange for the MS24693-S26 mounting screws. Countersink the panel to fit the screws.
- D12. Mount four K1000-06 nutplates to the flange using AN426A3-5 rivets.



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Horizontal Stab and Elevator

E. COUNTERBALANCING THE ELEVATORS

Install the outboard rib

E1. Cut 2 ribs from 2 core 2 prepreg and bond in place at each end of the elevator (see figure 7:E:1). To do this you must core out the edge of the rib about 1/4" deep and fill it with micro/flox (see figure 7:F:1). Fit the rib against the inner counter balance closeout and up against the spar. Use 2" 2BID tapes to secure the front of the spar web to the rib.

E2. Pre-fit the top skin. This is done by applying 2 layers of duct tape to the skin and trimming the rib to clear it. Make sure the outboard rib fits well against the top skin with the duct tape in place. Again core out the edge of the rib and fill with micro flox. Set the top skin in place and let cure. Remove the top skin and trim the squeeze out.

The elevators of the MKII are 100% mass balanced. Usually we prefer to close the elevators with plenty of weight and then drill the excess out after closing.

The elevators must move freely in order to balance them. You CAN NOT BALANCE an elevator that is not freely floating on the hinges.

IMPORTANT NOTICE: Balance the left and right elevator separately because they require different amounts of counterweight.

Before starting, the trim tab, servo, hinge, and all hardware must be temporarily installed or at least placed in their respective locations. The goal is to get as close as possible to the finished weight of the elevator.

E3. Drop the counterweights in place. Place the top skin in place. Note that what is still missing is the adhesive for closing, primer, and paint. Balance the elevator such that the L.E. of the counterweight arm hangs freely 1" to 1-1/2" below the 100% balanced position. This means that you will be adding weight as far forward as possible until the you have achieved the correct balance.

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Chapter 7

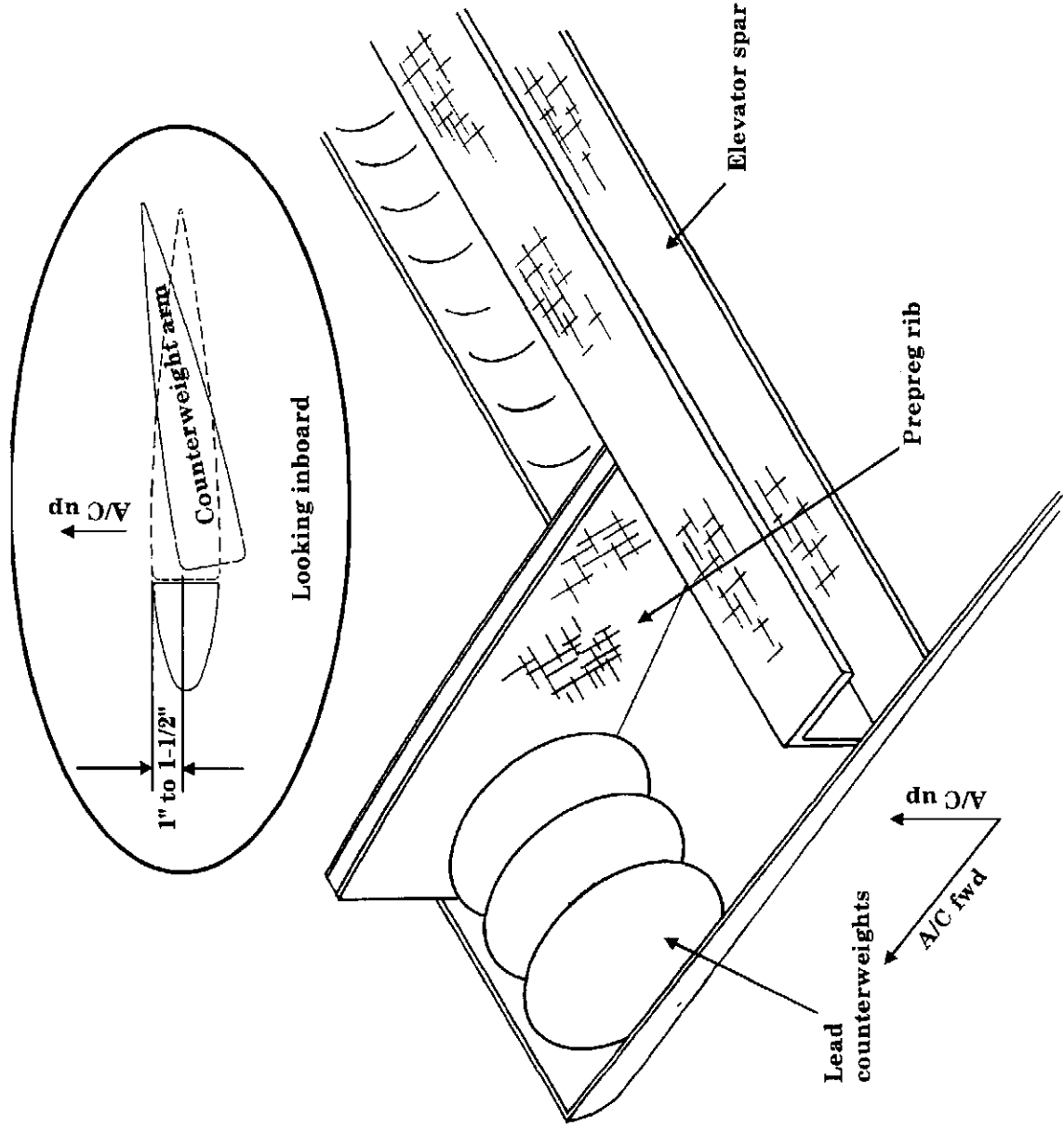
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Horizontal Stab and Elevator

Installing the Counterweights

Fig. 7.E:1.



E4. When satisfied that you have sufficient counterweight, install the lead with epoxy/flox. Apply a 2 BID reinforcement to the aft side of the counterweight.

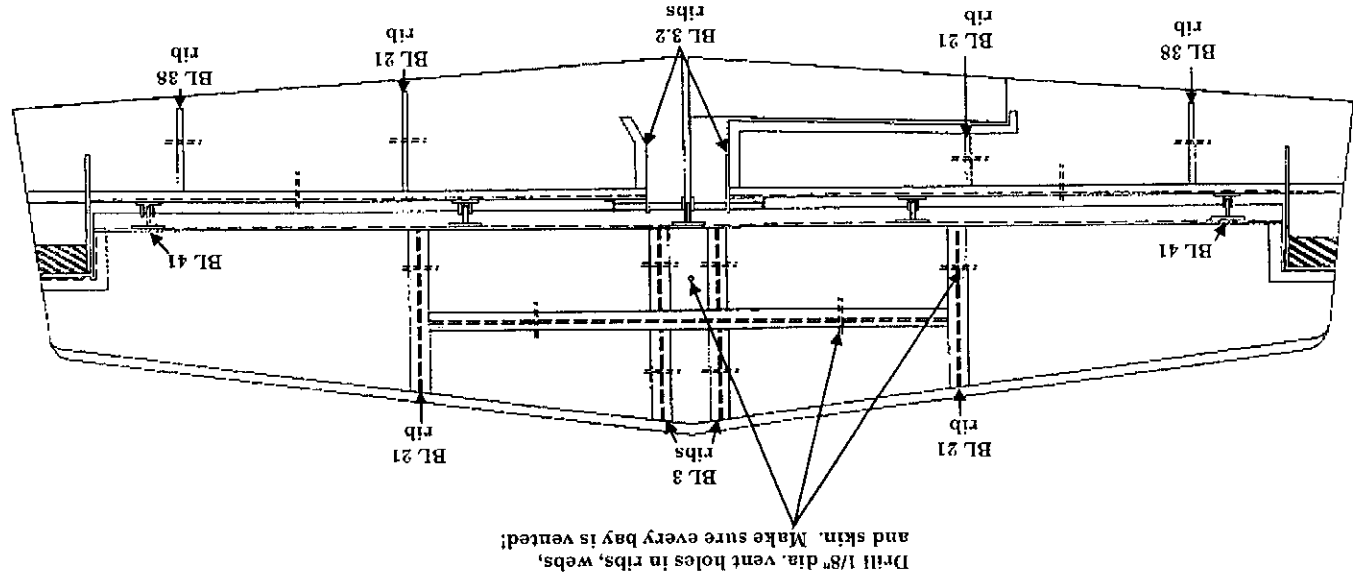
E5. When the elevators are closed and primed (ready to paint), check the balance again. Prior to paint, the counterweight should hang approx. 1" below the 100% balance position. If necessary, drill excess weight out. Fill the holes with micro and apply a 2 BID on top. Check the balancing again after paint and add or remove weight as necessary. Fill any drill holes with micro and touch up the areas.

F. CLOSING THE H. STAB AND ELEVATOR

F1. If holes are not already drilled, drill vent holes in ribs, webs, and the skin as shown in Fig. 7:F:1.

Horizontal Stabilizer and Elevator Vent Holes

Fig. 7:F:1.



WARNING: ALL INTERNAL BAYS MUST BE VENTED. Failure to vent these bays could result in excessive internal pressure at high altitudes and cause structural damage that could result in component failure.

F2. Check the fit of the upper H. Stab. and elevator skins. A few things to look for:

1. Place pieces of "play dough" every 6" on the spars, ribs, etc. Put the upper skins in place. Clamp the cradles in place and weight the skins down as if you were closing. If there are gaps between the top skin and the cradles, put a small wooden or prepeg shim in the area to hold the skin up in contact with the cradle. Look over the H. Stab. and elevators. There should be no visible bumps or irregularities, and it should fit the cradles well.

Remove the weights and cradles. The pieces of play dough should be .01 thick or flatter. If in excess of this, perform an epoxy floc release.

Epoxy/floc release:

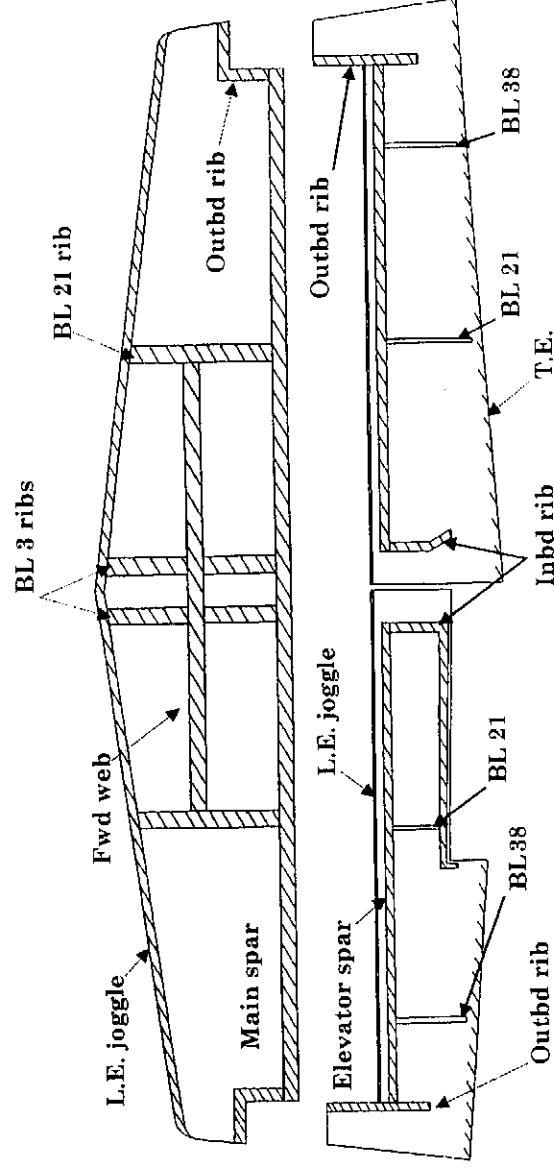
The areas to be released must be sanded and cleaned with MC. The upper skin must be release-taped (duct tape, clear tape or equivalent) in these areas. First apply pure epoxy to the bonding areas with a brush and then the epoxy/floc mix. Lower the upper skin in place and clamp cradles in place. Weight down as if closing. Let cure.

When checking the fit, take note of the fit in each area. Practice the closing a couple of times before getting started. Get all the things you may need for closing- weights, clamps, straight edges, clecoes, etc. Decide what you will use to hold the leading edge joggles together during bonding (wood screws, clecoes, duct tape?).

F3. De-wax all the ribs, spars, and joggles using MC. Apply a generous amount with a clean rag or paper. Follow immediately with another clean, dry rag.

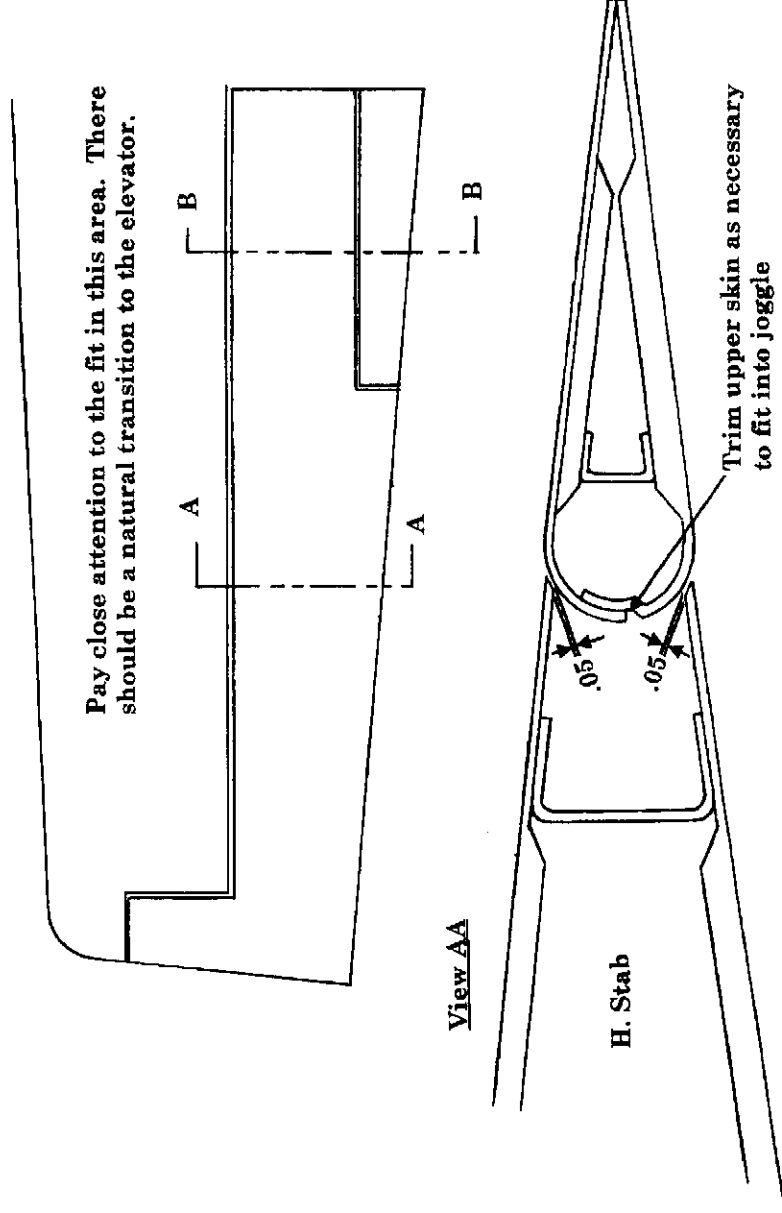
Preparing Surfaces for Bonding

Fig. 7.F:2.



Fitting the Upper Elevator Skin

Fig. 7:F:2:a



Note: The elevator is slightly thicker than the stabilizer

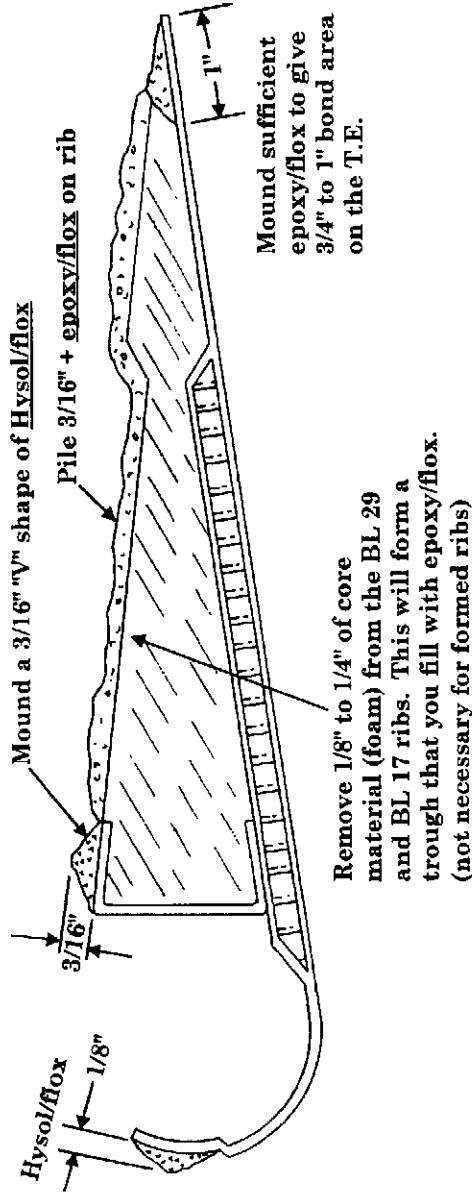
F4. Using 40 grit sandpaper, sand all bonding surfaces. Fig. 7:F:2 shows the bonding surfaces of lower H. Stab and lower elevator halves. Also sand the corresponding bonding surfaces of upper H. Stab. and elevator skins. Clean all bonding surfaces with MC.

Note: Before starting the closing process, the elevator and the H. Stab. must be positioned in the joggle. The weldment and hinges should be bolted in place (don't forget about the duct tape spacer on the weldment and the three layers of duct tape under the horizontal hinges).

Applying Adhesive to Bonding Surfaces of Elevator

Fig. 7:F:3.

Elev Cross Section @ BL 29



F5. Apply pure Hysol to the inboard and outboard ribs, the spars, the leading edge joggle and the parts of the counterweight arm that are to be bonded. Apply Hysol to the corresponding areas of the upper skin.

Apply Hysol or epoxy to the T.E. and the BL 29 and BL 17 ribs. Apply Hysol or epoxy to the corresponding areas of the upper skin.

Mix in flox with the Hysol and/or epoxy. Hysol: Mix in 1 tablespoon per 2 ounces of Hysol. Epoxy: Mix in enough flox to give it the consistency of peanut-butter (when you lift up a batch with the mixing stick, it shouldn't fall off).

Apply the Hysol/flox and/or epoxy/flox mixes to their respective bonding areas of the lower skin and structure (see Fig. 7:F:3).

F6. When satisfied that all bonding surfaces have been sufficiently covered, carefully lay the upper skin in place and weight it for cure. Once clamped in place, you should see squeezeout along the T.E. and L.E., inboard rib, etc. Take a peek at whatever you can get to and assure yourself there is sufficient squeeze out.

NOTE: Once again you must use a straight edge to check that your skin is not bowed. You may have to shuffle your weights around to allow room for the straight edge check, but it's worth it. This is for all the marbles, so check and double check. Readjust weights if necessary.

Follow the same methods as you used on the elevators to close the H. Stab.

F7. When the Hysol has cured, sand the outboard joggles of each elevator. Clean with MC, and apply 2" wide 2 BID strips in the joggle.

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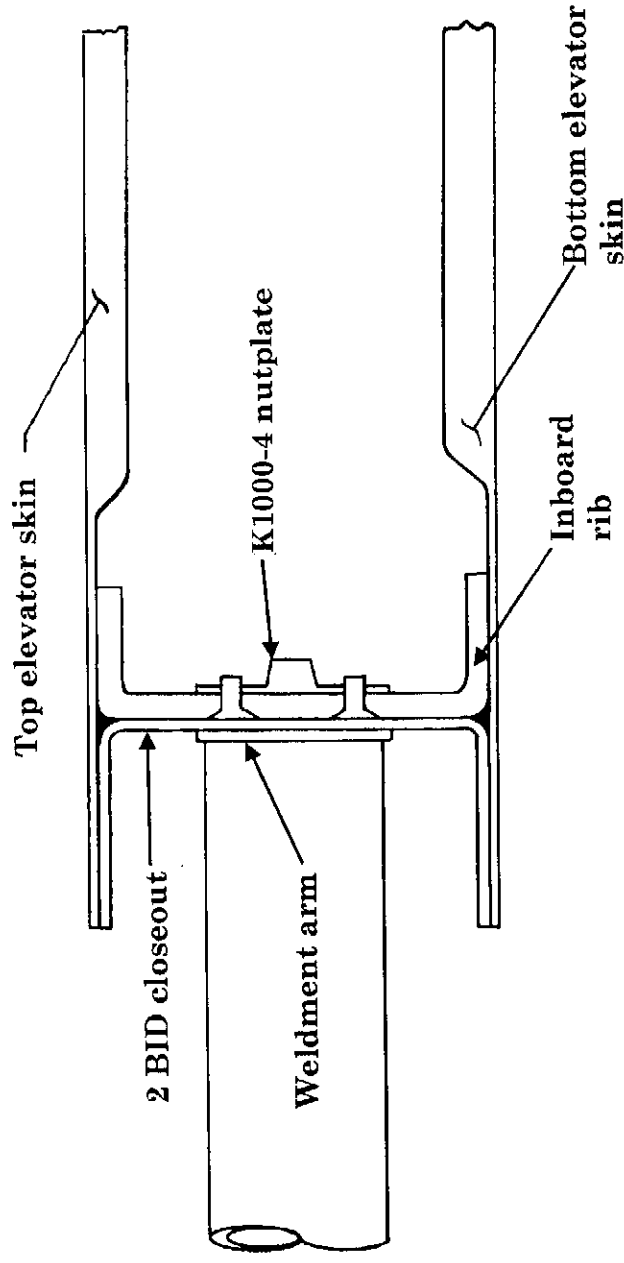
Horizontal Stab and Elevator

F8. When the 2 BID has cured, sand it with 40 grit and smooth the outboard edges of the elevators with micro. Sand the micro to the same curvature as the horizontal stab.

F9. Remove the center hinge assembly and sand the inboard side of the BL 3.2 elevator ribs. Clean with MC and apply 2 BID, rolling onto the upper and lower elevator skins. Push some modeling clay, Silly Putty, etc. into the two mounting bolt holes on the inboard rib to prevent resin from clogging the threads. When the glass is in the green cure state you can trim around the bolt holes and remove the clay plugs. You can now remove the three layers of duct tape from the arms of the center hinges assembly that rested against the inboard elevator ribs. The surfaces that the weldment arms rest against should be absolutely flat (see Fig. 7:F:5).

Weldment Arm Mounting

Fig. 7:F:5.



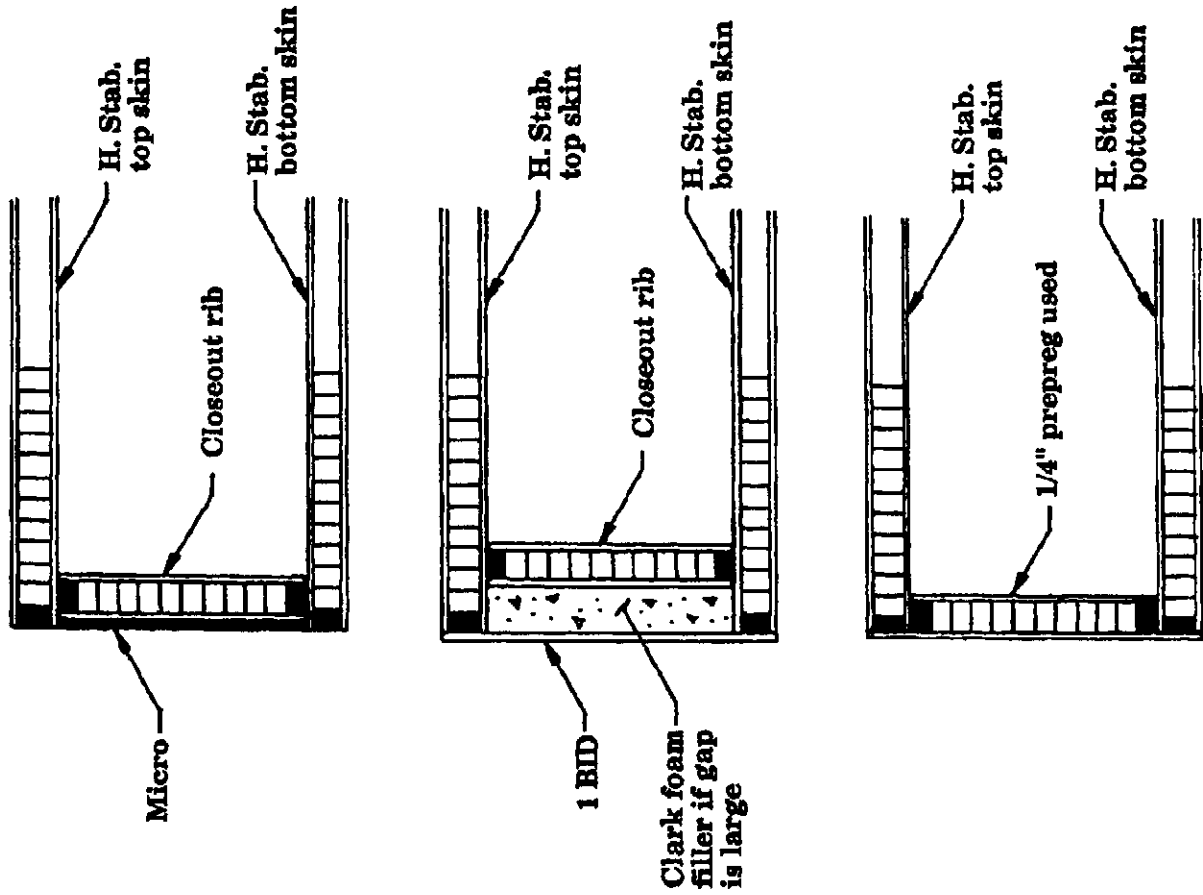
Remove the hinges from the H. Stab. and elevator. After cleaning and sanding, push modeling clay into the bolt holes like you did on the elevator and rib. Apply 3 BID to the rear face of the H. stab. spar making sure to roll it onto the upper and lower skins. Open the bolt holes, remove the clay plugs, and remove the duct tape from the hinges.

NOTE: To remove the bolts that secure the center hinge assembly to the elevator spars, you must grind an access hole in each elevator L.E. Make this hole just large enough on the bottom side so you can remove the bolts with a 3/8" socket.

F10. Close out the edges of the horizontal stab in the counterweight area with 2 BID, 2 ply per side fiberglass prepreg. Keep about a 0.050" gap between horizontal stab and counterweight, and be sure that gap doesn't close or open up when the elevator is moved up and down. The H. Stab. BL 45 rib is probably very close to being flush in the counterweight area. If it isn't you can either flush out this face with micro or bond in a piece of Clark foam with 1 BID over it. Or you can use a piece of 1/4" prepreg with inside skin and core trimmed to slip into cavity.

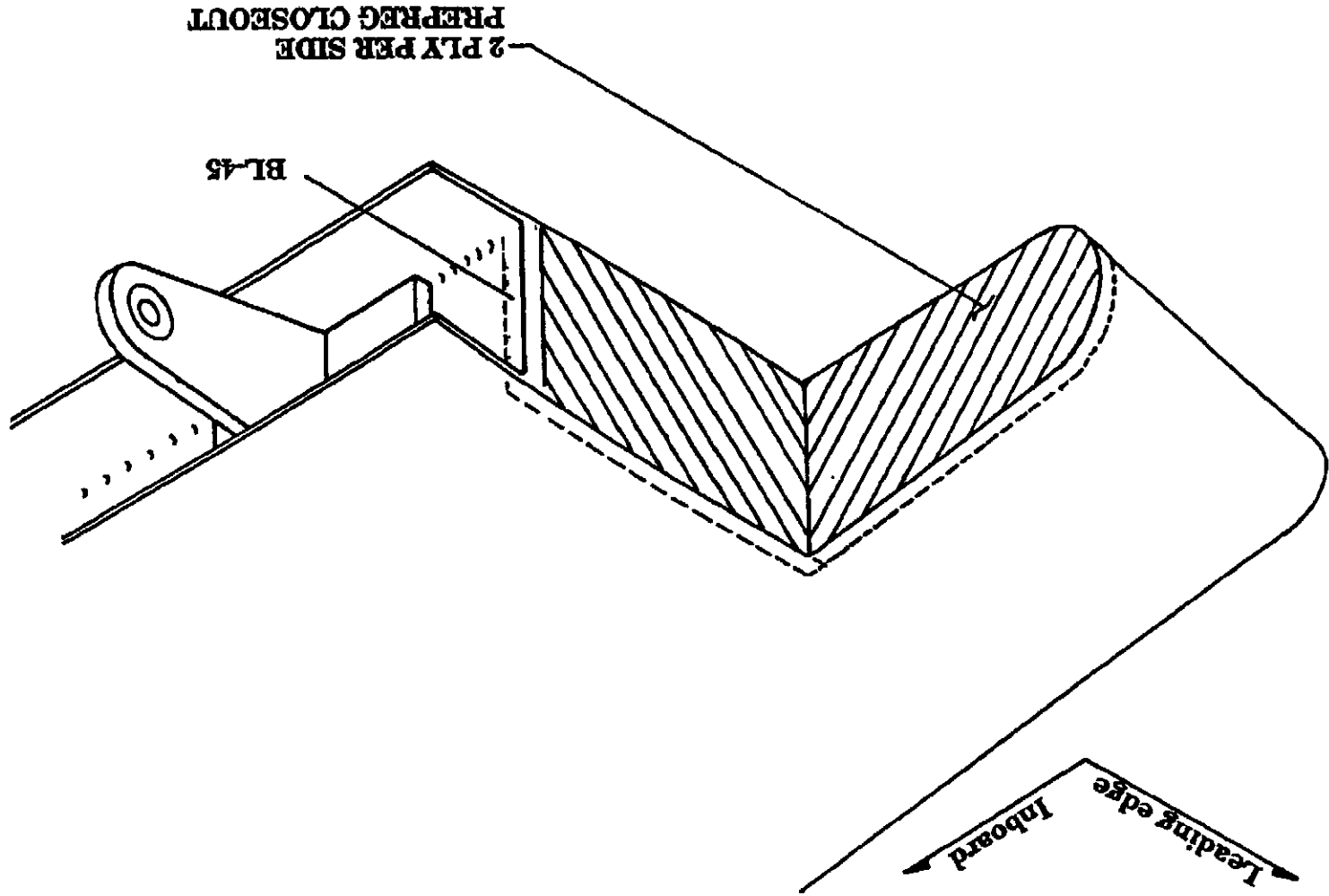
Flushing out face

Fig 7:F:6



Closing of Horizontal Stabilizer

Fig. 7:F:7



F11. Use micro to smooth out the inboard and forward faces of the counterweight arm, again making sure the gap doesn't close up when the elevator is moved. Sand a 3/8" radius along the forward top and bottom edges of the counterweight arm to lessen the drag when the elevator is trimmed out of neutral.

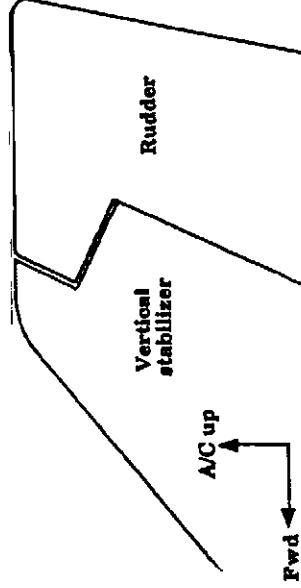
NOTE: If you are concerned about icing around the control surface gaps you can open up the gaps to a 1/4" and round out the counterweight arms more. This will give you a little more time to get out of the icing conditions. As a reminder, this A/C is not approved for flight in known icing conditions.

Opening Up the Control Surface Gaps

Fig. 7:F:8



Open gaps to 1/4" minimum

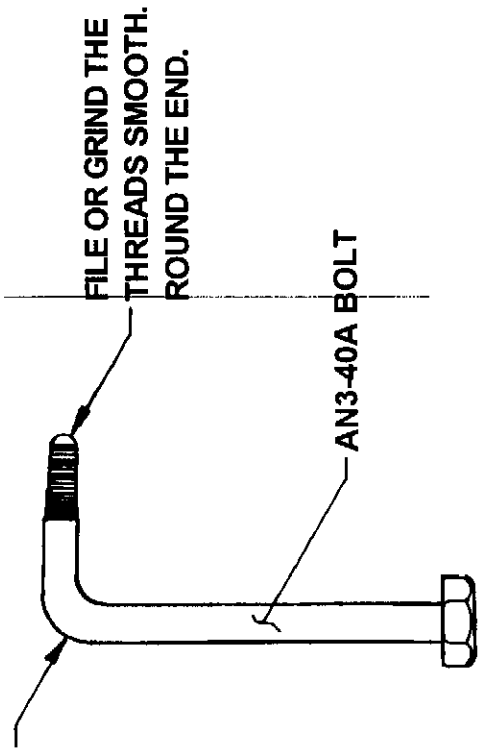


F12. To remove and install the hinge bolts, you will have to notch the bottom leading edge of the elevator. Remove just enough carbon so you can get to the bolts with needle-nose pliers. As you will soon discover, installing the elevator is not all fun and games, especially when it's mounted on the fuselage and you have to hold the elevator while aligning and bolting the hinges, upside down. A wonderful tool to simplify this procedure is made from a long AN3 bolt with the threads cut off. See Fig. 7:F:6. Use the tool to align the elevator hinge half with the horizontal stab hinge half that has the 1/4" bearing pressed into it. Insert the proper AN4 bolt into the other side of the elevator hinge half, wiggle it slightly, and push the alignment tool out with the bolt. Easy!

Hinge Alignment Tool

Fig. 7:F:9.

HEAT THE BOLT
WITH A PROPANE
TORCH TO BEND.



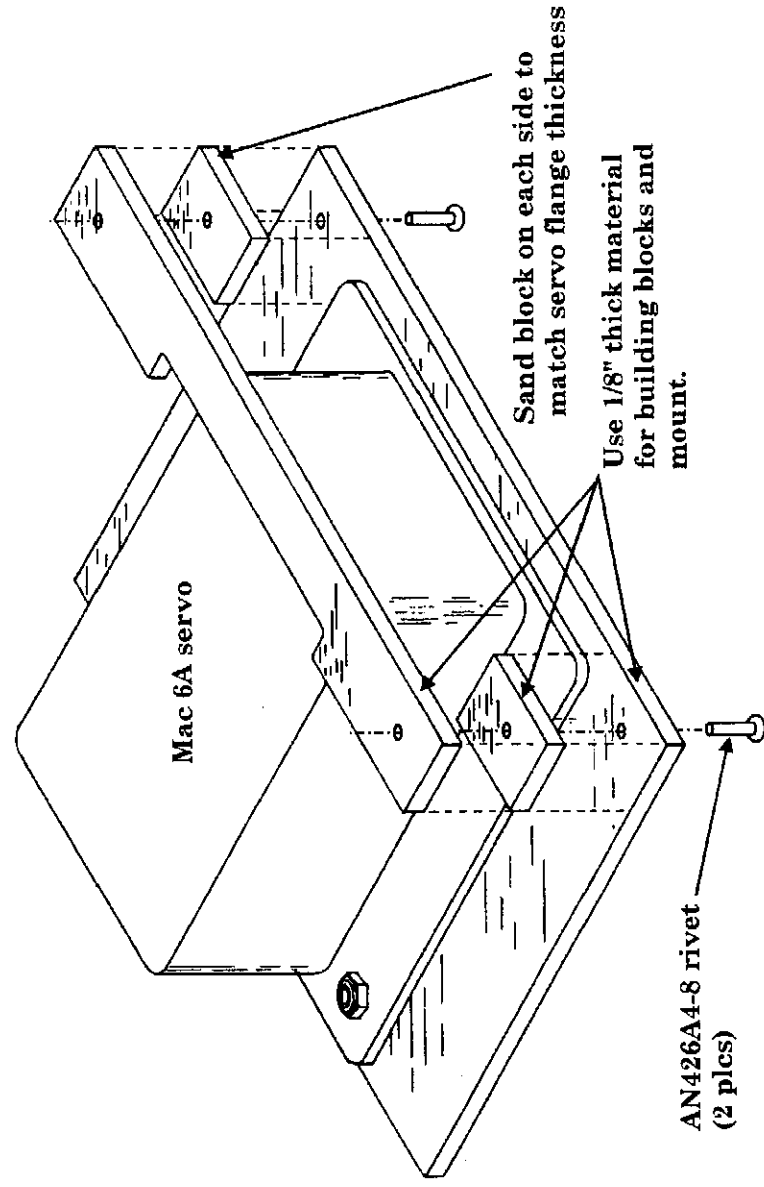
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G. MAC SERVO STANDARD TRIM TAB INSTALLATION

- G1. Cut a 3" X 3-1/2" piece of 1/8" thick phenolic to be used as a servo mount.
- G2. Center the servo on the phenolic. Use the servo as a guide to drill two #29 mounting holes in the phenolic for the two rear screws.
- G3. Countersink the holes on the underside of the phenolic to accept MS24693-S28 screws. Trim the screw heads flat on one side so that when they are potted into the phenolic they won't turn.

Trimming Screw Heads

Fig. 7:G:1



- G4. Using epoxy/flox or Hysol, pot the screws into the phenolic. Use the trim servo to align the screws (now referred to as studs) while the epoxy/flox cures. Wipe off excess epoxy/flox before setting the servo into position to avoid bonding the servo permanently and let cure. Make the blocks and the flange out of 1/8" phenolic. Sand both the phenolic parts and servo mount. Release tape the servo and bond the blocks in place with Hysol. Drill an 1/8" hole through each block set and install AN426A4-8 rivets. Be sure to insert the rivet up through the bottom of the servo mount.

- ✓
- G5. Sand the flat face of the phenolic and the top skin bonding area with 40 grit and clean with MC.
- G6. Using Hysol, bond the phenolic servo mount to the inside of the top elevator skin. Position the mount so that the servo is aligned with the inspection panel and the trim tab hinge line and is as far forward as possible.
- G7. Drill holes in the bottom elevator skin as guides and saw out the trim tab from the elevator. A hand held hack saw blade works well for cutting through top and bottom skin at one time. Notice that your hingeline cut in the top elevator skin should be parallel to the hinge line of the elevator.

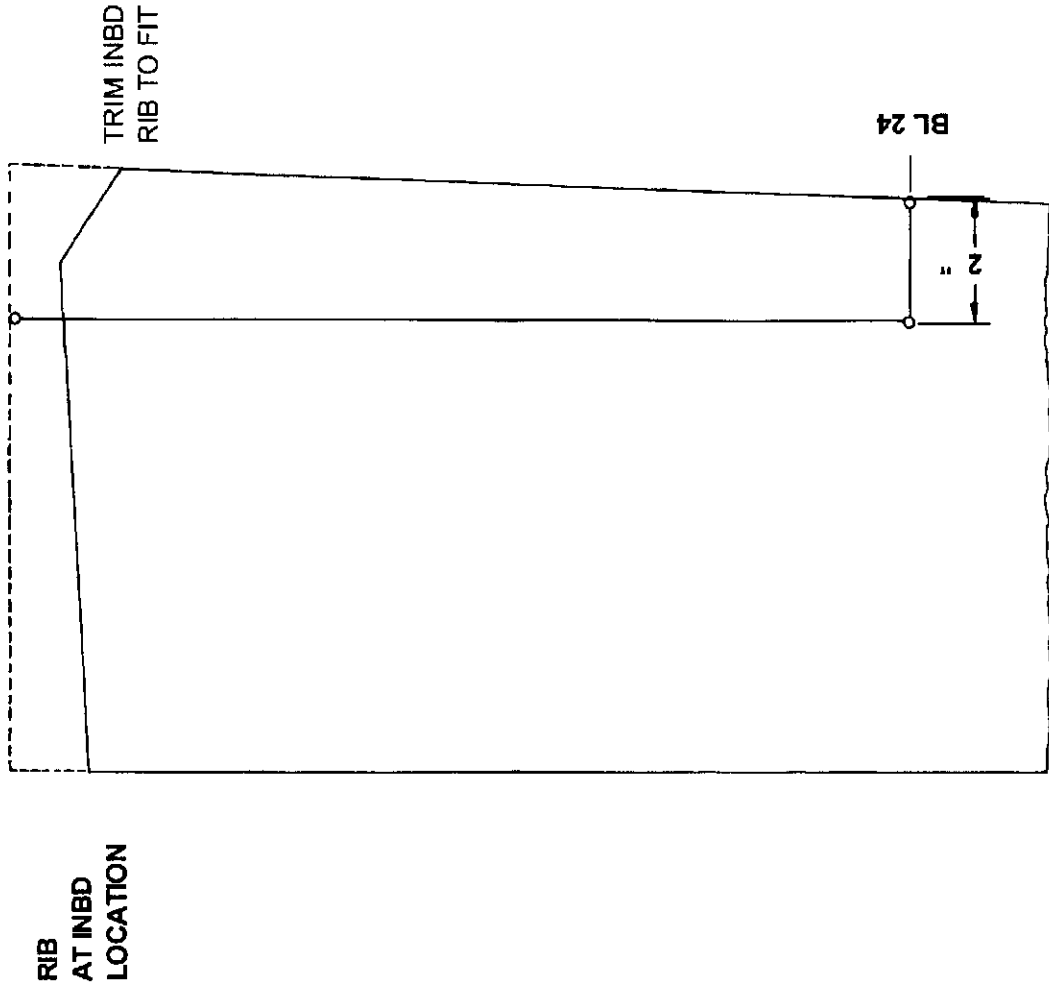
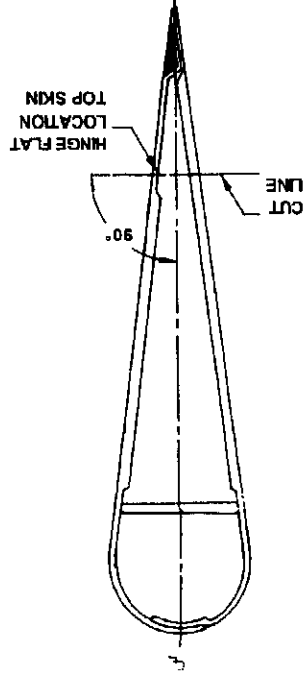
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Horizontal Stab and Elevator

Cutting Out Trim Tab

Fig. 7:G:2.

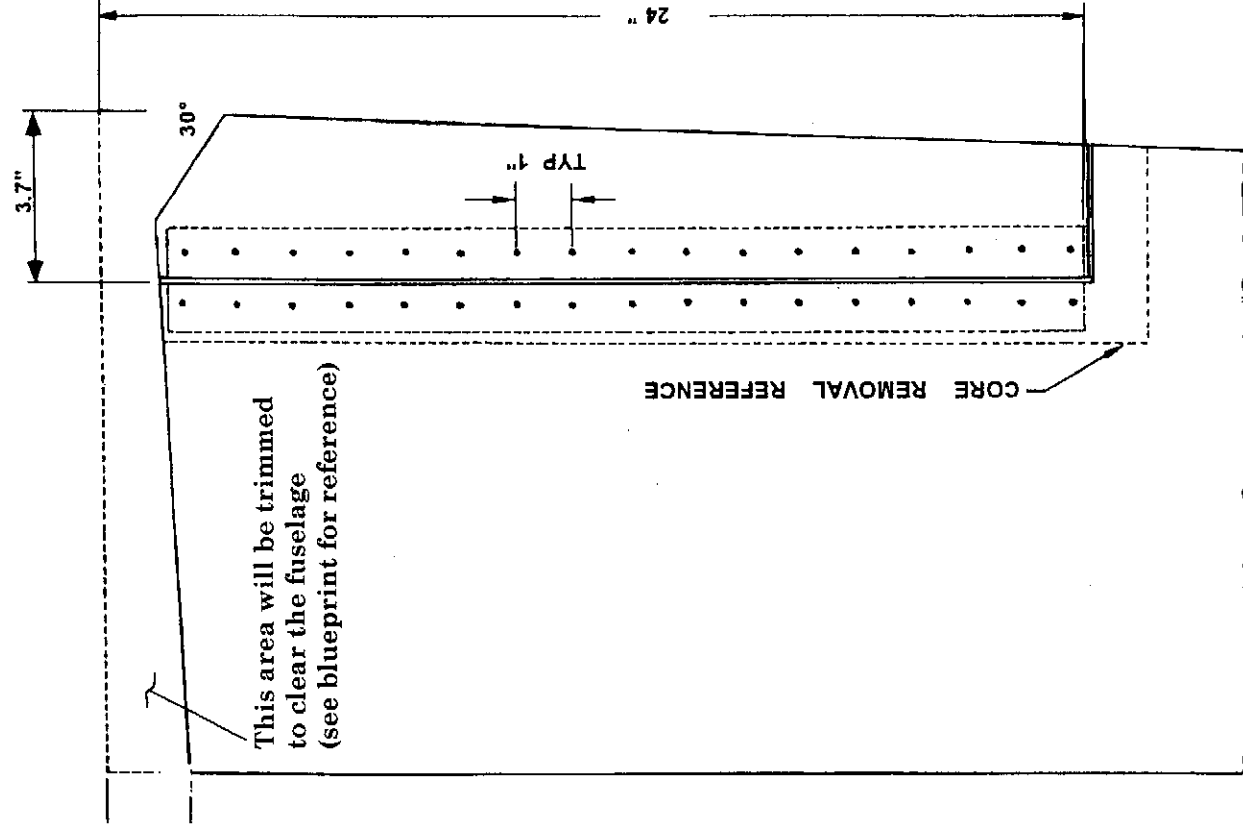


G8. Cut a 20" piece of MS2001-5 hinge.

G9. Sand the edges you have just cut straight. Fit the hinge to the trim tab and the elevator so the T.E. of the tab is in line with the T.E. of the elevator. You will have to sand the L.E. of the trim tab and the elevator (only in the trim tab area!) to allow the tab to achieve full "up" travel. Don't get confused here, "up" trim tab movement will force the elevator down, thus trimming the aircraft nose down (see fig. 7-F-8).

Hinging the Trim Tab

Figure 7-G:3.



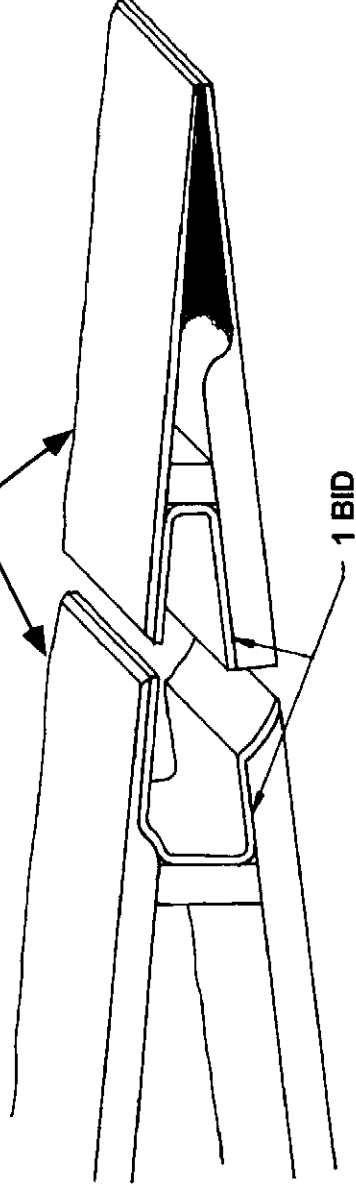
G10. You can test your hinge placement by temporarily bonding the hinge in place with instant glue. You can then swing the tab up, not down just yet, and see how much top skin you should bevel or remove. The BL 3.2 elevator rib must be trimmed away from the hinge area. Cut this rib back just far enough so the hinge can be mounted on a flat area.

G11. By now you have noticed that the forward edges of the trim tab tend to bow in. The rear edges of the elevator in the tab area will tend to do the same thing. This is because the skins are unsupported. Cut thin spars out of 1/4" thick, 2 PPS prepreg for the trim tab and the elevator to support the skins in these areas. Secure the spars in position with flox/micro and wrap 1 BID around the spar and onto the hinge areas and skins as shown in Figure 7:G:4.a. This BID is not shown in later figures for clarity purposes (see Fig 7:G:4.b).

Adding 1 BID

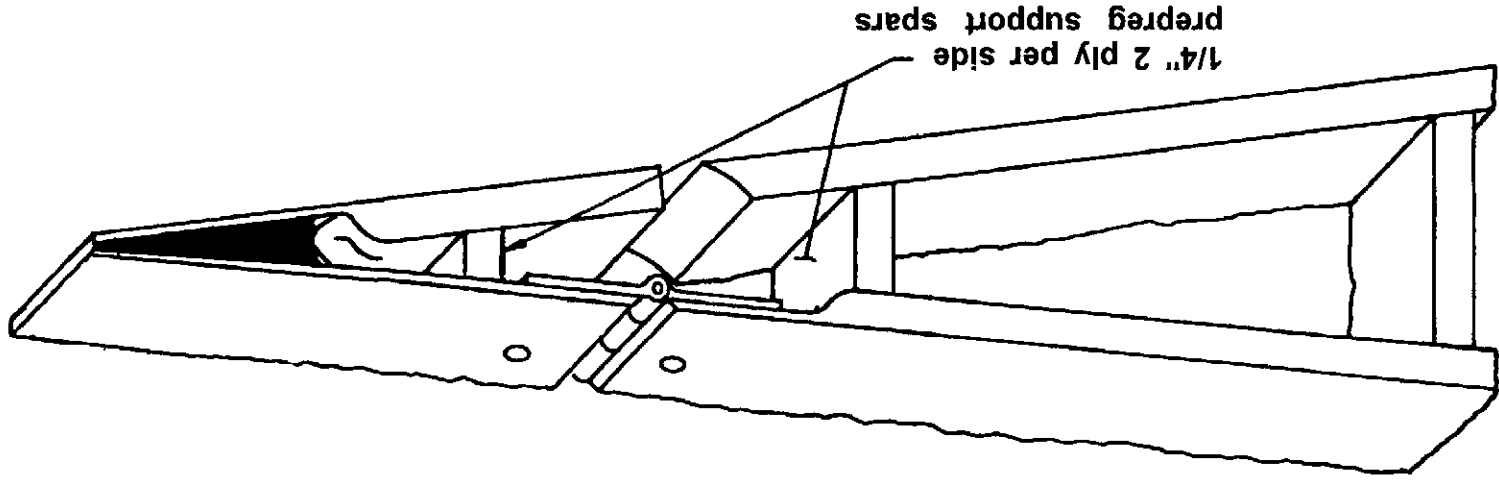
Fig. 7:G:4.a.

**Position the spars so you will have
enough flat area for your hinge**



Support Spars

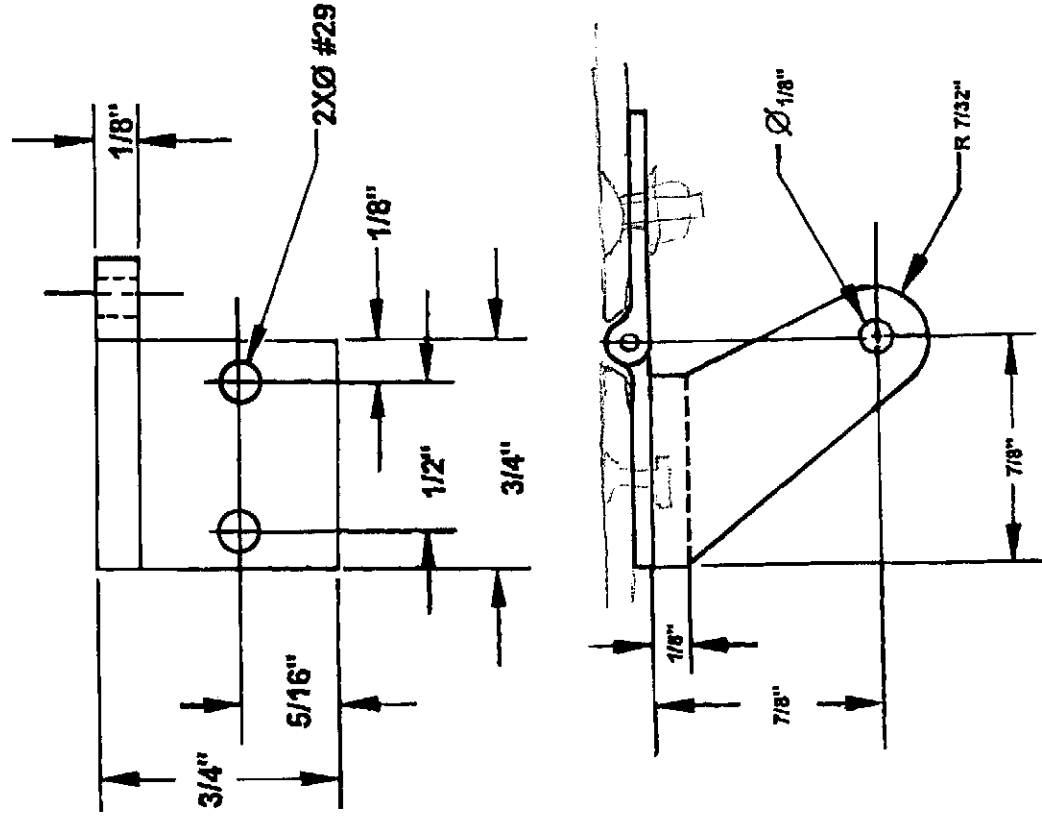
Fig. 7:G:4:b.



- G12. When satisfied with the hinge location, drill #40 holes spaced 1" apart and countersink for AN426A3-5 rivets on the trim tab. Drill six #20 holes and countersink for #8 screws on the elevator side. Mount nutplates on the hinge and mount the tab on the elevator. Secure the hinge halves to the trim tab with the rivets. Don't drill any holes in the hinge arm area yet (pre-align servo and hinge arm location).
- G13. Trim enough of the bottom trim tab skin and the elevator skin so the tab can be moved to the full down position.
- G14. Align the hinge arm with the servo actuator arm. Locate the hinge arm on the trim tab hinge as shown in Fig. 7:G:5.b. notice that you must slot the edge on the bottom skin for the hinge arm clearance.

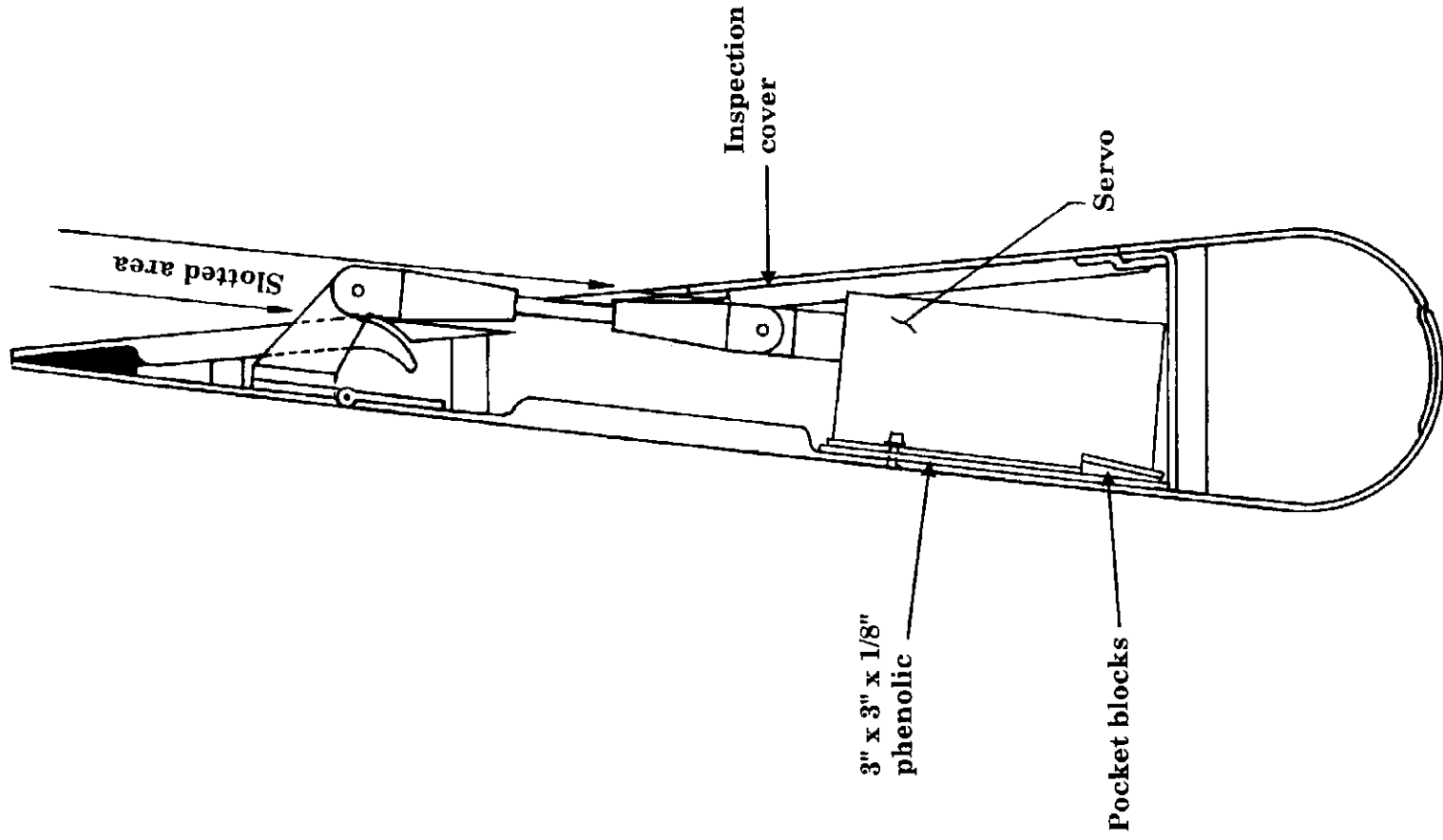
Trim Tab Hinge Arm

Figure 7:G:5.a.



Trim Tab Hinge Arm

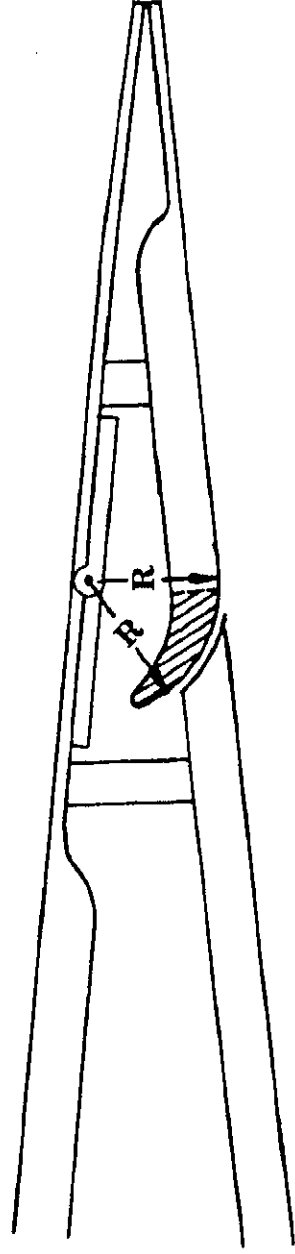
Fig 7:G:5:b.



- ✓
- G15. Mount the hinge arm to the trim tab hinge using MS24693-S26 screws. Use M21042-06 lock nuts.
- G16. Slot the bottom elevator skin for the trim tab actuator rod. Using a Dremel tool, slowly expand the slot so the rod and clevis will clear at both extremes of travel. Don't worry about notching the skin support spar, that is OK.
- G17. You can test the servo and check for proper tab deflection by using a nine volt battery to run the servo. To reverse the direction of servo travel, simply reverse the white power leads on the battery. The servo will shut itself off at extremes of travel. The tab should extend approximately 25°-30° up and down.
- Note: If an anti-servo tab is to be used, additional travel ranges will be required, up to approximately 45° in both directions.
- G18. Drill a small hole through the elevator spar to route the wires for the servo. Keep the servo wires close to the center of the hinge to avoid excessive bending and wear on the wires.
- G19. Now you have to bond in and form a foam block to fill the ugly gap on the underside of the trim tab.
- G20. Using micro, bond a 1/2" x 20" x 1-1/4" piece of Clark foam to the L.E. surface of the bottom trim tab skin leaving a gap for the hinge arm.
- G21. Shape the foam so when the tab is moved to its extreme travel, the gap stays constant. This will be a contour lined that scribes a radius off the hinge pin axis (see fig. 7:G:6:a and b).

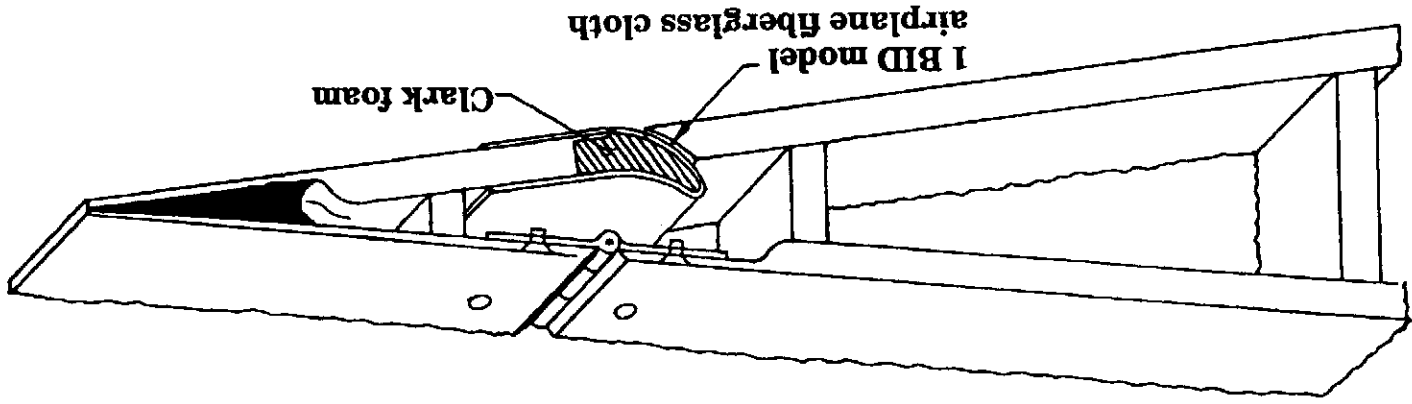
Shape of the Foam

Fig. 7:G:6:a



Trim Tab L.E. Shape

Fig. 7:G:6:b



- ✓
- G22. When satisfied with the trim tab elevator gap, apply 1 BID to the curved surface, overlapping the bottom tab skin by 1/2". Light model airplane fiberglass cloth works well for this application.
- G23. Sand the excess Clark foam from the inside of the tab. Lay 1 BID onto the inside surface of the bottom tab skin, wrapping it around the foam L.E. and onto the outside surface previously glassed.
- G24. Finish the trim tab by smoothing the curved foam area with micro. If you wish, you could block off the outboard edge of the trim tab with Clark foam and sand it flush so it won't bind at travel extremes.
- G25. Lay up one bid over the pop rivets on the trim tab and then body work the area for a smooth surface.

H. ELEVATOR TRAVEL STOPS

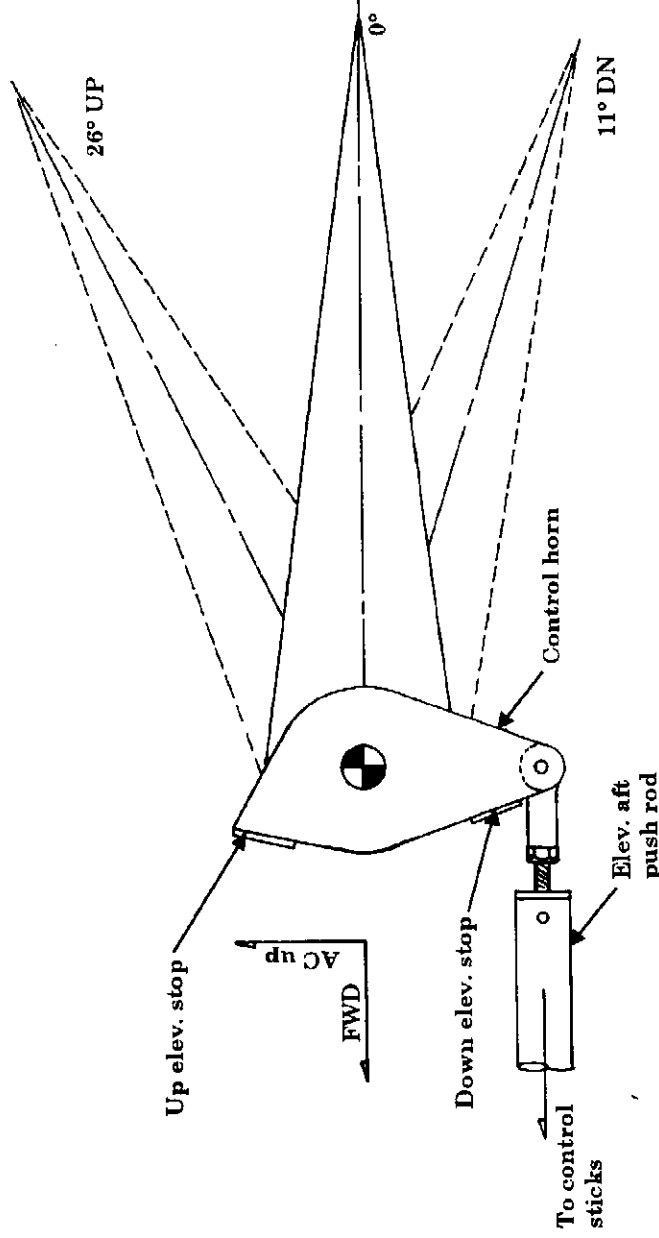
To provide positive stops for the elevator, you must form an E-glass bracket into which a threaded bolt will lock.

1. Raise the elevator to its full up travel limit of 26° . A Smart Level or dial type protractor is handy to check control throws, or you can use the Blueprint pattern gauge. Lock the elevator in this position with a piece of scrap wood and a blob of Bondo or instant glue.

NOTE: You will have to notch the trailing edge of the Horizontal Stab. to attain full elevator travel. Do not notch any more than is necessary to get the proper deflection.

Travel Range

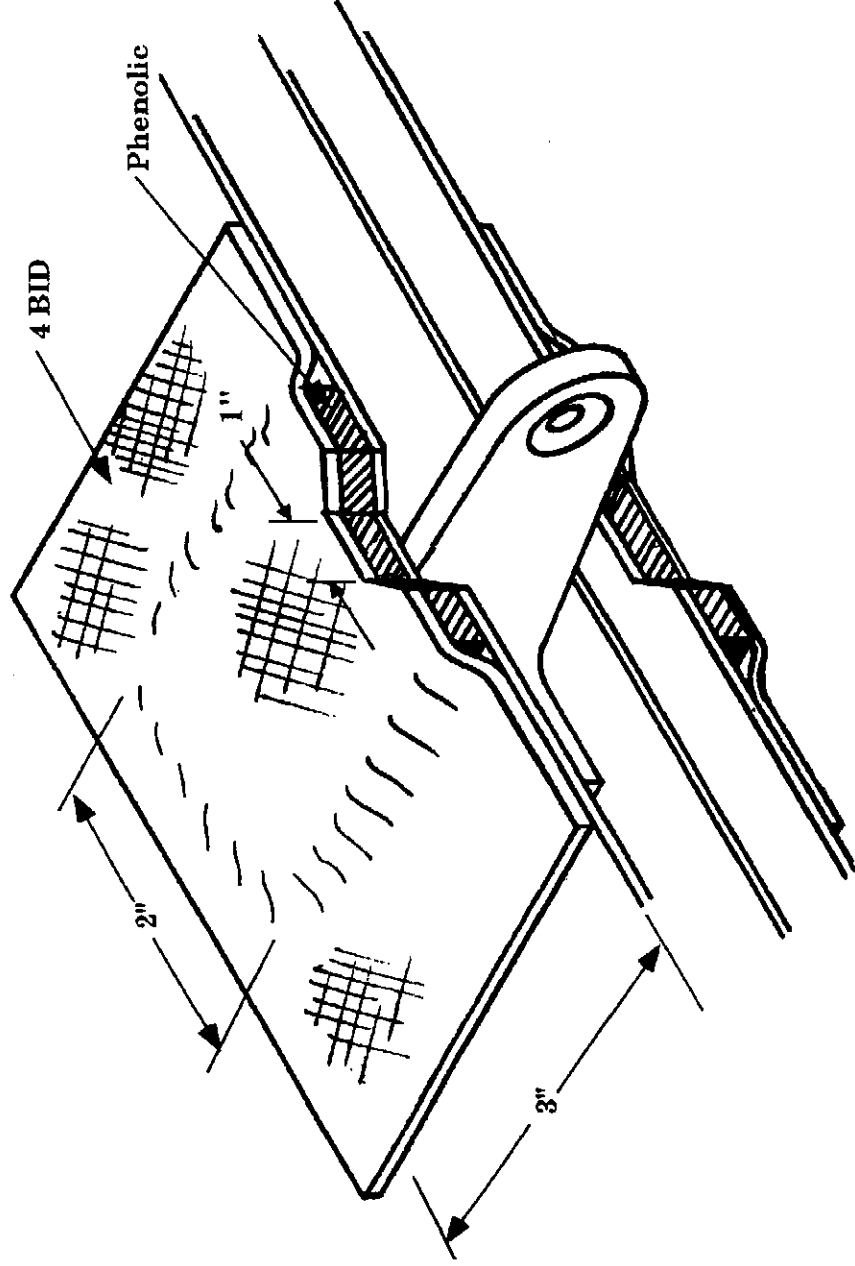
Fig. 7:H:1.



1. Cut a 1/4" x 3" x 2" piece of phenolic. Sand both sides of the phenolic thoroughly with 40 grit sandpaper. Also sand the bonding surface of the H. Stab.
2. Install the phenolic with Hysol™ or epoxy flox. At the same time, form a fillet around all sides of the phenolic for the 4 BID. Clean all bonding surfaces with MC.
3. Install a 4 BID to secure the phenolic.
4. Set the travel by grinding a notch in the phenolic.

Phenolic Travel Stop

Fig. 7:H:2.



I. HORIZONTAL STABILIZER MOUNTING & BULKHEAD, VERTICAL STABILIZER SPAR

NOTE: You may prefer to move on to the wing assembly and come back to this chapter balance. In this manner, with the vertical tail not yet on the fslg, it is easier to position the fslg upside down.

Before mounting the horizontal stab, the fillets will require structurally stiffening. Also, the vertical stab stern post must be installed so that the high density foam block can be glassed into position (It would be inaccessible after the H. Stab. was installed).

- I1. Level the fslg in the upright position. It must be level both spanwise and fwd to aft.
- I2. Note that the fslg sides at the aft end where the V. Stab. spar or stern post installs should measure 2-3/8" to 2-1/2" at the lower portion of the fslg (measured 2" up from the base), see Fig. 7.1:1. It is necessary to establish this dimension early by simply cutting a block of wood and clamping in position to achieve and hold this dimension.
- I3. Prior to mounting the H. Stab., the fillets will require stiffening.
NOTE: Before continuing, check to verify and establish that the fillets are properly aligned so as to position the H. Stab. correctly. Blueprint "G" has the H. Stab. alignment template, however we have found that a simple water level check is actually a better method.

The fillets are very flexible and require trimming in a scalloped manner so as to align with the stabilizer properly.

CORRECT HORIZONTAL STABILIZER INCIDENCE IS (-1/2° TO -1°)
This is perhaps most easily achieved by using water level differences between L.E. chord line and T.E. chord line.

- I3.1 Locate the L.E. chord line as closely as possible at the most inboard location possible (i.e., against fuselage side). This will produce a chord length of 16.4" at approximately BL-4 (which is as close to centerline as you can get to measure).
- I3.2. Draw a straight line aft that is parallel to the fslg centerline.
- I3.3 Locate the T.E. chord line as closely as possible. This is a symmetrical airfoil section so simply locate a point that is vertically in the middle of the H. Stab. T.E. chord thickness.
- I3.4 Now you can simply use a water level against the side of the fslg to set the incidence. You won't need the pattern cut out on the blueprint.
- I3.5 The correct incidence range is when the L.E. of the chord line is 5/32" to 5/16" below the T.E. chord line as measured at a baseline point where the fslg fillets end.

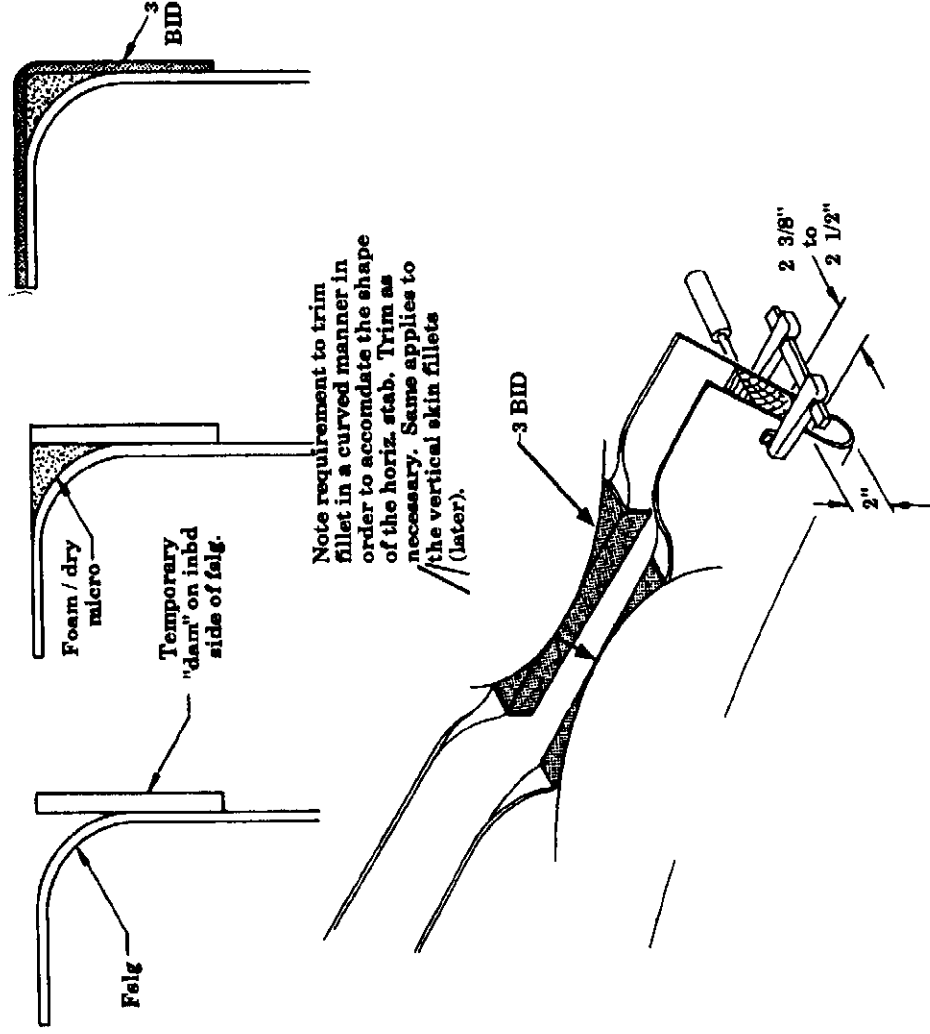
Simply establish this relationship and the incidence will also be established.
NOTE: On early MKII kits, the fillets will require trimming in a scalloped shape to accommodate the additional curvature of the H. Stab. Any other adjustments can be made up with the pad shape itself.

Use weights as required to hold the H. Stab. in proper alignment. Don't get too involved with this alignment yet, simply take it far enough to know that the proper alignment is attainable. That's good enough for now.

- I4. Cover the lower side of the H. Stab., over the joggled area, with plastic tape.
- I5. Construct a temporary dam on each side of the fslg using any suitable material (cardboard, etc.) and cover with plastic tape as a release. Contour the top edge of the cardboard to fit against the H. Stab's lower surface so it is fairly snug.

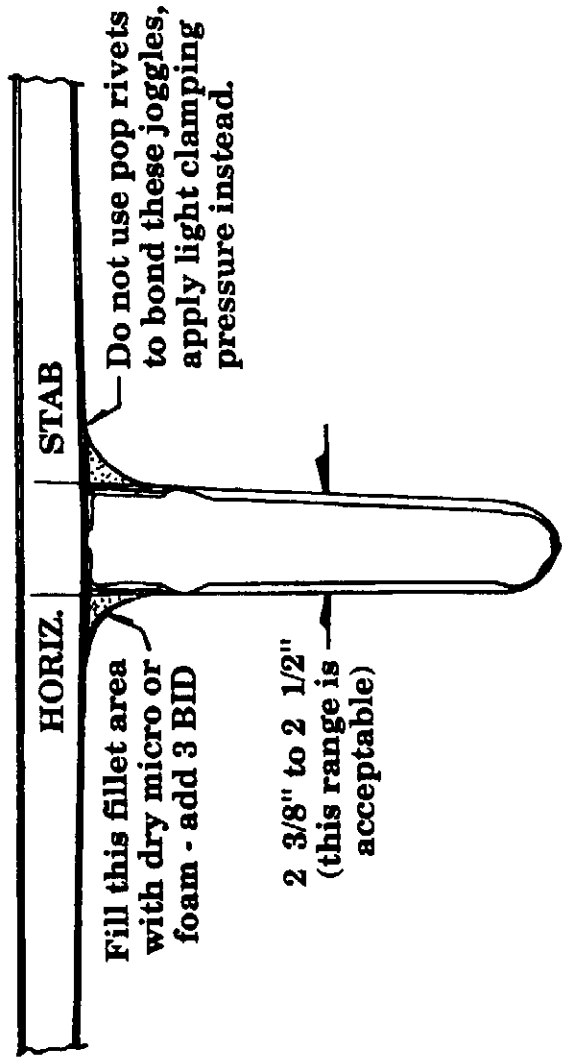
Horizontal Stabilizer Fillet Pads

Fig. 7.I.2.



Horizontal Stabilizer to Fuselage Section

Fig. 7:I:3.



I6. Position the cardboard and fill in the resulting triangular area with dry micro. The cardboard can be taped in place. Now place the H. Stab. on top of this and establish the proper incidence and spanwise level of the stabilizer. Use weights to hold it in place until the micro cures.

In this manner, you will form the micro to the proper contour to later accept the Stab. After cure, recheck the H. Stab. alignment and adjust if necessary by sanding or filing on the micro pads. Note that these pads will receive a 3 BID overlay but that will not alter the alignment.

I7. When the alignment is verified as correct, add the 3 BID (see Fig. 7:I:1). Overlap 1-1/2" onto the fslg interior sides.

J. VERTICAL STABILIZER SPAR

J1. Per Fig. 7:J:1, construct the V. Stab. spar (or stern post). It requires 2 BID per side initially with an inner (fwd side) 2 BID attached plus one additional BID (or 3 BID total) from the base up to 22". The aft side will attach with 3 BID. Note that the stern post is 28° as in Fig. 7:J:1. In the figure the fwd to aft position of the stern post is illustrated. Note that it is relatively tolerant of position.

Adequate clearances must be maintained between elevator, elevator control horn and stern post.

J2. Flox the V. Stab. spar (stern post) into position having checked for square condition. To do this:

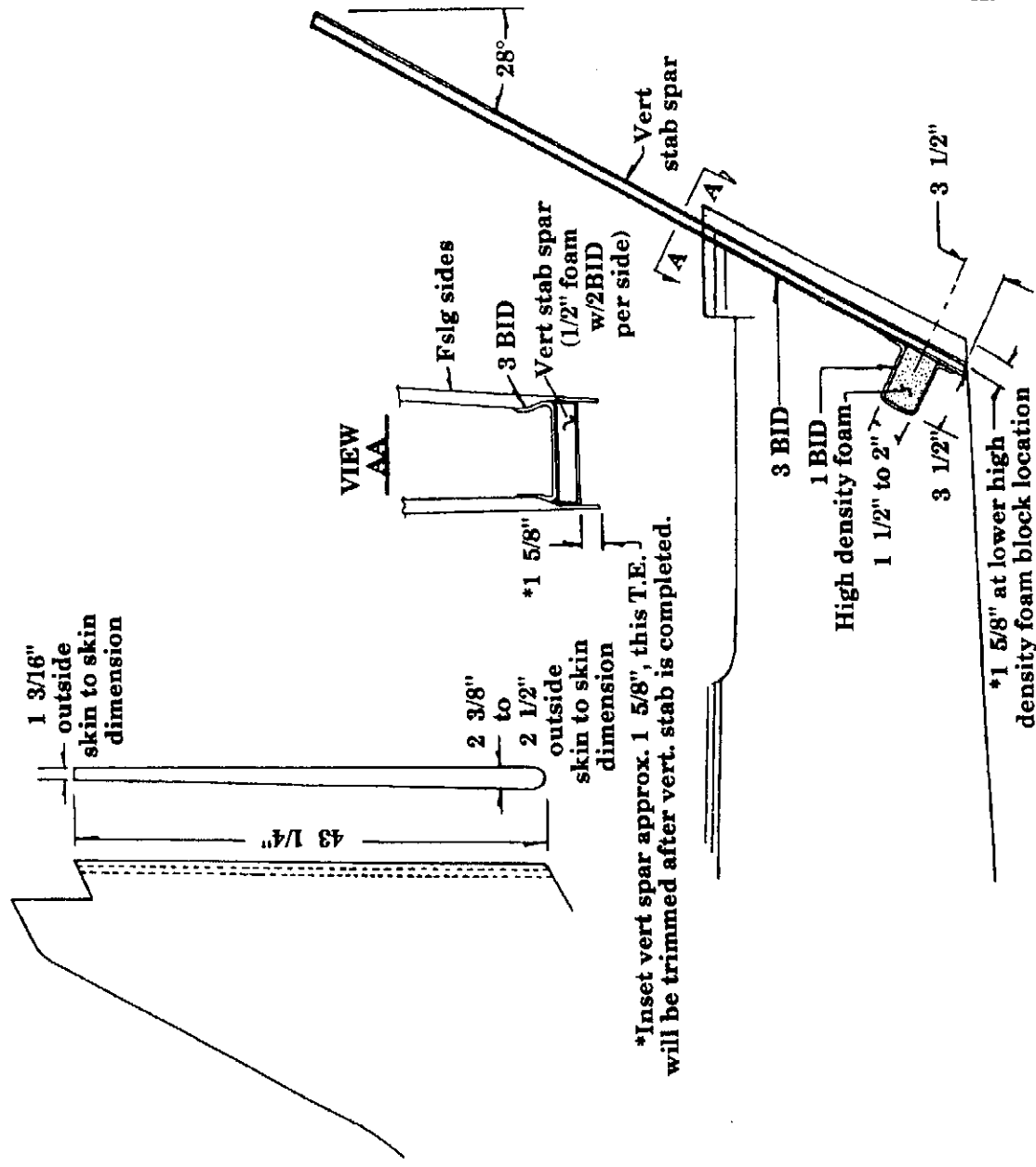
- a. Check again that the fslg is level in both directions.
- b. Drop a plumb bob down to the floor from the center line at the firewall and the center line of the fslg at the lower tail area.
- c. Draw a straight line or snap a chalk line on the floor between the two points and extend that line aft a couple of feet.
- d. From the top center tip of the V. Stab. spar, drop a plumb bob and align it with the line on the floor which is the fslg center line. This will assure that the spar is truly vertical.

Bond and clamp the V. Stab. spar to the vertical sides of the fslg at this time.

NOTE: After you have bonded the V. Stab. spar into position, place two straight edges along the side of the fslg and clamp in position while the flox cures. This will assure that the side areas there will come out straight. Otherwise a slight bow could result and the rudder would not fair in smoothly.

Vertical Stabilizer Spar

Fig. 7-J:1.



- J3. Add 3 BID along the inner junctures of the fslg to the V. Stab. Spar. Do NOT add the outer (aft side) 3 BID yet, they will be added when the whole vertical fin is attached.
- J4. Add the high density foam block which will accept the lower rudder pivot assembly (see Fig. 7-J:1). This block should fit snug against each fslg side skin. Add 1 BID around it which will also roll up onto the fslg sides approx. 1". On the outside of the fslg, mark the location of the high density foam for later reference. Prefit the rudder to help locate the position of the foam blocks.

K HORIZONTAL STABILIZER FORWARD BULKHEAD

This bulkhead should be traced from blueprint "C". It will be positioned at the fwd leading edge of the H. Stab. It will also extend up into the vertical fin sides but don't be concerned with that aspect yet. It is best to leave a little extra "trim stock" above the H. Stab. for now.

K1. This bulkhead will be 1/2" core with 2 BID per side (or 3/8" x 2 BID per side prepreg). The fwd bulkhead will incorporate a 30° aft "lean" and bump up to the fwd edge of the H. Stab.

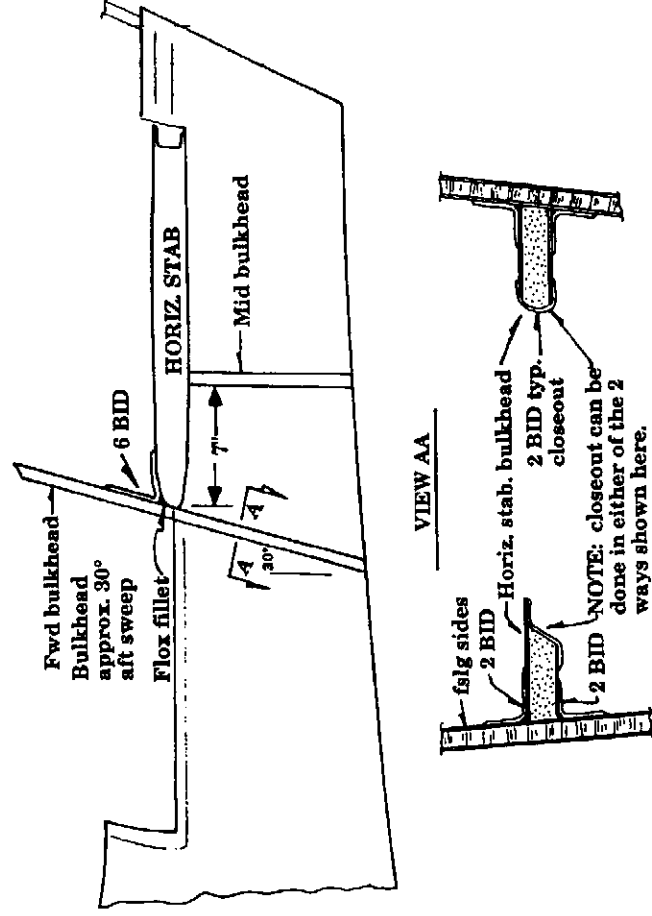
K2. Make the ctr cutout for the elevator pushrod and make a glass to glass seam around the circumference.

NOTE: Before bonding this bulkhead into position, it is advisable to install the rudder cable guide tubing (ref. blueprint "H"). For now, drill through the small fillets on the fslg sides and insert the tubing through to the exterior. It should run snug to the fslg as it exits at the fairings. On the inside, extend the tubing fwd past the bulkhead position on a line that aims toward the baggage bulkhead bottom ctr position. Use hot or instant glue to hold the tubing (3/16" Nylo-flo) against the fslg sides temporarily. Place 1 BID over to bond into permanent position. Now the two upcoming bulkheads can be installed over this rudder guide tubing.

K3. Bond the bulkhead into position with epoxy/flox and add 2 BID (2" wide) around the perimeter on both fwd and aft faces.

Horizontal Stabilizer Bulkheads

Fig. 7:K:1.



L. HORIZONTAL STABILIZER MID BULKHEAD

This bulkhead will position at approximately the 25% of chord position under the H. Stab. It will, in a like manner, be constructed as the fwd bulkhead has been, i.e., 1/2" core plus 2 BID per side or 3/8" core plus 2 prepeg BID per side.

- L1. From Blueprint "C", trace out and construct this bulkhead.
- L2. Make the ctr cutout for the elevator pushrod and make a glass to glass seam along the circumference.
- L3. Locate the position (7" aft of the H. Stab. L.E. position measured at BL-0) and fit into the fslg.
- L4. Bond in position with 2 BID on fwd and aft faces.
- L5. Grind the upper edge down to mate with the lower surface of the H. Stab.
- L6. Drill 1/8" drain hole just behind the aft face through the fslg bottom ctr.
- L7. The fwd face of this bulkhead is an ideal location for a tail tie down. If you're going to add that, now is the time- or at least before you attach the H. Stab. See the wing tie down installation in Chapter 9 for a suitable approach to this tiedown.

P3-40



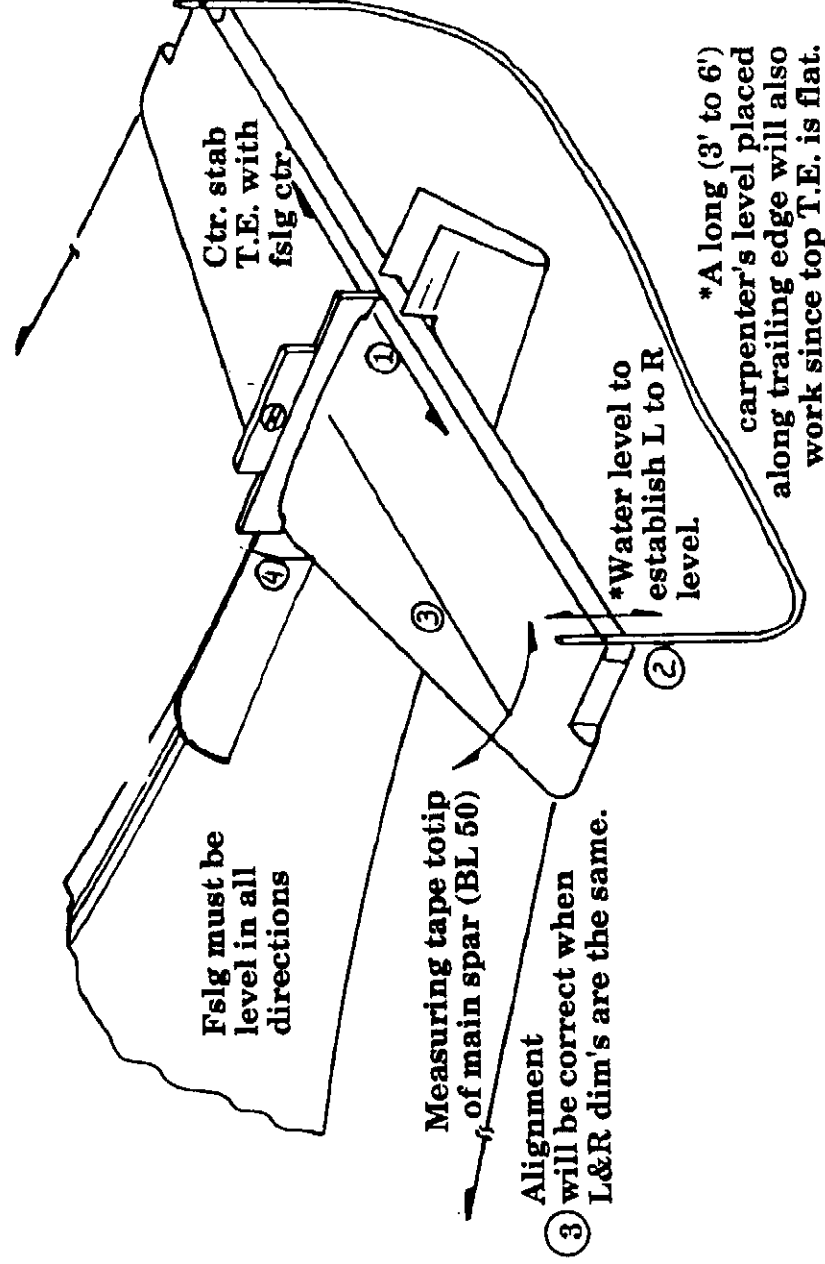
M. HORIZONTAL STABILIZER FINAL BOND TO FUSELAGE

- M1. Position the H. Stab. on the built up fillets and recheck the alignments (see Fig. 7:M:1).
- Check for spanwise centering on fslg ctr line.
 - Check for spanwise level. Use either a long carpenter's level on the upper T.E. or use a water level at respective locations at the tips.
 - Check for proper sweep. Measure from tip to BL-50 main spar tips.
 - Check for proper incidence using the template on blueprint "G". If a correction is required, use floc to shim as necessary.

NOTE: The template will establish an incidence of (-1/2°).

Horizontal Stabilizer Alignment to Fuselage

Fig. 7:M:1.



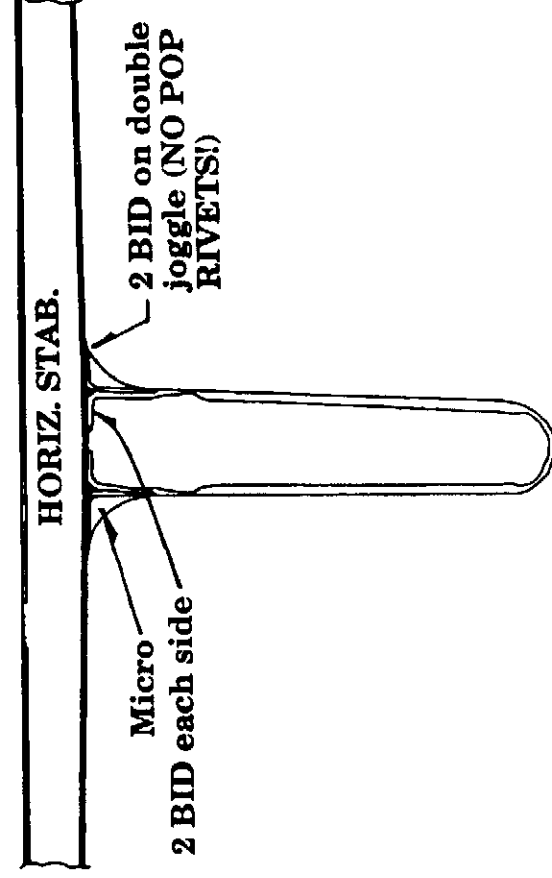
- M2. Bond the H. Stab. down into the fillet pads using structural adhesive with 10-20% floc added. Use weights to apply pressure during cure. You can also attach with one cleco at each aft side and one cleco at each fwd side (Do not use pop rivets at the fwd side).

M3. After cure, add 2 BID to the under side where the joggles are and also on the interior side between the fwd and mid bulkheads. This bulkhead can easily be reached from the fwd side.

M4. Add the 6 BID layup at the L. E. top of the H. Stab. where it meets the fwd bulkhead (see fig. 7:M:2). *Fig 7:K:1*

Horizontal Stabilizer/Forward Bulkhead Joined

Fig. 7:M:2.



Date: Thu, 01 Apr 1999 19:02:25 -0700 From: "C.L.Keller" <clkeller@burgoyne.com> To: lanceair.list@olsusa.com Subject: Horiz. Stabilizer and Elevators 0Subject: 360 Horizontal Stabilizer

A couple of questions relating to the 360 H.S. and elevators:

- (1) The manual doesn't give any good information about trimming the inboard end of the elevators. It seems this should be done before closing the elevators, but Marv's web site pictures make it look like he closed them with the narrow - perhaps a quarter inch - gap between the two surfaces. Marv?
- (2) The manual suggests an outboard rib at the counterweight station (pp 7-33, 7-34), but the SFB elevator includes no such thing. Is this a remnant of the old stabilizer?
- (3) In Marv's photos it appears the trim tab extends only to the BL 21 rib although the manual suggests the tab should extend to BL 24. Is the shorter tab adequate?
- (4) The manual gives the elevator deflection limits as +26, -11 degrees on pp 7-22 and 7-53, but in the next chapter (8-20) it calls for +27, -13 degrees. Is the larger deflection left over from the old stab?

Charles Keller

[Charles, since most of the questions seem to be pointed at me, I'll try to handle them here for you.

Re: trimming the inboard end of the elevators, it was recommended to me by Orin to leave any trimming operations until absolutely required.. This goes for the stab skins as well. The i/b end of the elevators can wait until you hang the rudder to insure that the lines are positioned correctly. The closeout will happen after trimming.

That outboard rib you mentioned has been deleted in the MKII tail.

There was some confusion about the location of the trim tab due to the placement of a rib in the elevator. I contacted the factory and spoke to Doug Weeldryer about it, and he put me on hold and measured the tab on the MKII factory demo plane. The dimension I used was based on that measurement, and Doug assured me that there was plenty of authority at that dimension. Don't forget, you're probably going to want to put a potentiometer or resistor inline with the trim tab switch to give you variable speed operation of the tab... normal tab speed at cruise is reported to be pretty twitchy, that's another part of the reason the tab is a bit smaller.

I believe that the +27/-13 in chapter 8 relates to the small tail. You must remember that there are many parts of the manual which haven't been updated since the MKII tail became standard equipment. I suspect this is one of them. Perhaps one of our builders/fliers out there with the original tail will chime in here and let us know if those are the specs that they used. Given the extra area of the MKII elevators, it makes lots of sense that the deflection requirements are less..

I hope this helps. <Marv>]