

CHAPTER 3

REVISION LIST

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

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

Page(s) affected	Current Rev.#	Action	Description
3-1 & 3-2	0 or 1	None	
3-3	A15	R&R	Added S6A to MAC servo.
3-4	A14	R&R	New figure.
3-4.1 & 4.2	A14	Add	New pages.
3-5 & 3-6	0	None	
3-7	A1	R&R	Corrected Figure 3:2.
3-8	A1	R&R	Corrected Figure 3:A:1.
3-9 thru 3-10	0 or 1	None	
3-11	A2	R&R	Corrected Figure 3:A:3.
3-12	A4	R&R	Corrected Step A7.
3-13	0 or 1	None	
3-14	A7	R&R	Changed Step B2.
3-15 thru 3-17	0 or 1	None	
3-18	A1	R&R	Corrected note after Step B10.
3-19 thru 3-26	0 or 1	None	
3-27	4	R&R	Changed Figure 3:C:2:a.
3-28 thru 3-29	A2	R&R	Corrected Step C8.
			Corrected Figure 3:C:2.
3-30 & 3-32	0 or 1	None	Either Rev. # is correct.
3-33	A9	R&R	Revised Figure 3:D:2.
3-34	0 or 1	None	
3-35	A1	R&R	Added note after Step D15.
3-36	0 or 1	None	
3-37	A14	R&R	Edited Figure 3:E:1.
3-38	0 or 1	None	
3-39	A14	R&R	Added note after title.
3-40	A15	R&R	Removed 1-side capstrip.
3-41	A14	R&R	Added paragraph F13.
3-42	0 or 1	None	
3-43	A10	R&R	Edited Figure 3:G:1.



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Page(s) affected	Current Rev.#	Action	Description
3-44	A10	R&R	Edited paragraph G2.
3-45	A15	R&R	Re-dimensioned; BL-1 is now BL-0.
3-46 & 3-47	0 or 1	None	
3-48	A11	R&R	Edited dimensions in G9.
3-49 thru 3-51	0 or 1	None	
3-52	A1	R&R	Corrected Step G25.
3-53	0 or 1	None	
3-54	A10	R&R	Edited Figure 3:G:6:b.
3-55	0 or 1	None	
3-56	A14	R&R	Re-wrote entire page.
3-57	A14	R&R	Edited Figure 3:H:1.
3-58	A14	R&R	New paragraph number.
3-59	1	None	
3-60	A14	R&R	New paragraph numbers.
3-61	A15	R&R	Redesigned travel stops.
3-62	A15	R&R	Redesigned travel stops.
3-63	A15	R&R	Redesigned travel stops.
3-64	A15	R	Redesigned travel stops.
3-65	A15	R	Redesigned travel stops.
3-66	A15	R	Redesigned travel stops.
3-67	A15	R	Redesigned travel stops.



CHAPTER 3

ELEVATOR ASSEMBLY

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 When such revisions are made, you should immediately replace all outdated pages with the revised pages.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 out dated 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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 - D. ELEVATOR CAPSTRIPS
 - E. TRIM MOTOR INSPECTION PANEL
 - F. CLOSING THE ELEVATORS
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 - I. ELEVATOR TRAVEL STOPS
4. PHOTO PAGES



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Elevators

1. INTRODUCTION

The elevator is assembled in a manner very similar to that used with the horizontal stabilizer. In addition, the elevator must be properly mated to the stabilizer, a trim tab must be built into the elevator and the elevator must be 100% mass balanced using lead in the mass balance areas fwd of the hinge line at each elevator tip. The elevator will have one spar web and four ribs per side.

You already have the cradle built for the elevator assembly, it is simply the rear of the H. Stab. cradle.



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Elevators

2. SPECIAL PARTS, TOOLS & SUPPLIES LIST

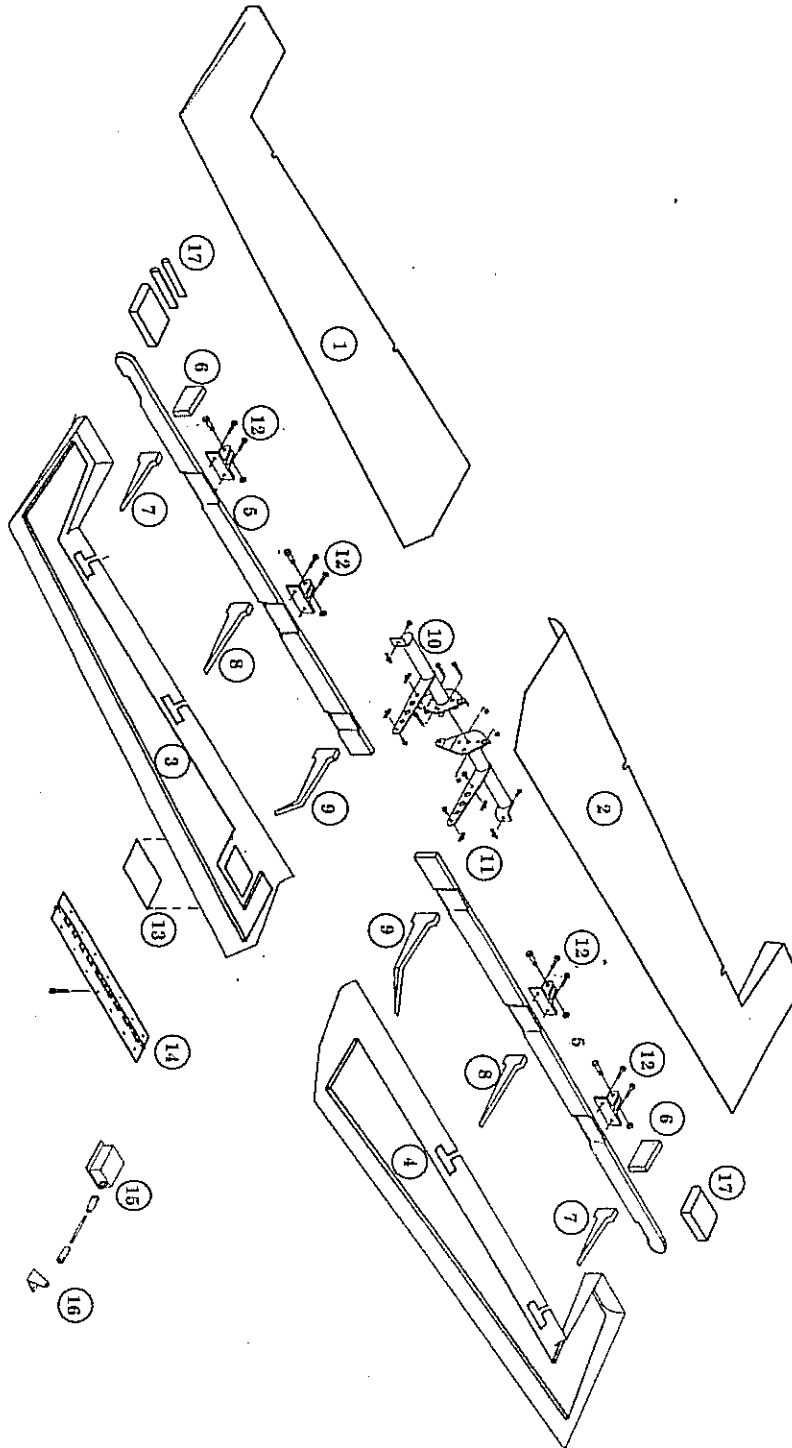
A. PARTS LIST

Item #	Qty	Description
1	1	Elevator skin, upper (no L.E. joggle)
2	1	Elevator skin, lower (with L.E. joggle)
3	4	Elevator hinge bracket
4	1	Elevator control horn weldment, left side
5	1	Elevator control horn weldment, right side
6	68	AN426A3-5 rivet
7	10	K1000-3 nutplate
8	a/r	1/4" 3 ply per side fiberglass prepreg sheet
9	a/r	MS2001-5 hinge material
10	1	1/2" x 18" x 2" Clark foam
11	4	MK1000-06 nut plate
12	1	1/8" x 3" x 3" phenolic plate
13	6	MS24693S26 screws
14	1	Hinge arm, TT-01
15	a/r	Prepreg bulkhead materials (2 BID - 1/4" E-glass sheet)
16	8	AN3-5A bolt
17	4	AN4-10A bolt
18	4	AN365-428A locknut
19	4	AN960-416 washer
20	4	MS24693-S28 servo mounting stud
21	3	AN3-7A bolts for center hinge weldment
22	3	AN365-1032A locknut
23	3	AN960-10 washer
24	6	MS21042-06 lock nut
25	4	AN4-5A bolt
26	4	K1000-4 nut plate
27	a/r	Lead weights (for balancing elevators)
28	1	MAC servo S6A
	2	3/16" bolt, 1 1/2" long, coarse thread (for up/down stops)
	4	3/16" nut, coarse thread (for up/down stops - not shown)
	a/r	6 ply E-glass sheet



Elevator Assembly

Figure 3:1



Assembly No.	Ship	Assembly Description	Part No.
1	1	Left top elevator skin	
2	1	Right top elevator skin	
3	1	Left bottom elevator skin	
4	1	Right bottom elevator skin	
5	2	Elevator spar	
6	2	Nose rib	
7	2	Rib, outboard	
8	2	Rib, BL 34	
9	2	Rib, inboard	
10	1	Weldment assembly, center, left	
		Weldment, center, left	
		Bolt (3)	AN3-7A
		Bolt (2)	AN4-5A
		Bolt (1)	AN3-5A
		Rivet (6)	AN426A3-5
		Nutplate (1)	K1000-3
		Nutplate (2)	K1000-4
11	1	Weldment assembly, center, right	
		Weldment, center, right	
		Bolt (2)	AN4-5A
		Bolt (1)	AN3-5A
		Washer (3)	AN960-10
		Locknut (3)	AN365-1032A
		Rivet (6)	AN426A3-5
		Nutplate (1)	K1000-3
		Nutplate (2)	K1000-4
12	4	Hinge assembly, elevator	
		Hinge, elevator	
		Bolt	AN4-10A
		Bolt (2)	AN3-5A
		Locknut	AN365-428A
		Washer	AN960-416
		Nutplate (2)	K1000-3
		Rivet (4)	AN426A3-5



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Horizontal Stabilizer

Assembly No.	Ship	Assembly Description	Part No.
13	2	Inspection panel, 4 x 4	
		Screw (4)	MS24693-S26
		Nutplate (4)	MK1000-06
		Rivet (8)	AN426A3-5
14	1	Hinge, trim tab	
		Rivet (34)	AN426A3-5
15	1	Servo	
		Phenolic plate	3" x 3" x 1/8"
		Screw (4)	MS24693-S28
		Push Rod (servo)	
16	1	Actuator arm screw (2)	MS24693-S26
		Locknut (2)	MS21042-06
17	2	Counterweight	Lead
		Brick (2)	WTLD-EL
		Half-round (2)	WTLD-HR



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Horizontal Stabilizer

B. TOOLS

Weight bags
Band or jig saw
Tape measure
Dremel™ tool, with
 ball grinding head and
 #426 fiberglass reinforced cut-off wheels
Straight edge, 1' or longer
Drill motor with bits;
 #40 drill bit
 #50 drill bit
 1/8" drill bit
 3/16" drill bit
Multi purpose hack saw blade



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C. **SUPPLIES**

Instant glue
Duct tape
Release tape
Sandpaper, #40 grit
MC (methylene chloride cleaner)
Microballoons
Epoxy
BID tape
light model airplane type fiberglass cloth
Safety wire



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Chapter 3

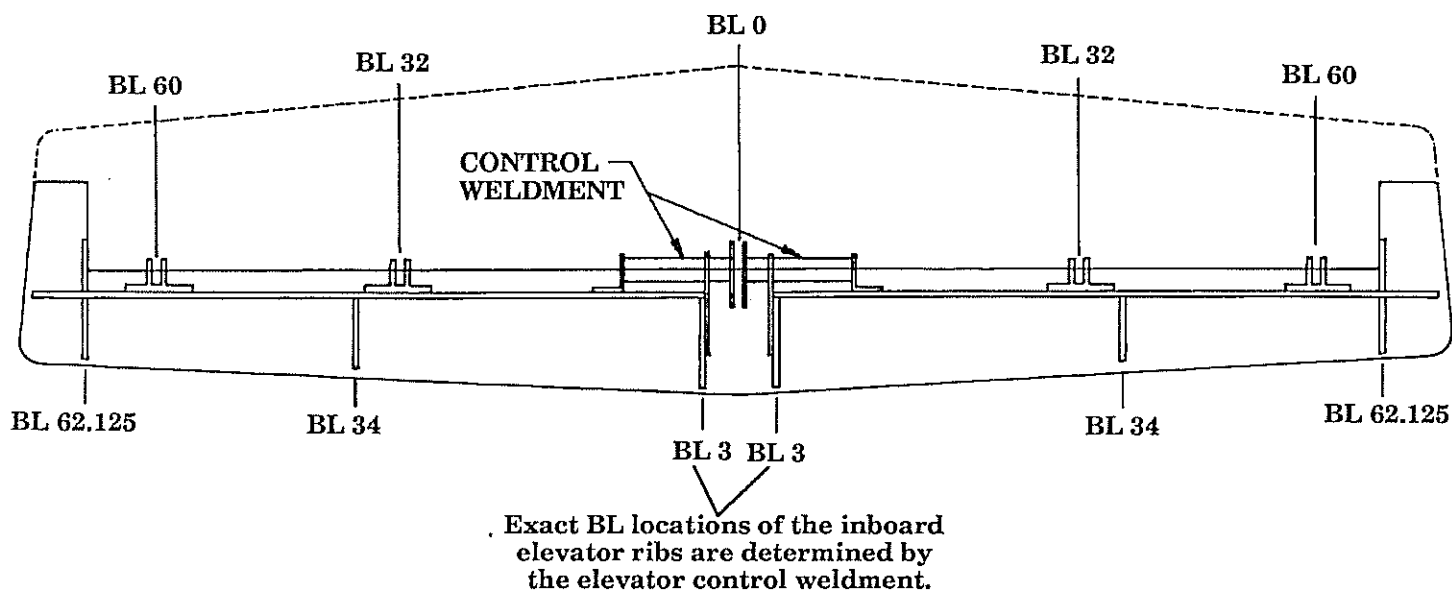
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Elevators



Elevator assembly plan view
Figure 3:2



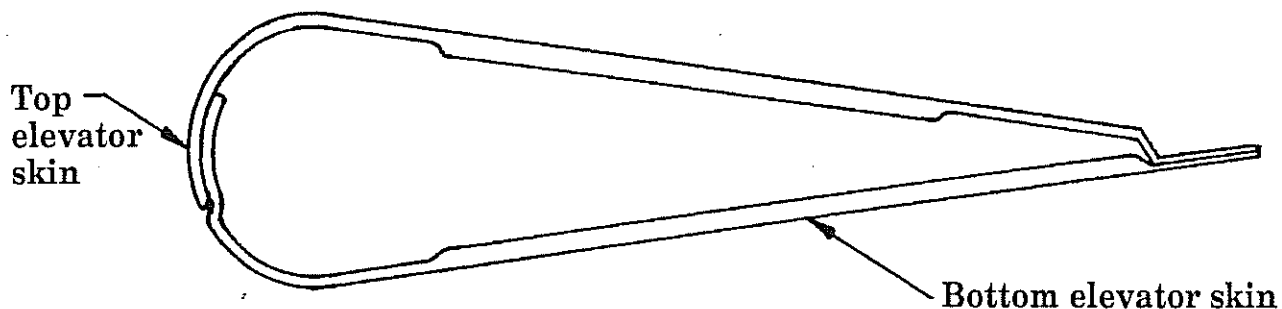
3. CONSTRUCTION PROCEDURE

A. TRIMMING BOTTOM ELEVATOR SKINS

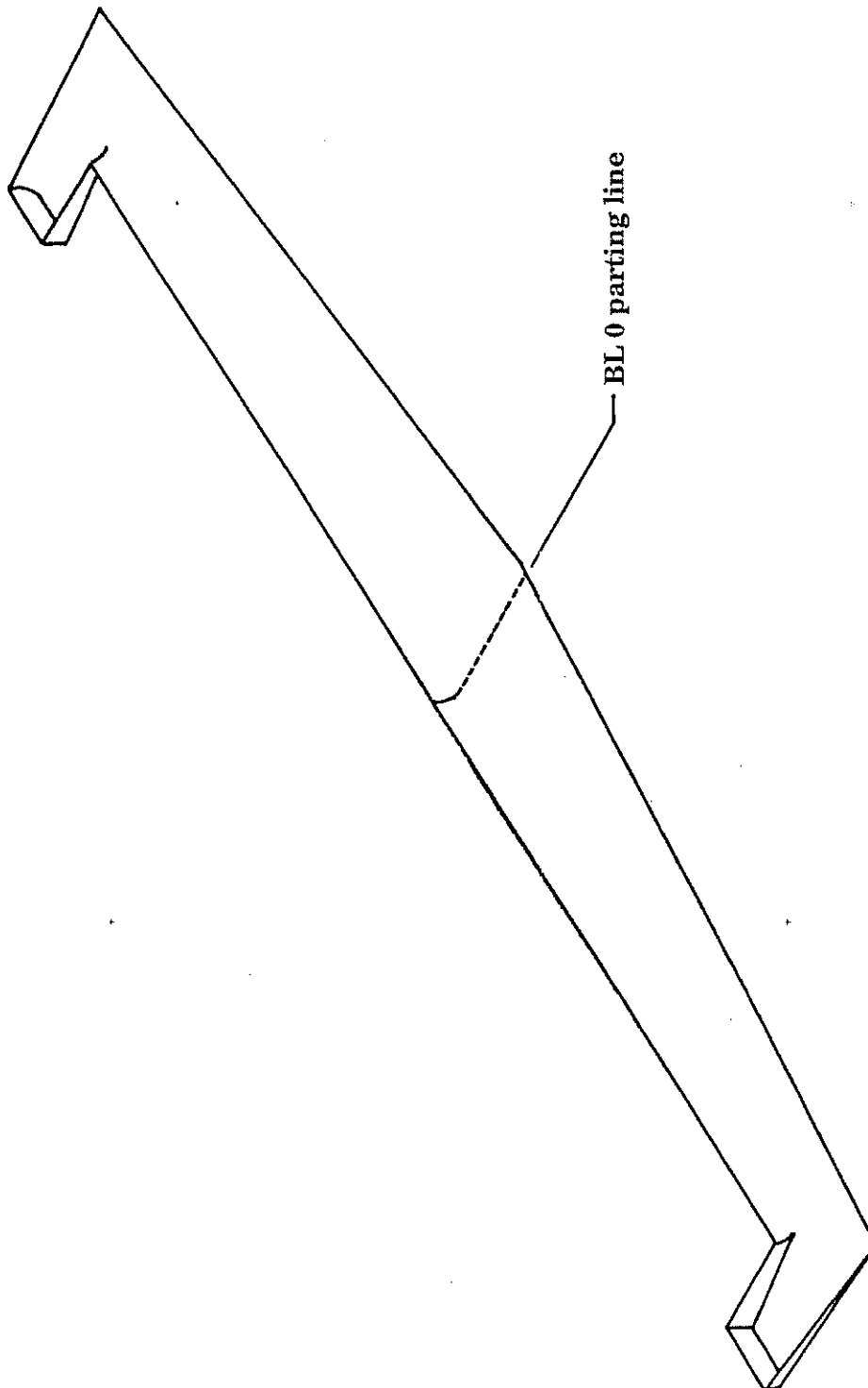
- A1. Make sure the horizontal stabilizer is properly positioned and weighted down in it's jig.
- A2. Install the hinge halves that bolt into the H. Stab.
- A3. Cut your top and bottom elevator skins in half at BL 0 as shown in Figure 3:A:2. You don't have to be too accurate with this cut since the center 5" (2-1/2" per side) will be trimmed away later. If you try to build the elevator in one piece and separate it later, the elevator skin radii around the hinge points will be wrong.
- A4. Spanwise, locate the bottom elevator skin, the one with the joggle in the L.E. and a flat T.E., so the inboard face of the counterweight arm is at BL 62. Trim the H. Stab. to clear the counterweight arm. The outboard edge of the counterweight arm should be flush with the edge of the H. Stab.
- A5. Notch the bottom elevator skins to clear the elevator hinges at BL 32 and BL 60. Simply cut a 3/8" slot at these locations, just deep enough so you can slide the elevator into position. See Figure 3:A:1.

Elevator skins (typical cross section)

Figure 3:A:1



Cutting elevator skins
Figure 3:A:2



- A6. Use the dimensions in Figure 3:A:3 to position your bottom elevator halves. These dimensions are not written in stone and may be altered $\pm 1/8"$. There should be about a 0.050" gap between the trailing edge of the horizontal stab and the leading edge radius of the bottom elevator skin. Notice that the trailing edges will tend to overlap at BL 0. This will be corrected in the next step.



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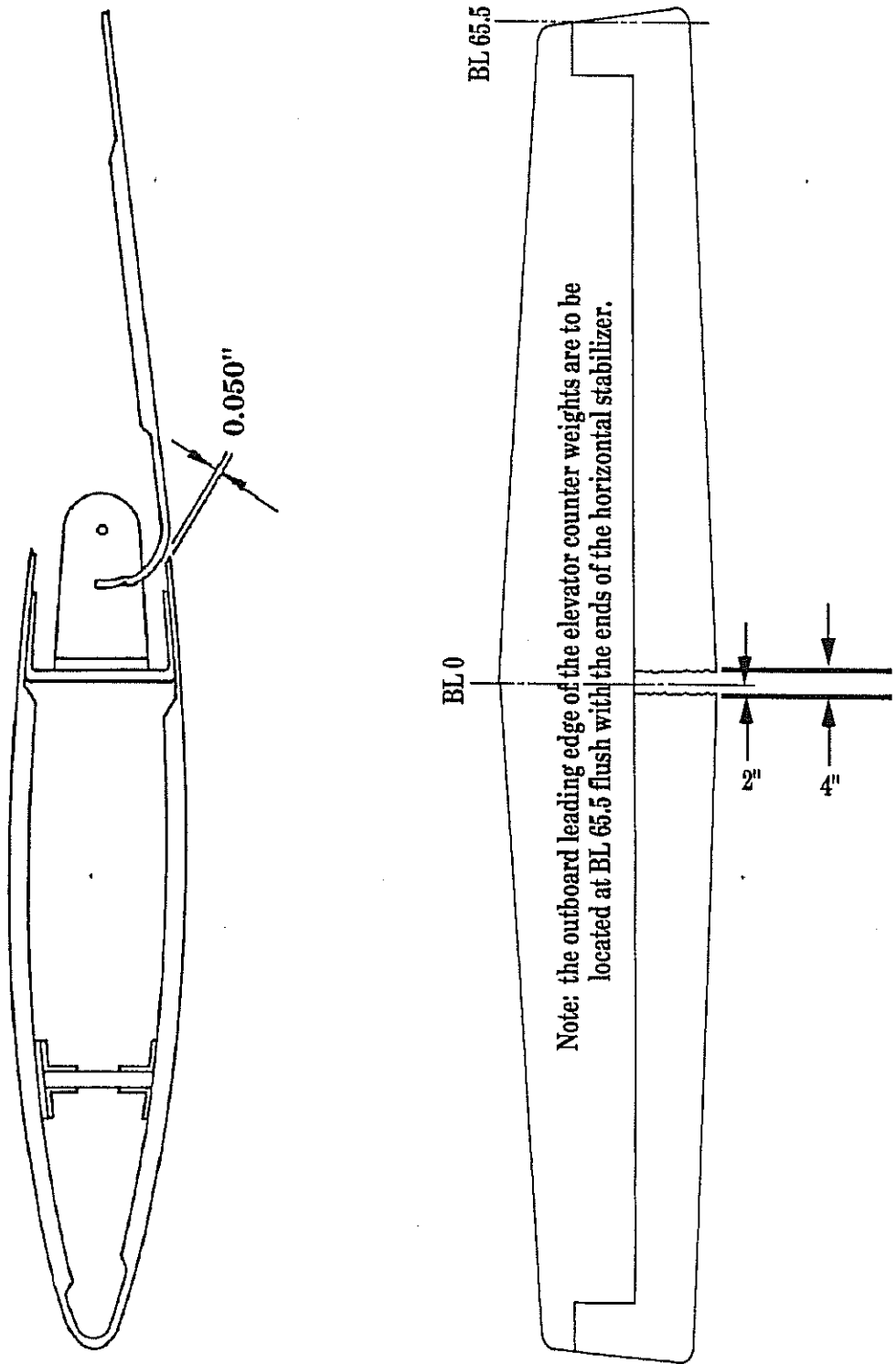
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Elevators



Positioning bottom elevator skins

Figure 3:A:3



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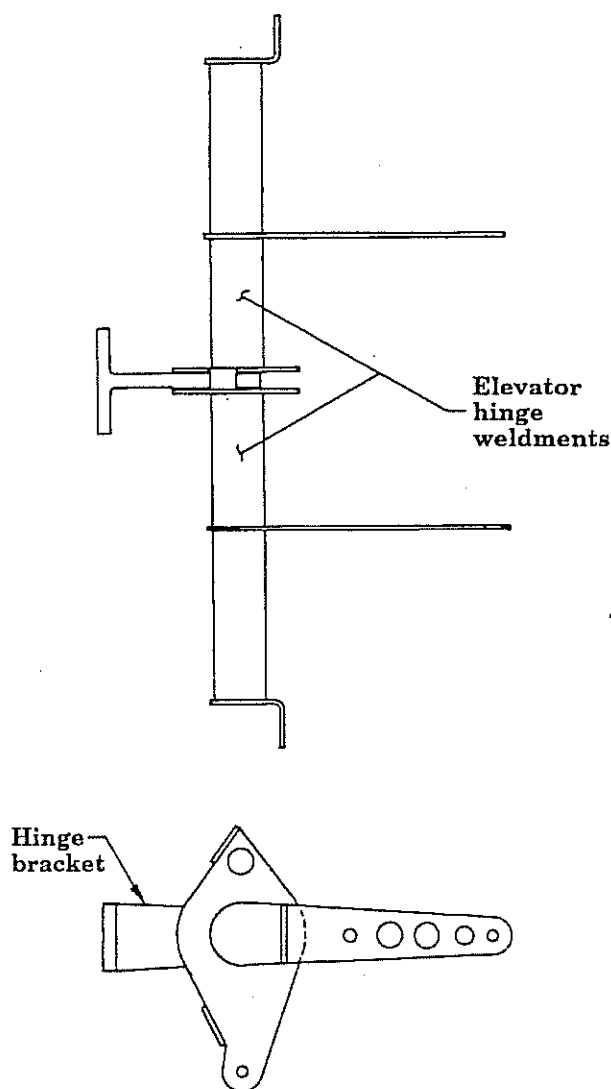
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Elevators

- A7. Cut 2" off the inboard edge of the elevator skins to provide clearance for the center hinge assembly. This cut is not critical as 2" will leave plenty of carbon to trim later when you fit the elevators to the fuselage.
- A8. Bolt the elevator hinge halves to their respective stab hinge halves. Also install the center elevator hinge assembly. The aft face of the hinges, where they will bolt to the elevator spar, should be flat to each other. The center elevator hinge weldment (Figure 3:A:4) should be bolted together as shown in Figure 3:A:5. Notice that you will have to notch the T.E. of the H. Stab. so the weldment can be mounted to the center stab hinge.

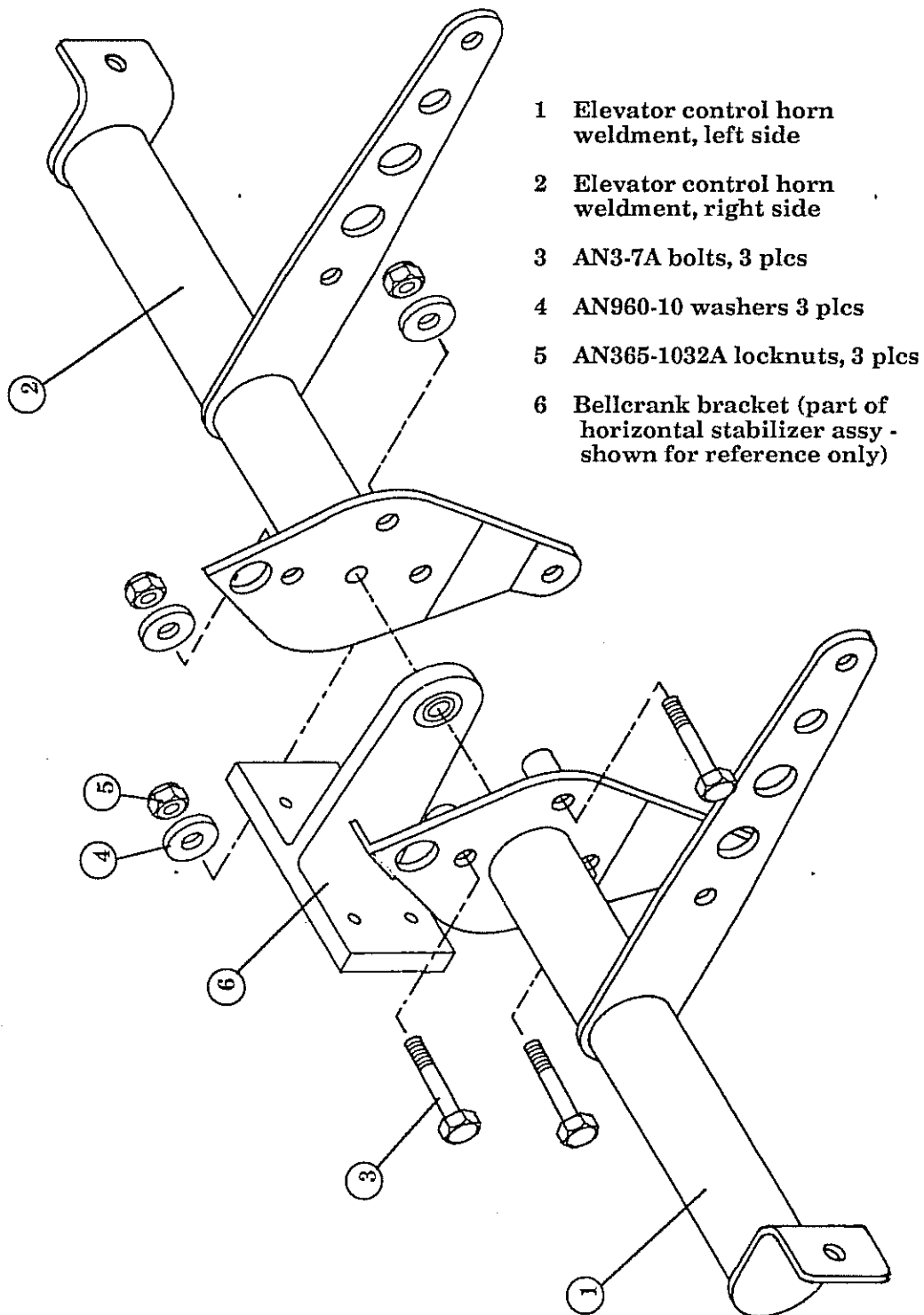
Center elevator hinge weldment profile

Figure 3:A:4



Center elevator hinge weldment

Figure 3:A:5

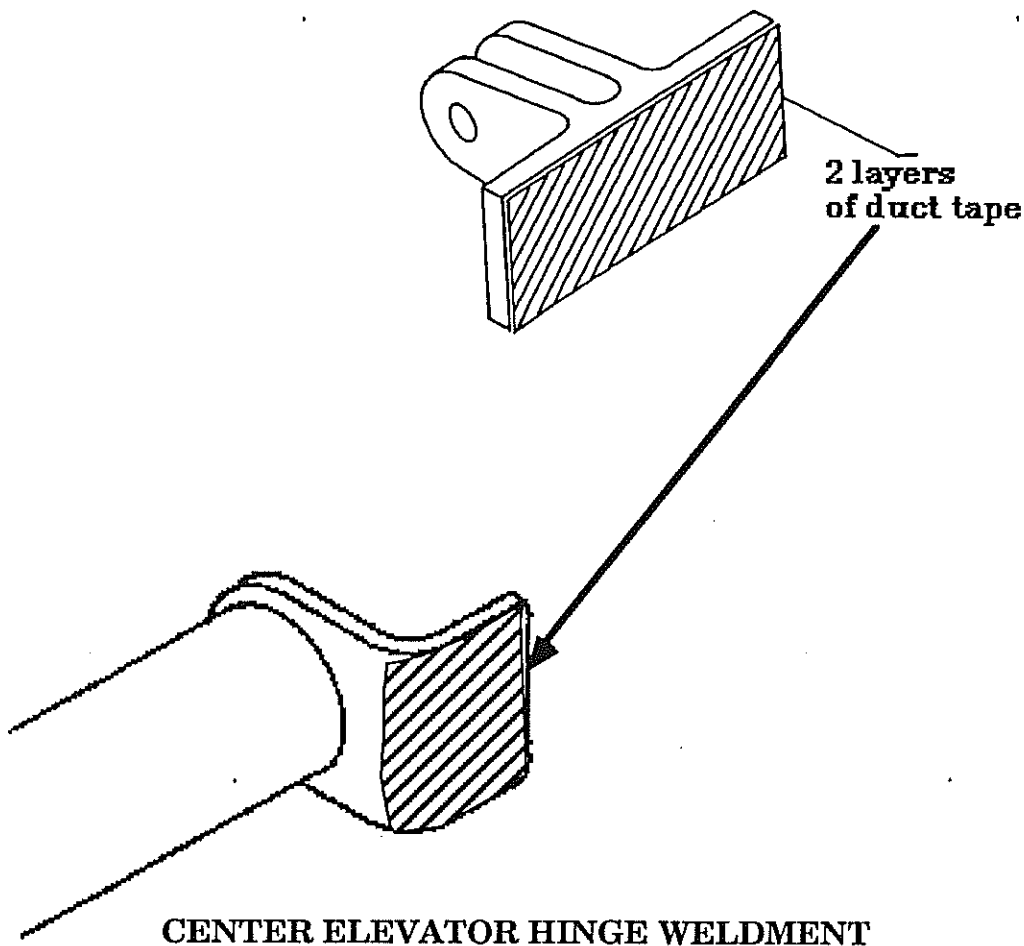


B. ELEVATOR SPARS

- B1. To simulate the 1 BID that will be applied to the front of the elevator spars, apply two layers of duct tape to the aft faces of the elevator hinges. See Figure 3:B:1.

Taping elevator hinges

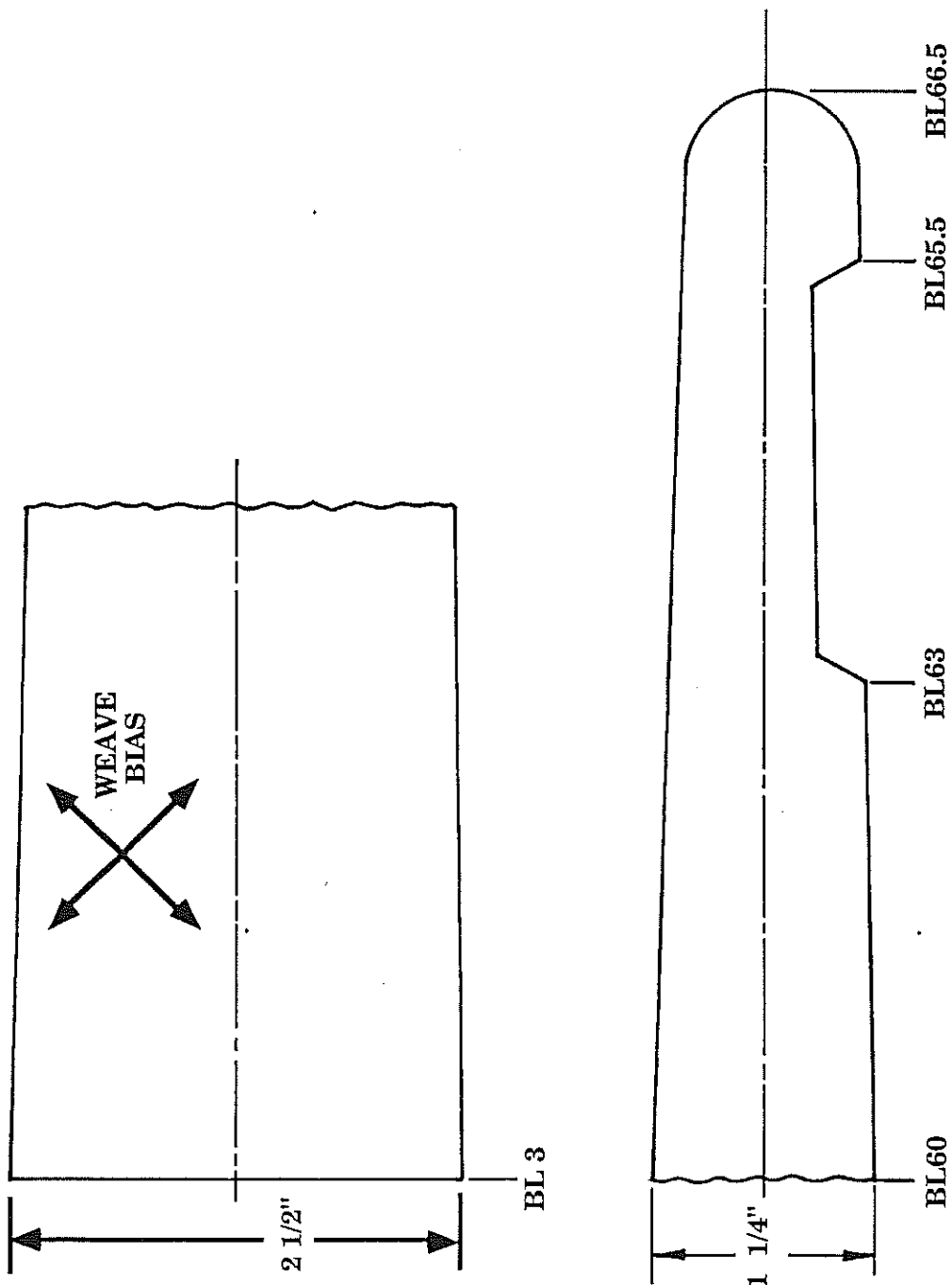
Figure 3:B:1



- B2. Cut two elevator spars from 1/4" thick 3 ply per side fiberglass prepreg on a 45 degree bias. See Figure 3:B:2. Also see Blueprint A-053 which includes all templates needed for the H. Stab. and elevator ribs. Early and later prepreg panels have a different weave bias, so be sure your spars have the correct weave orientation. If you have to cut a spar in two pieces, rejoin the pieces with micro and reinforce the joint with 3 BID, 3" wide on both sides.

Elevator spars

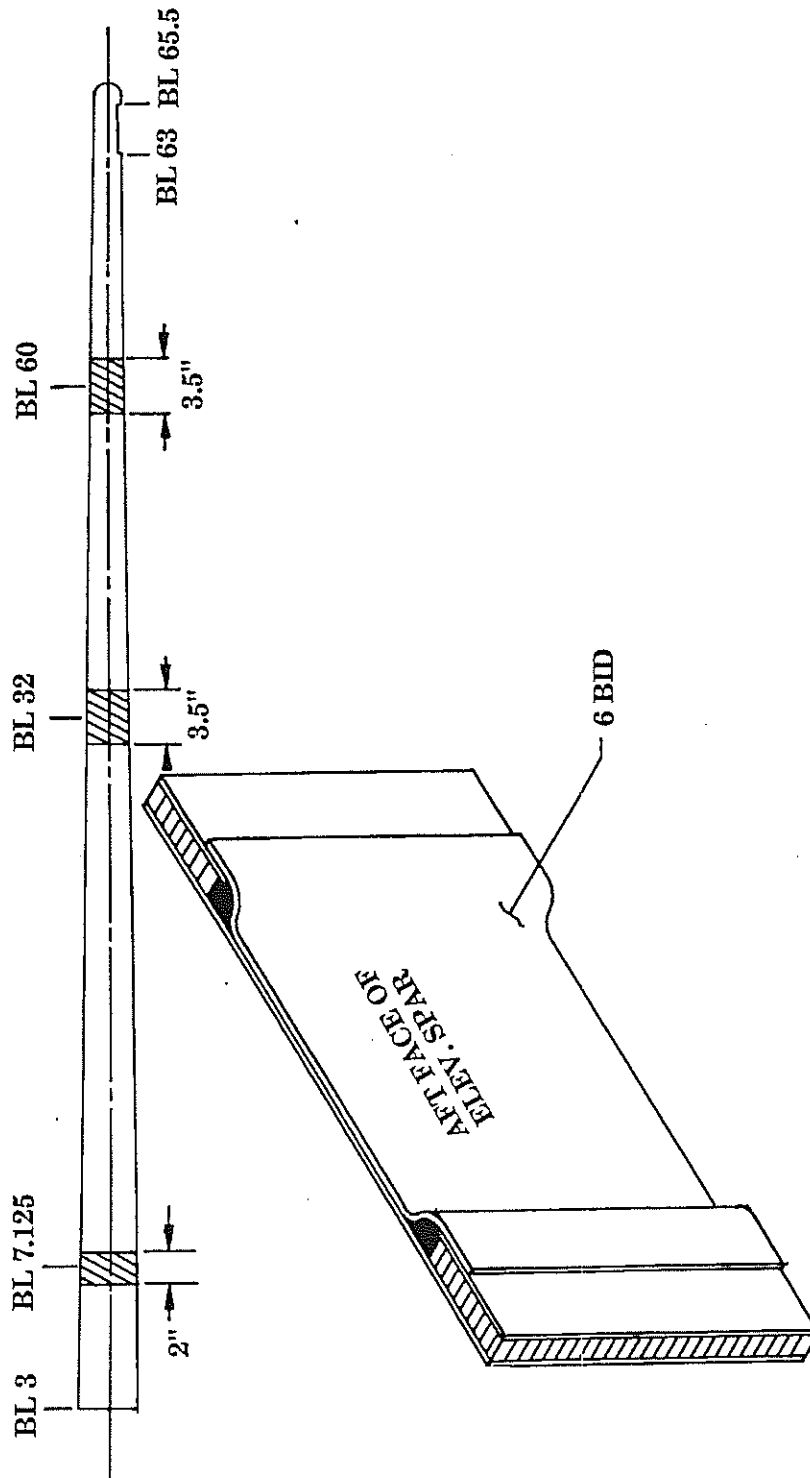
Figure 3:B:2



- B3. Sand the edges of the spar straight. Fit the spar into the elevator and butt it against the hinges. Trim the inboard end of the spar to butt against the center hinge weldment.
- B4. The hinges should be mounted on glass to glass areas of the spar. Remove 3 1/2" of the core and aft laminate of the spars behind each BL 32 and BL 60 hinge location as shown in Figure 3:B:3. You need only remove 2" of core where the center hinge weldment bolts to the spar at BL 7.125 (7 1/8").



Hinge mounting areas
Figure 3:B:3

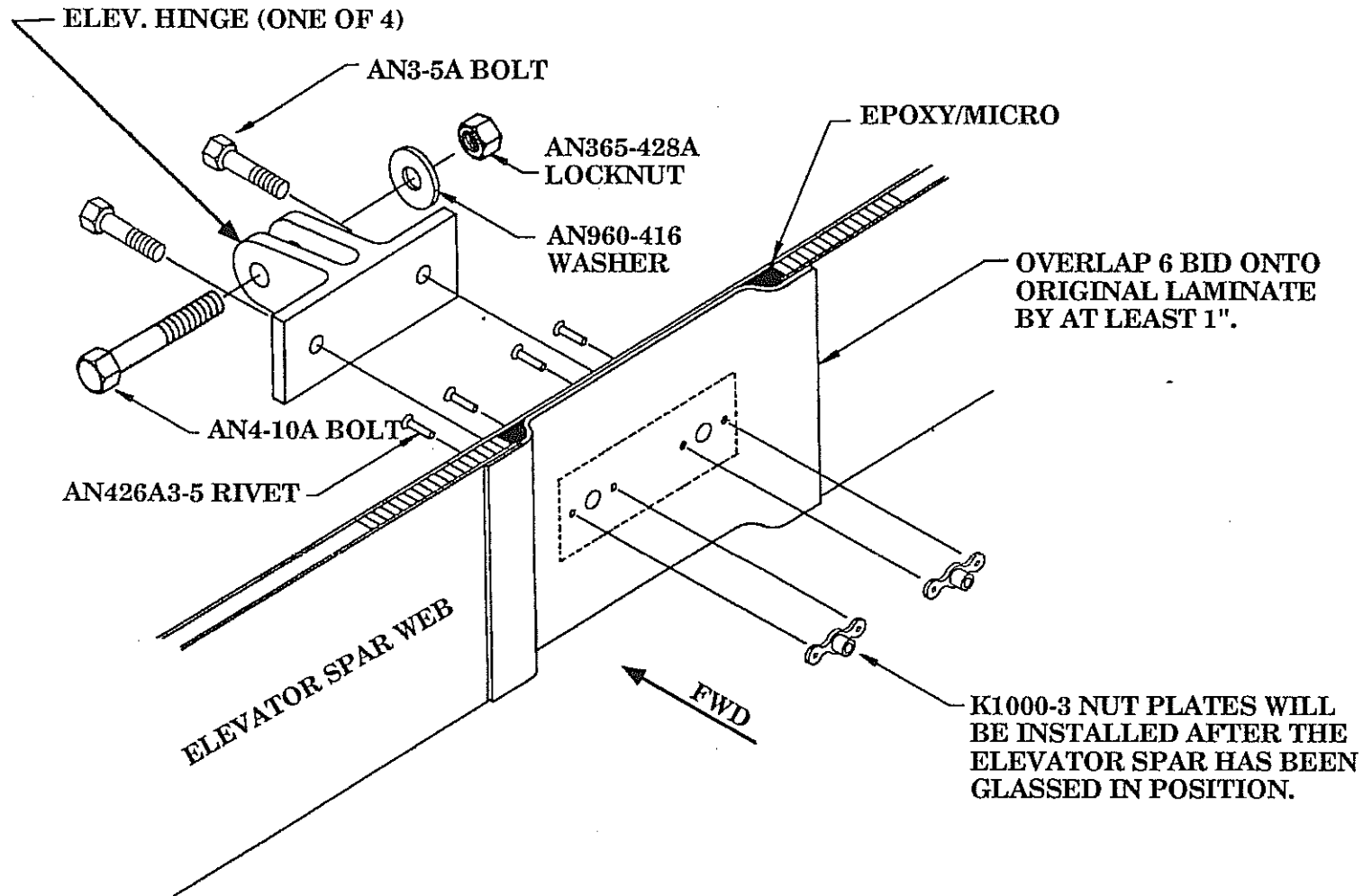


- B5. Sand the areas in and around the hinge mounts thoroughly with 40 grit. A Dremel with a ball head bit works well for grinding and smoothing the core removal area. Push the spar core back slightly where it is still exposed. Clean with MC.
- B6. Mix a small batch of micro and push it into the exposed core. Form a small radius around the core removal area.
- B7. Lay a 6 BID reinforcement over the hinge areas, overlapping 1" onto the surrounding surfaces. Lay the spar flat face down on a straight surface while the 6 BID is curing so the spar won't be warped. See Figures 3:B:3 and 3:B:4.
- B8. After the 6 BID has cured and been trimmed flush with the edges of the spars, place the spar back in position against the hinges. Use a few drops of instant glue around the edges of the hinges to secure them to the spar. This should be sufficient to hold them in position for drilling. Be sure the hinges are properly aligned. If a hinge were tilted at a 15° angle, this could cause binding in the ball bearing. The vertical edges of the elevator hinge should be parallel to the vertical edges of it's H. Stab. counterpart.
- B9. With the instant glue now temporarily holding the 4 hinges and center bellcrank weldment in position on the elevator spar web, carefully remove the four AN4-10A hinge bolts and the AN3-7A bolts that secure the center weldment halves together. Without breaking the hinges off, carefully remove the spars from the elevators. Use the hinges as a guide to drill the #12 mounting holes through the elevator spar. See Figure 3:B:4. Don't install the nutplates yet, they would interfere with the BID tapes that secure the spar to the skin.
- B10. As a test of your elevator placement temporarily secure the spar, with hinges temporarily installed, to the elevator skin with instant glue or hot glue. The elevator can now be carefully moved to its upward travel limit. If the elevator/H. Stab. T.E. gap stays fairly even when you raise the elevator T.E., your elevator skin and spar placement is good enough. If one elevator skin persistently wants to close the gap and hit the stab T.E., then you can pull that elevator skin back slightly to compensate and find a happy medium. It is better to leave the stab T.E. straight and adjust the radius of the elevator, than the other way around. So long as the elevator doesn't contact the stab T.E. during it's travel, you're okay.

NOTE: Because of the counterweight arm you will have to raise the H. Stab. off the jig to check the elevator/stab T.E. gap. Be careful not to break the temporary spar/skin bond. You will also have to notch the Horiz. Stab. T.E. for the center hinge weldment. Notching slightly into the aft stab spar cap is okay, but notch only enough for proper elevator travel.



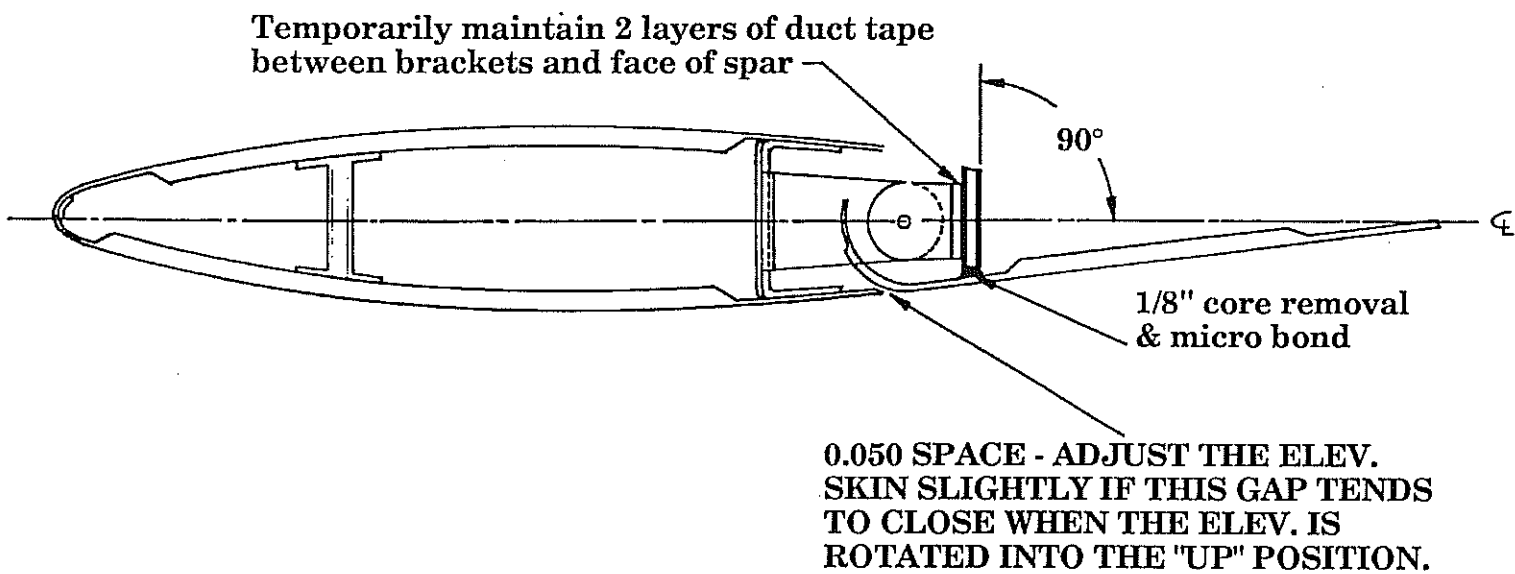
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Mounting elevator hinges
Figure 3.B.4

- B11. Clean off the temporary glue from the elevator skin and spar. With 40 grit, sand the spar and the area of the elevator skin where the spar will be bonded. Clean all sanded areas with MC.
- B12. After double checking that the elevator skin is positioned as before, remove 1/8" of core from the spar and bond it to the skin with micro. Bolt the spar to the aft face of the hinges to support it while the micro cures. Be sure the two layers of duct tape are still spacing the spar from the hinges. Weight the spar against the skin while curing and make sure the spar is true vertical. A properly constructed jig should support the elevator underneath the spar so the elevator can be firmly weighted into position. Refer to Figure 3:B:5.
- B13. Apply 2 BID to secure the aft face of the elevator spars to the skins, overlapping 1" on each surface. Also apply one additional 6" x 2" 2 BID to the hinge areas. When the 2 BID is in the "green cure" state, trim it around the hinge bolt holes. If you let the 2 BID completely cure, you must carefully redrill the #12 holes.

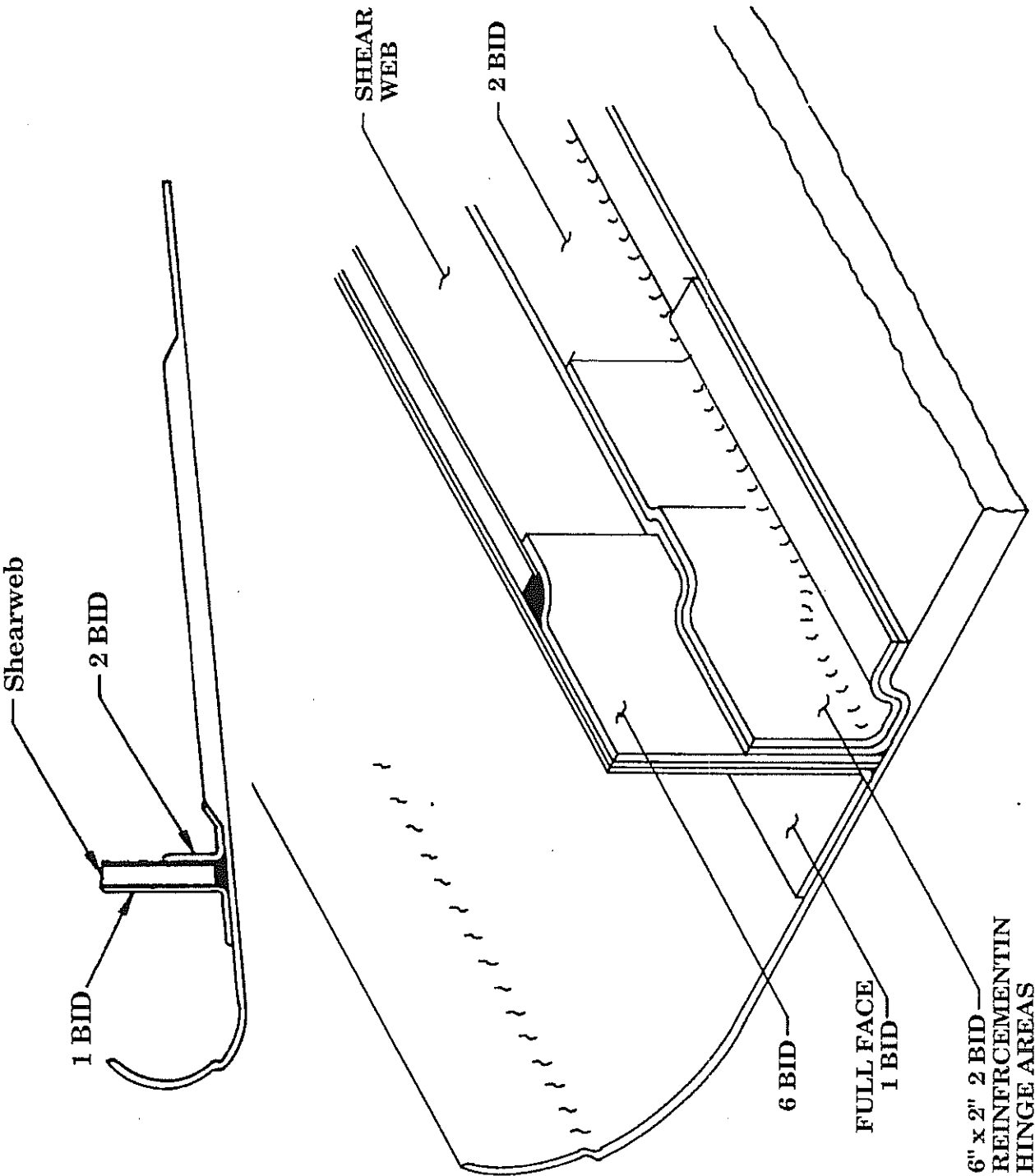
Bonding in the elevator spar
Figure 3:B:5



- B14. After the spars have cured in position remove the hinges, and remove the duct tape from the aft faces of the hinges. Sand the forward face of the elevator spars and the elevator skin forward of the spars. Clean with MC.
- B15. Secure the front face of the elevator spar to the skin with 1 BID (see Figure 3:B:6). Extend the BID 1" onto the bottom elevator skin and all the way up the spar. Plug the hinge mounting bolt hole with modeling clay, Silly Putty, etc., to prevent the resin from clogging the hole. Trim around the bolt holes when the glass is in the green cure state and remove the clay.
- B16. Now you can install the K1000-3 hinge nutplates on the aft side of the elevator spar using AN426A3-5 rivets. Refer back to Figure 3:B:4.



Securing front face of the elevator spars
 Figure 3:B:6



C. ELEVATOR RIBS

- C1. Use the templates on Blueprint A-053 to cut the BL 3 ribs from the 6 ply E-Glass sheet (no core) provided in the kit. Cut and fit the BL 34 and BL 62 elevator ribs from 1/4" thick, 3 ply per side fiberglass prepreg. See Figure 3:C:1.



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Elevators



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TABLE 1

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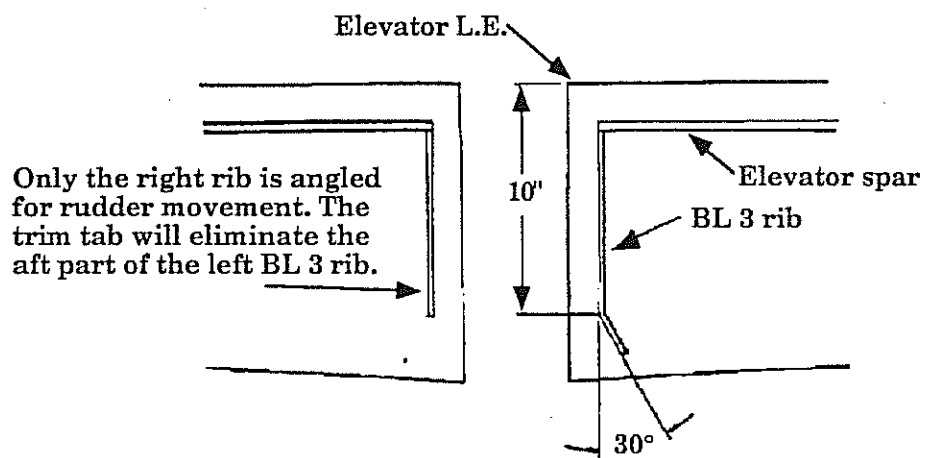
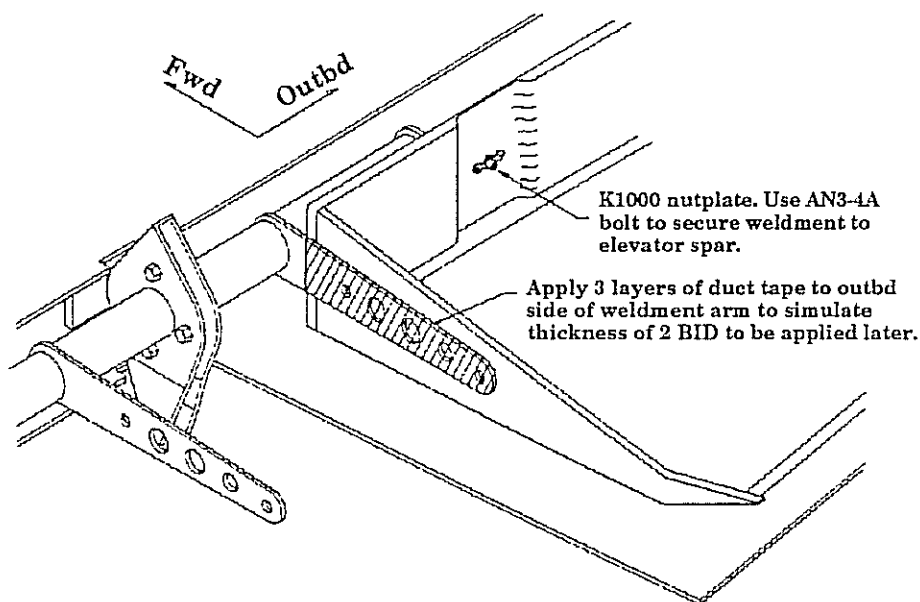
- C2. The proper placement of the inboard elevator rib is critical. Alignment is easy, and can be accomplished by just resting the rib against the center hinge assembly. Since the inboard surface of the rib will be glassed with 2 BID after the elevator is closed, you must apply an equal thickness (0.020") to the rib before bonding it to the elevator skin. See Figure 3:C:2.

Note: Do not skip this step. Your inboard rib **MUST** be spaced at least .020" away from the hinge weldment arm. Otherwise, the 2 BID that will be added to the inboard surface of the rib will push the elevator out an equal distance, binding it against the outboard hinges.

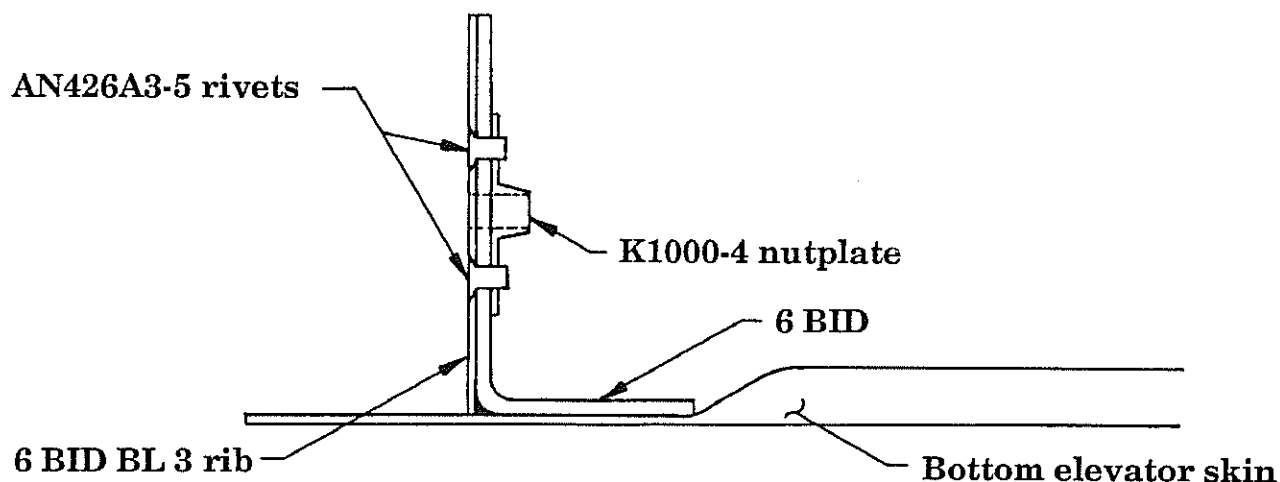


Inboard elevator rib

Figure 3:C:2:a



BL 3 rib
Figure 3:C:2:b

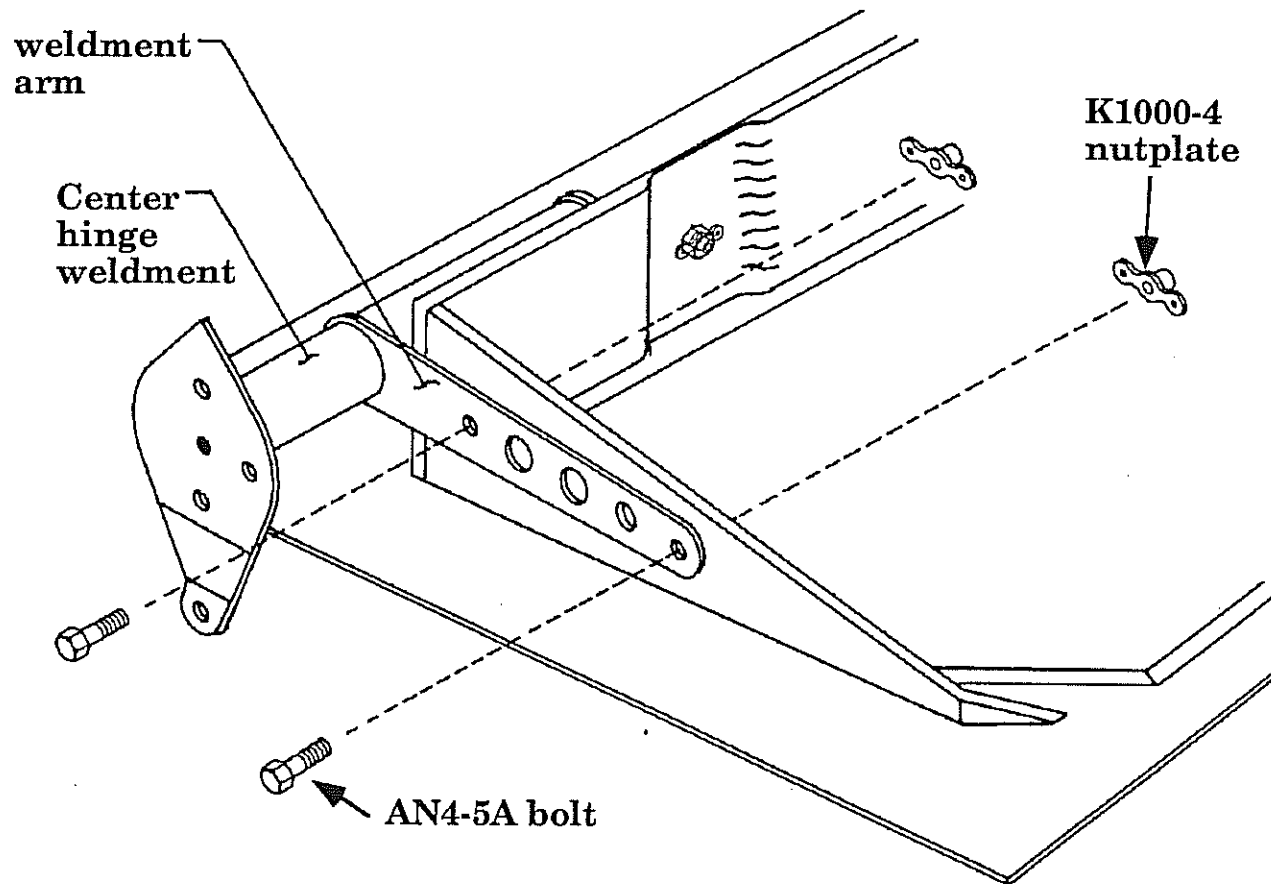


- C3. Three layers of duct tape should be placed as a spacer between the inboard elevator ribs and the center hinge assembly.
- C4. Scrape 1/8" core troughs in the outbd ribs and sand the areas where they will be bonded to the elevator skin. Clean with MC.
- C5. Bond in the outbd ribs with micro.
- C6. Be sure that the inboard ribs are clamped to the center hinge bracket while curing and bond the 2 solid (coreless) ribs with flox.
- C7. Form a small micro radius around all rib to skin and spar junctions. (For fillet purposes, micro is acceptable on the BL 3 ribs).
- C8. Apply 6 BID to the outboard faces of the BL 3 ribs. The laminate should cover the entire outboard face of the rib and overlap at least 1" onto the elevator skin and spar. See Figures 3:D:2 and 3:F:1 for more details of the laminates on the BL 3 ribs.
- C9. Secure the outbd ribs to the elevator skins and the spars with the standard 2" wide, 2 BID tapes.
- C10. After the BID tapes have cured, use the mounting holes in the center hinge weldment arms as guides to drill the two 1/4" mounting bolt holes in each BL 3 rib. Don't remove the duct tape spacer, just drill through it.

- C11. Now you can remove the center hinge weldment and duct tape spacers.
- C12. Secure two, K1000-4 nutplates to the outboard side of each BL 3 rib where you have just drilled. Use AN426A3-5 rivets to secure the nutplates.
- C13. The 2 BID laminates on the inboard face of the BL 3 ribs will be applied after the elevator has been closed.

Weldment arm mounting bolts

Figure 3:C:3



D. ELEVATOR CAPSTRIPS

- D1. Fit the top elevator halves to the bottoms. The templates used to cut out the elevator ribs should allow the top elevator skin to fit fairly well. As always, the ribs will require final shaping. Shaping can be done with a grinder, hand sander, etc., but the ribs should be taken down slowly, just enough to allow for the capstrip thickness. Be sure the top skin rests in the joggles without binding. Try to keep at least 1" of joggle for a gluing surface. It will help you in a later section (Counterbalancing) to fit the counterweight arms so they are about 0.040" (0.020" top and bottom) thinner than the horizontal stabilizer in that area. See Figure 3:D:1.

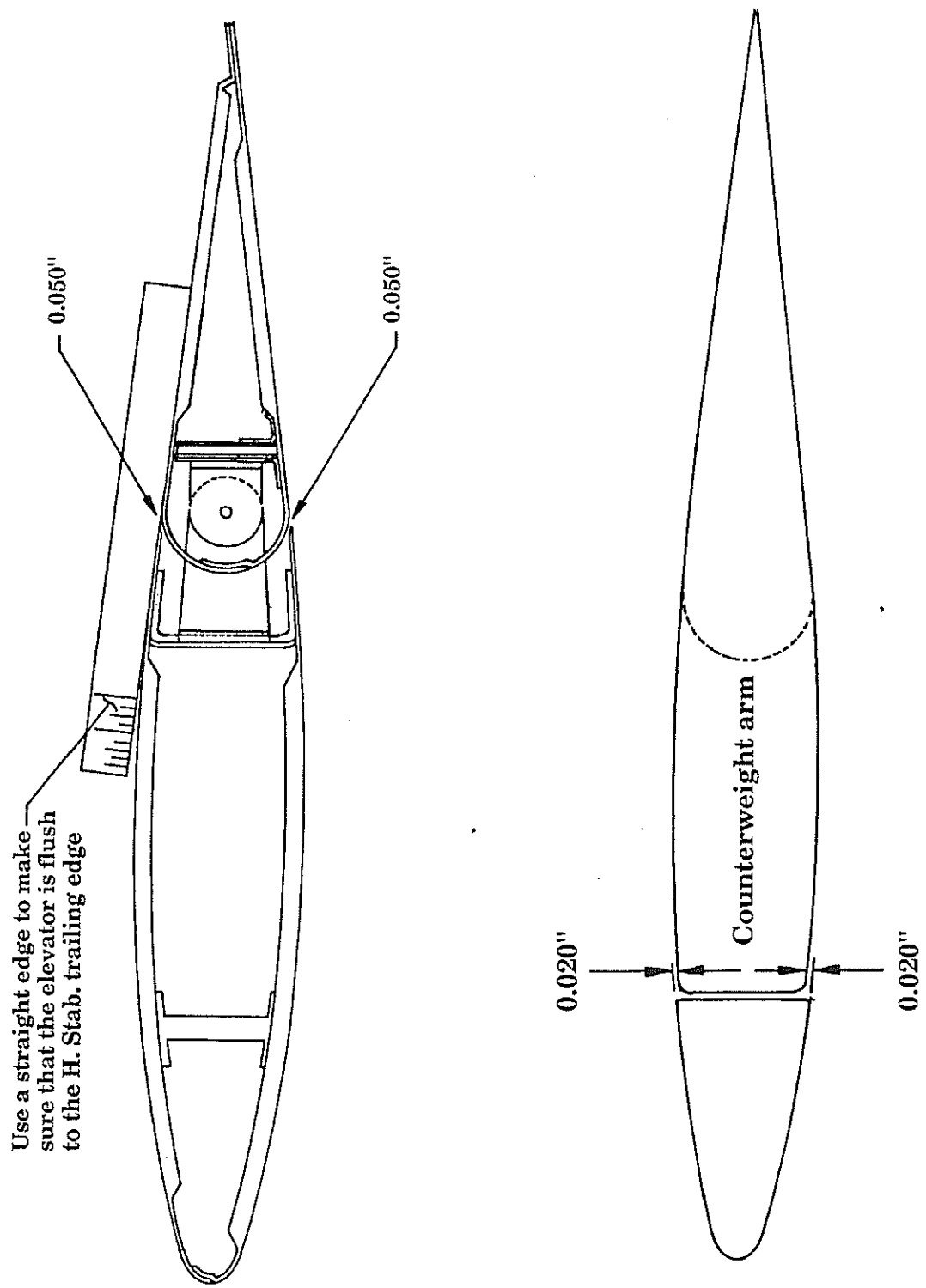
Note: If you seem to be having any difficulty getting the top skin to fit down onto the bottom, a little relief sanding/filing may be in order. Sometimes the L.E. radii get a little generous and make for an extra tight fit. A little filing around these corners and radii will make for an easy fit. The BL 3 ribs should be fit close enough that they will not need a microfit.

- D2. Check the H. Stab. T.E. clearance of the elevator top skin just as you did the elevator bottom skin. Hinge the elevator and check for 0.050" gap throughout the elevator's travel, and make small adjustments as required.
- D3. When satisfied that the top elevator skin is properly positioned, rout 1/8" of core from all the ribs and spars in preparation for a micro fit. Sand the areas of the ribs and spars where the capstrips will be secured with 2 BID. It is easier to sand them now rather than after the capstrips are applied.
- D4. Mark the locations of the ribs and spars on the inside surface of the top elevator skin. Apply three layers of duct tape to these areas to act as a release for the capstrips, which also provides room for them as well. See Figure 3:D:2 for a summary of the procedures to form elevator capstrips.



Fitting top elevator skin

Figure 3:D:1



- D5. Push micro into the rib and spar troughs and mound it up so the top elevator skin will make good contact. Lay the top skin into position and, by placing weights where necessary, attain a flat surface on the elevator. Remember, treat this microfit as you would treat closing the elevator for a final time. Is the trailing edge straight? Is there an even gap between elevator and stab T.E.? Do the counterweight arms have the proper thickness?

Note: Use a straight edge to check your elevator skins and make sure they are not bowed. If the micro cures while the skin is bowed, this goof will show up in both the capstrips and after the elevator is closed. Always check for straightness.

- D6. After the micro has cured, remove the top elevator skin. Sand the micro flush to the sides of the ribs and spars. Also sand the tops of the ribs and spars where they will be bonded to the capstrips.
- D7. Now remove two layers of duct tape from the top skin, leaving one layer for a release. Remark the location of the ribs and spars on the duct tape making sure you have enough tape width for a 2" wide capstrip release. Clean the ribs and spars with MC.



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Elevators

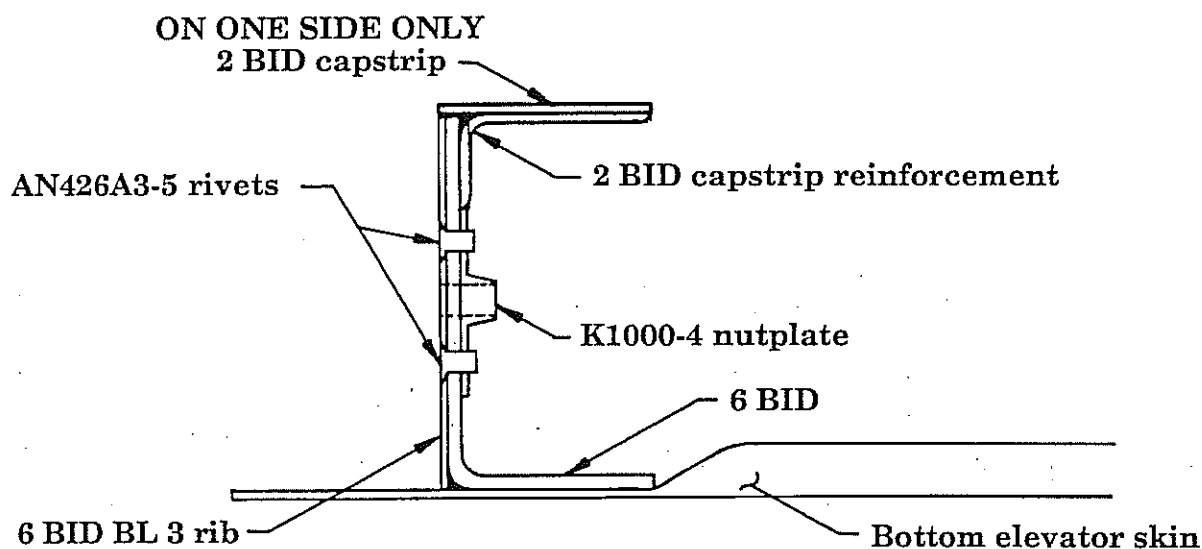


- D8. Apply 2 BID, 2" wide capstrips to the inside surface of the top elevator skin. Be careful to cut the capstrips to the proper length and don't run them off the release tape. The capstrips should all be centered on the ribs, except for the BL 3 ribs, which have the capstrip on one side only. See Figure 3:D:2

WARNING: Always be sure to remove the plastic carrier film before final closeout - Failure to do so will result in bond failure.

BL 3 rib capstrip

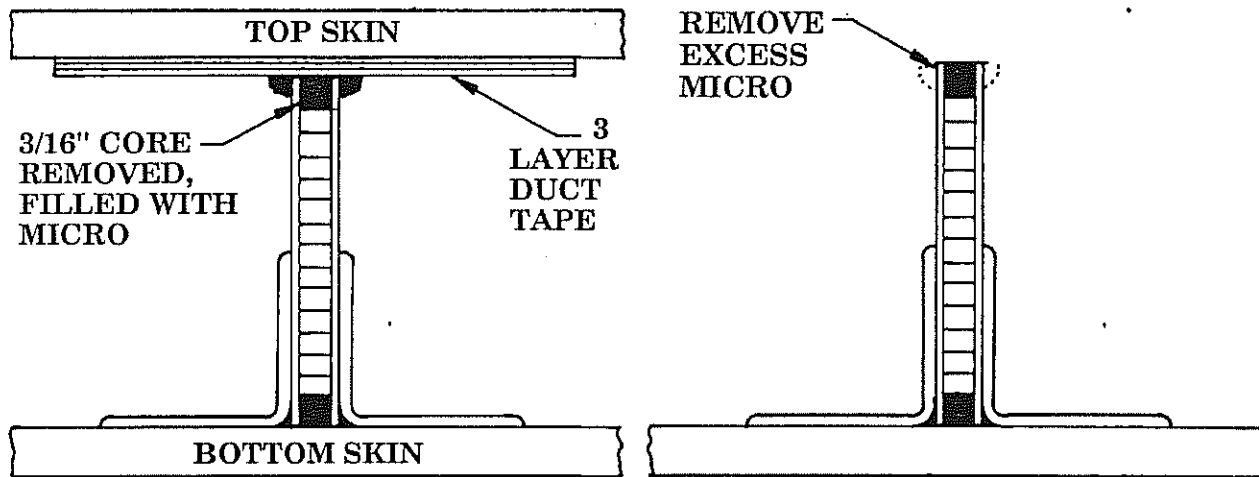
Figure 3:D:2



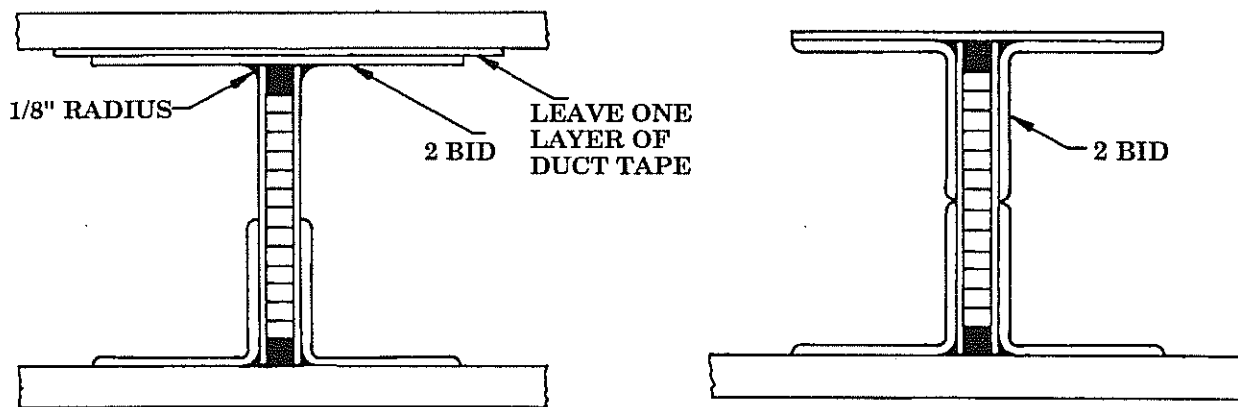
- D9. Apply a small amount of micro, mixed very thin, to the tops of the ribs and spars. Remember that they should already be micro fit to the top skin, so don't go overboard on the micro, just a coating. On the BL 3 ribs, simply apply a small bead of flox along the edges of the ribs that will contact the capstrips.

Summary of the procedures to form elevator capstrips

Figures 3:D:3:a and 3:D:3:b



Figures 3:D:3:c and 3:D:3:d



- D10. Lower the top elevator skin into position once again, aligning it just as when you did the microfit a few steps back. Let cure.
- D11. After cure pop off the top skin and trim the edges off your capstrips so they are $1\frac{1}{2}$ " wide $\pm 1/4$ ". There should be very little squeezout of micro, but if there are any large blobs that will interfere with a radius underneath the capstrips, sand them down accordingly. Also sand the underside of the capstrips and clean with MC.
- D12. If there is not enough micro to form into a radius under the capstrips, push some micro into these areas and form a small radius before adding the final 2 BID attachment.
- D13. Secure the capstrips to the ribs and spars with the final 2 BID, 2" wide strips.

D14. After cure, trim these 2 BID attachments and recheck your top elevator skin fit.

D15. Like you did on the Horiz. Stab., drill 1/8" vent holes in all ribs of the elevator.

WARNING: Failure to vent your elevators could lead to a pressurized chamber at high altitude which could cause a bond failure and/or component failure.

NOTE: When securing the capstrip to the forward face of the spar, avoid applying the 2 BID to the areas where the hinges rest. You want to keep a flat surface in these areas to avoid possible misalignment.



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E. TRIM MOTOR INSPECTION PANEL

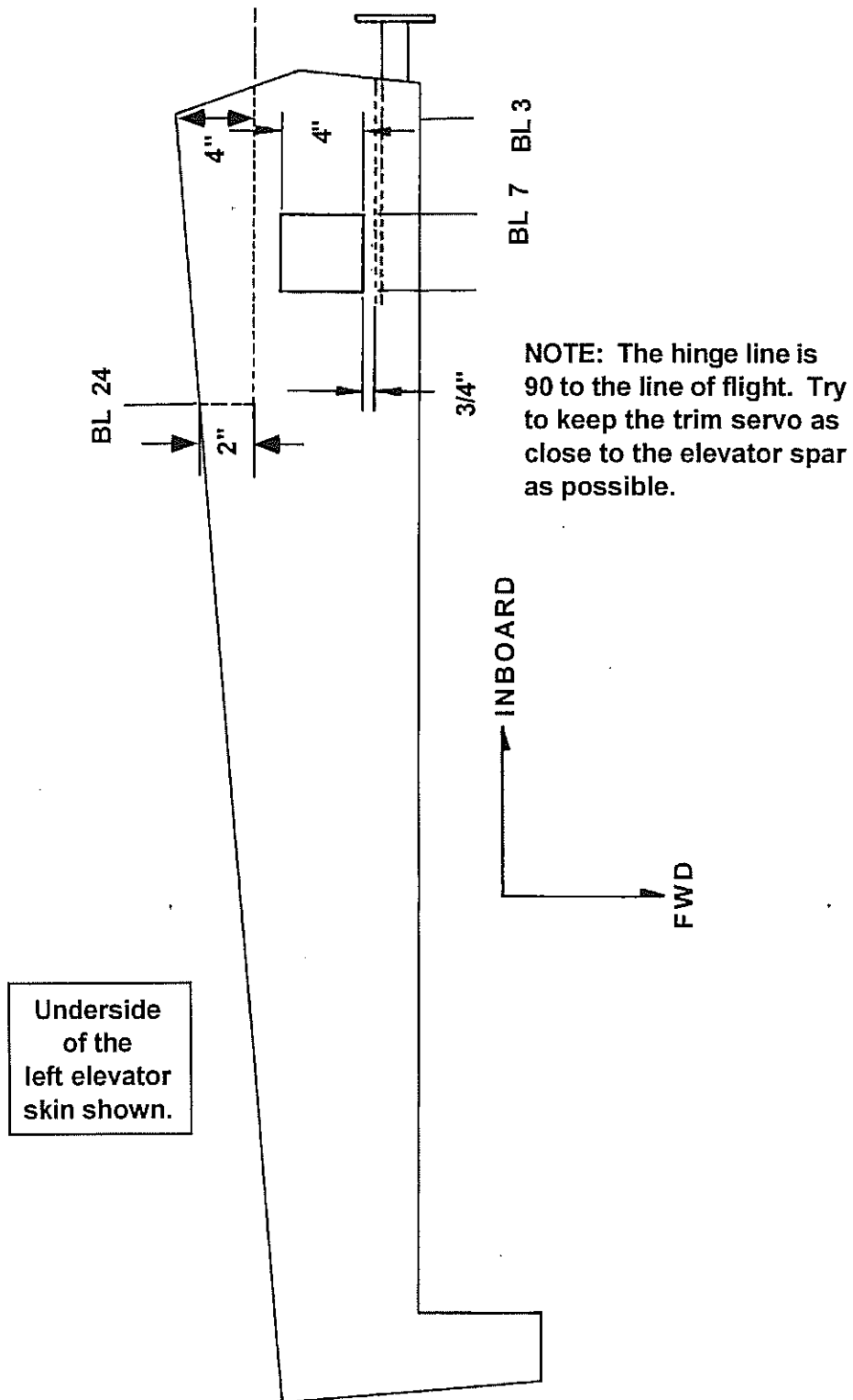
The Lancair IV uses a MAC servo to adjust a tab on the elevator, thus providing pitch trim. There is a glass to glass area on the bottom elevator skin from which the inspection panel will be cut. To find the proper angle of the inspection panel you will first mark the location of the trim tab.

- E1. Mark out the location of the trim tab on the bottom elevator skin from the dimensions given in Figure 3:E:1.
- E2. Drill #40 reference holes in 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.
- E3. 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 3/4" aft of the elevator spar. Mark the 4" x 4" outline of the inspection panel onto the inside of the bottom skin. The panel should be roughly centered in the coreless area of the skin. If it's not, adjust the panel outline to center it. The position of the servo is not critical.
- E4. Do a segmented cut around the inspection panel. In other words, cut through the bottom skin on the panel outline, but leave 1/4" of 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 motor 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.
- E5. Sand the area 1" around the panel with 40 grit to prepare it for the flange. Clean with MC.
- E6. Apply a 4"x4" release to the inspection panel area. Clear tape or packing tape will work well as a release here.



Trim Tab and Inspection Panel Locations

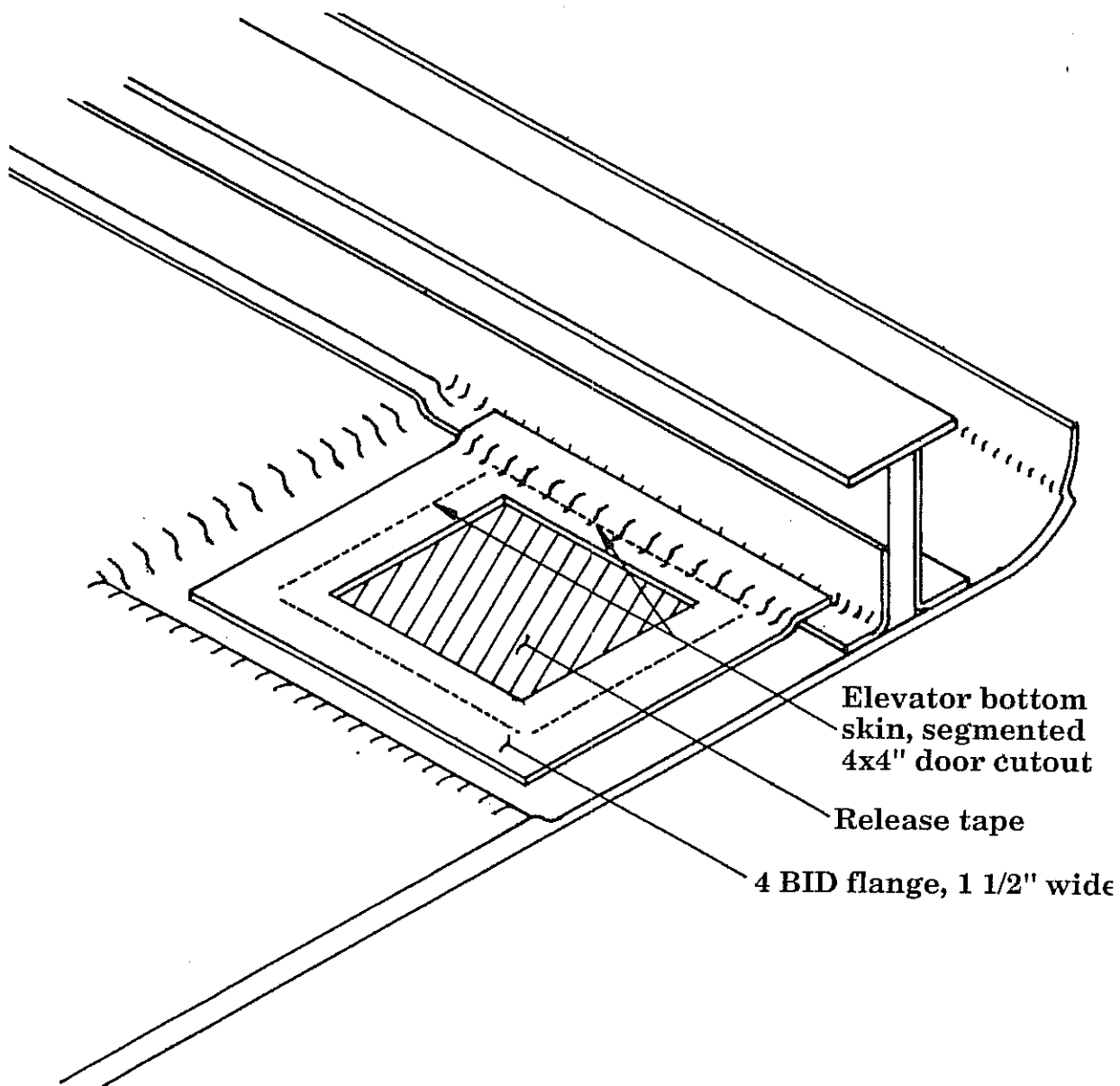
Figure 3:E:1



- E7. Apply a 4 BID, 1 1/2" wide flange around the inspection panel, centered on the segmented cut (see Figure 3:E:2).
- E8. Now leave the flange to cure and forget about the panel until the elevator is closed.

Inspection panel flange

Figure 3:E:2



F. CLOSING THE ELEVATORS

(Prior to closing, refer to section H, page 3-56.)

- F1. Sand the capstrips, joggles and top elevator skin where they will bond during closing.
- F2. Recheck the top skin fit to assure a straight and true elevator. You can never double check enough times. Be sure the hinge bolts are installed so you won't permanently alter the hinge alignment when weighting the elevator for closing. Also replace the 3 layer duct tape spacer between the center hinge weldment arms and BL 3 ribs, then bolt the assembly in position.
- F3. Clean all bonding surfaces with MC.
- F4. Apply a thin film of Hysol to the bonding areas of capstrips, T.E. joggle, counter-weight joggles, and top elevator skins. Then mix a bit of flox into the Hysol, about 1 tablespoon per 2 ounces, and build up a slightly thicker layer on the capstrips and T.E. joggles. Don't bond the L.E. joggle right now.
- F5. Carefully lay the top skin into position and weight it for cure. Be sure you have good squeeze out from the joggled bonding areas. Clamp the trailing edge to your jig (if your jig is straight) while the elevators are curing. Again, be sure your hinge bolts are installed for proper alignment.

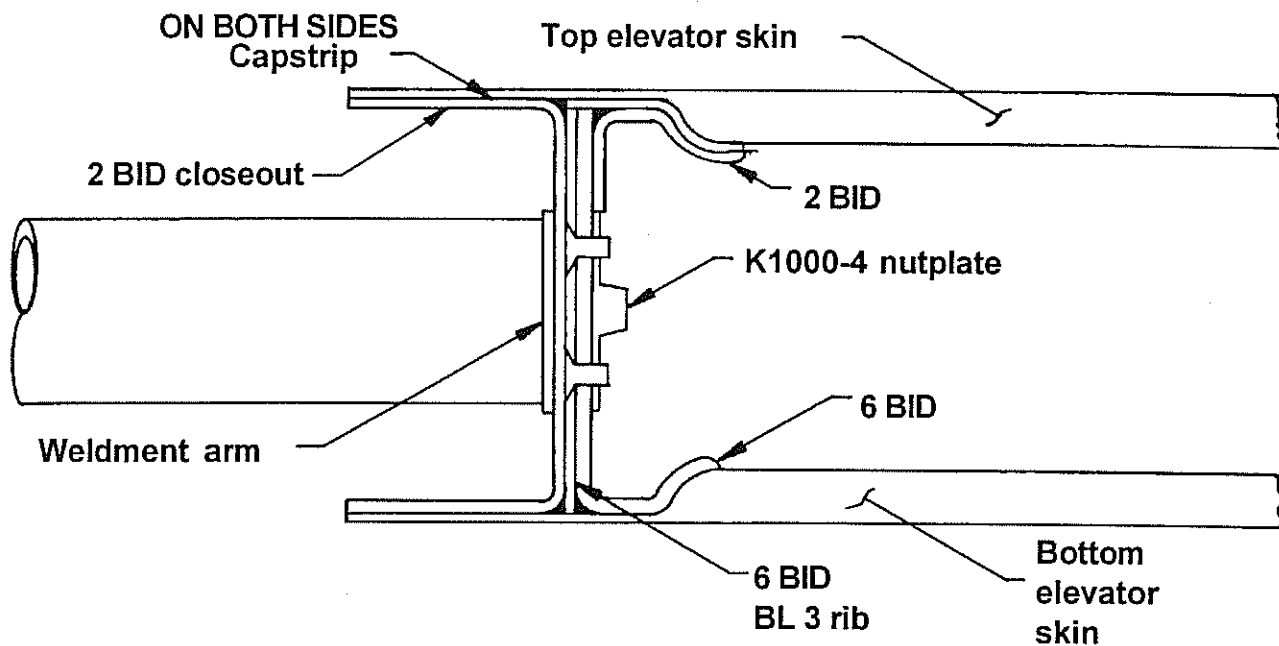
NOTE: Once again you must use a straight edge to check that your skin is not bowed. You may have to shuffle your weights around to allow room for the straight edge check, but it's worth it. This is for all the marbles, so check and double check. Re-adjust weights if necessary.

- F6. When the Hysol has cured, sand the outboard joggles of each elevator. Clean with MC, and apply 2 BID, 2" wide strips in the joggle.
- F7. 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.
- F8. Remove the center hinge assembly and sand the inboard side of the BL 3 elevator ribs. Clean with MC and apply 2 BID rolling onto the upper and lower elevator skin. Like you did on the spar mounting bolts, push some modeling clay, Silly Putty, etc. into the two mounting bolt holes on the inboard rib to prevent resin from clogging the threads. Trim around the bolt holes when the glass is in the green cure state. You can now remove the three layers of duct tape from the arms of the center hinge assembly that rested against the inboard elevator ribs. When the 2 BID is in the green cure state, trim around the bolt holes and remove the clay plugs. The surfaces that the weldment arms rest against should be absolutely flat. See Figure 3:F:1.



Weldment Arm Mounting

Figure 3:F:1



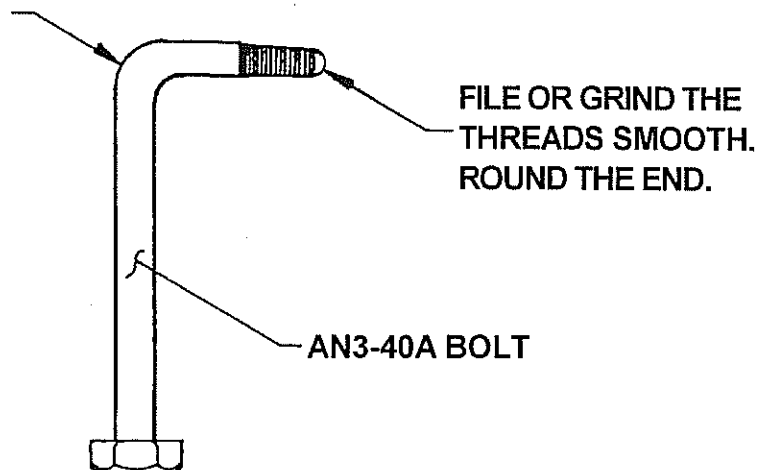
NOTE: To remove the bolts that secure the center hinge assembly to the elevator spars, you must grind an access hole in each elevator L.E. Make this hole just large enough so you can remove the bolts with a 3/8" socket.

- F9. 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 Figure 3:F:2. 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

Figure 3:F:2

HEAT THE BOLT
WITH A PROPANE
TORCH TO BEND.



- F10. Sand the trailing edge joggle of the elevator in preparation for filling it with micro. Clean the joggle with MC.
- F11. Mix a thick batch of micro and fill the trailing edge joggle. After the micro has cured, sand the micro so you have a straight trailing edge of uniform thickness (about 1/8").
- F12. Now that the elevators are removed from the H. Stab., you can bond the L.E. joggles together with Hysol. To hold them together during cure, you can sue the #6 x 1/2" sheet metal screws or clecos.

G. TRIM TAB INSTALLATION

- G1. Using the reference holes you drilled in the bottom elevator skin as guides, 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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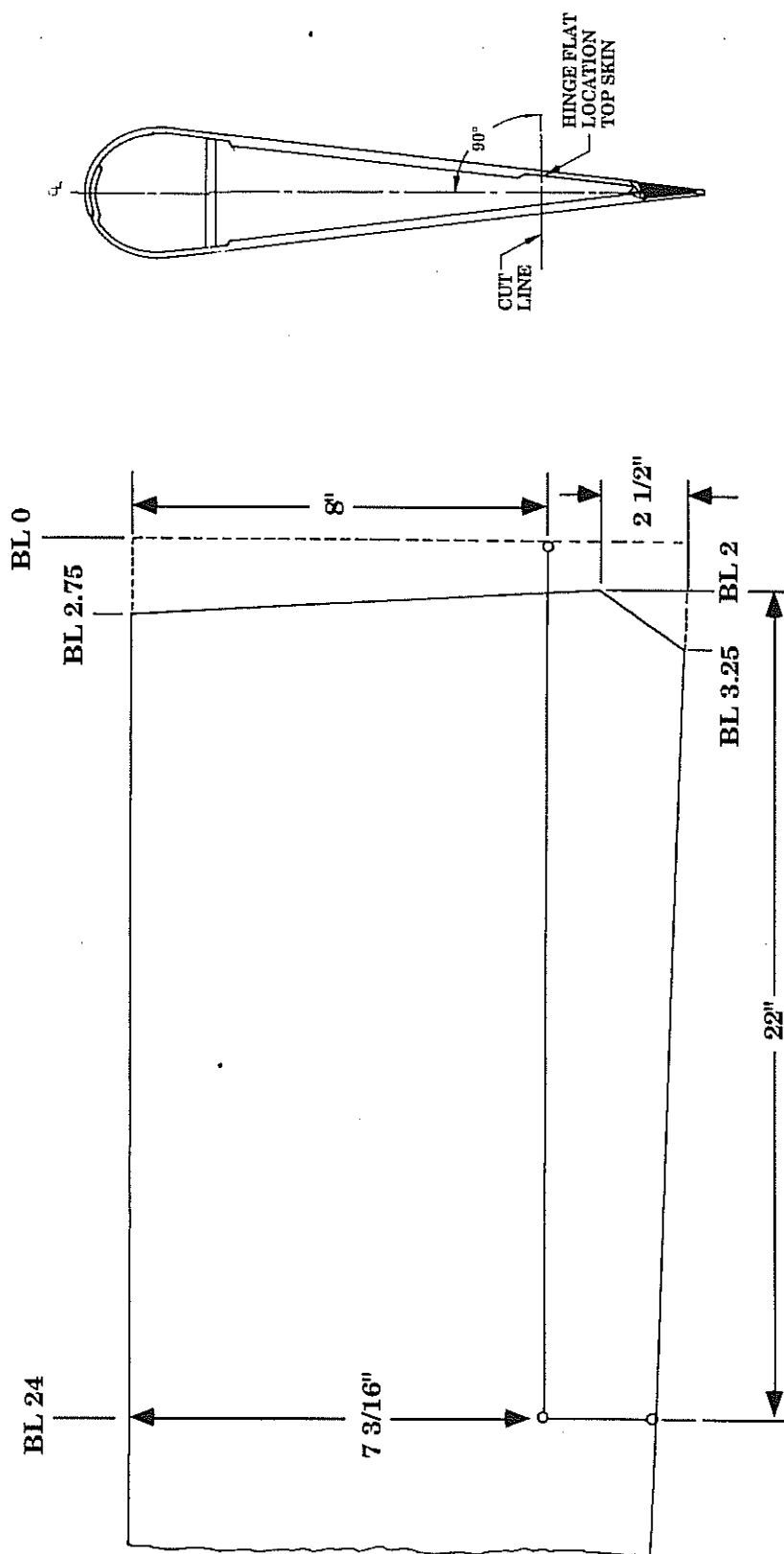
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Elevators



Cutting out trim tab

Figure 3:G:1



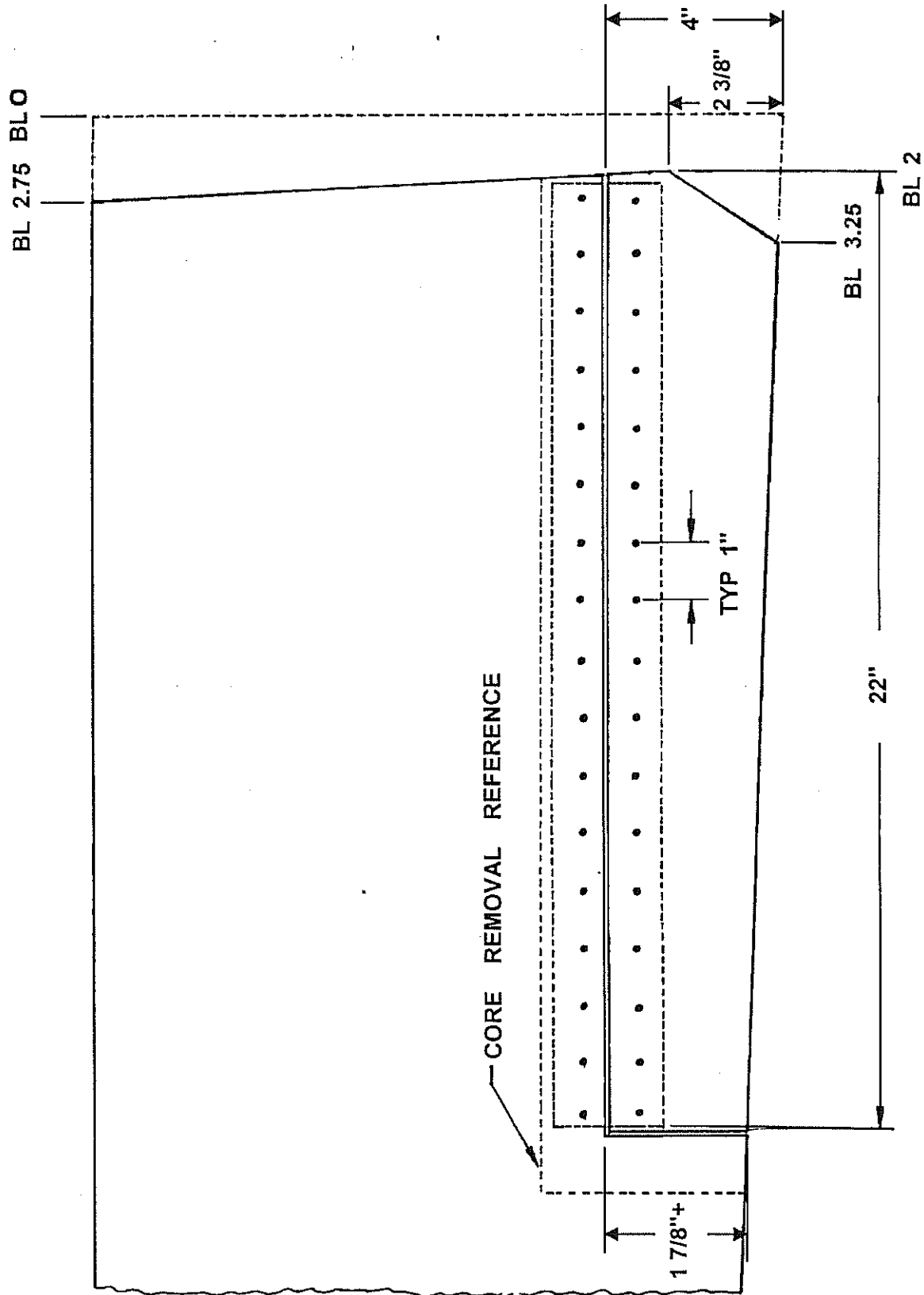
G2. Cut a 21 1/2" piece of MS2001-5 hinge.

G3. 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 Figure 3:G:2.



Hinging the Trim Tab

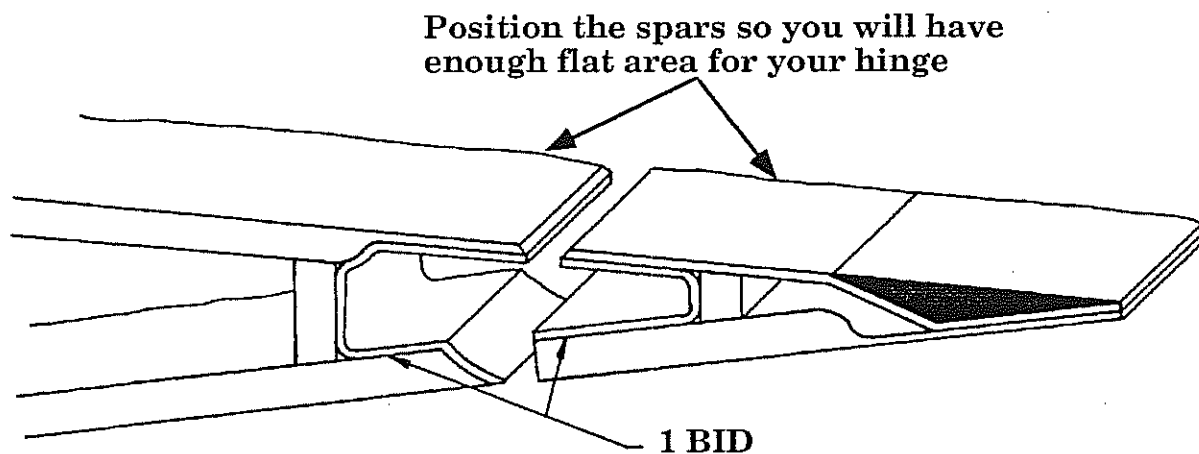
Figure 3:G:2

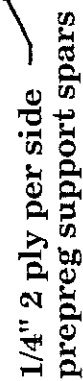


- G4. You can test your hinge placement by temporarily bonding the hinge in place with instant glue. You can then swing the tab up, not down just yet, and see how much top skin you should bevel or remove. The BL 3 elevator rib must be trimmed away from the hinge area. Cut this rib back just far enough so the hinge can be mounted on a flat area.
- G5. 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 and wrap 1 BID around the spar and onto the hinge areas and skins as shown in figure 3:G:3:a. This BID is not shown in later figures for clarity purposes. See Figure 3:G:3:b.

Adding 1 BID

Figure 3:G:3:a

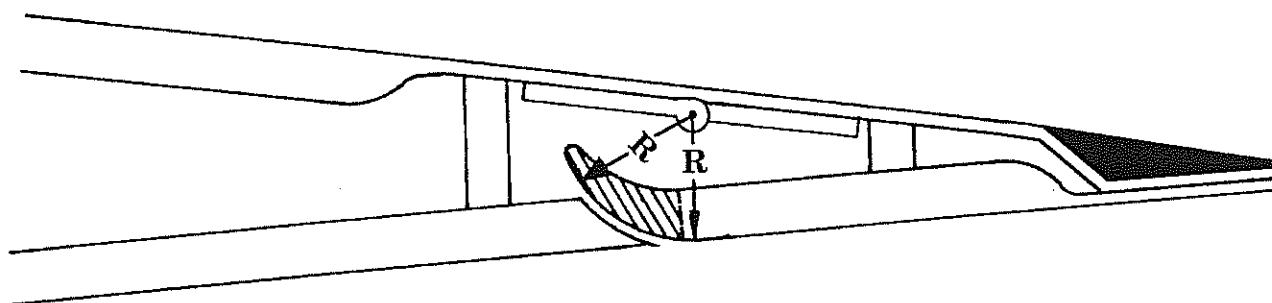




- G6. When satisfied with the hinge location, drill #40 holes spaced 1" apart and countersink for AN426A3-5 rivets. Secure the hinge halves to the elevator and trim tab with the rivets.
- G7. Cut the bottom trim tab skin back enough so the tab can be moved to the full down position.
- G8. Now you have to bond in and form a foam block to fill the ugly gap on the underside of the trim tab.
- G9. Using micro, bond a 1/2" x 22" x 1 1/4" piece of Clark foam to the inside surface of the bottom trim tab skin.
- G10. Shape the foam so when the tab is moved to it's extreme travel, the gap stays constant. This will be a contour line that scribes a radius off the hinge pin axis. See Figure 3:G:4:a and 3:G:4:b.

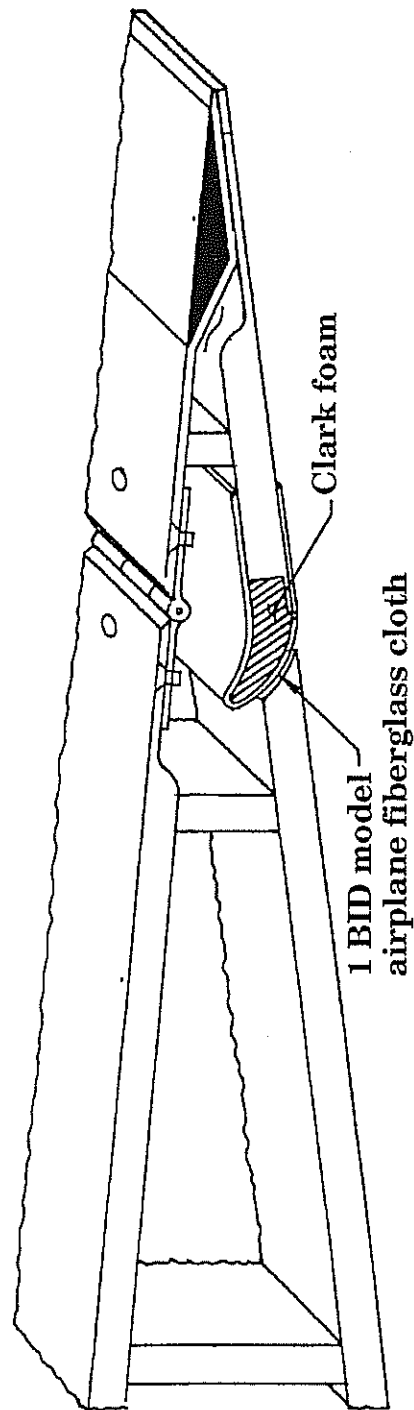
Shape of the foam

Figure 3:G:4:a



Trim tab L.E. shape

Figure 3:G:4:b



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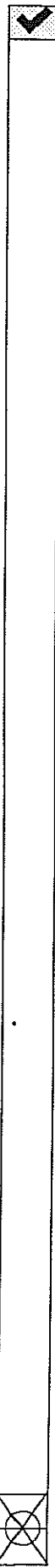
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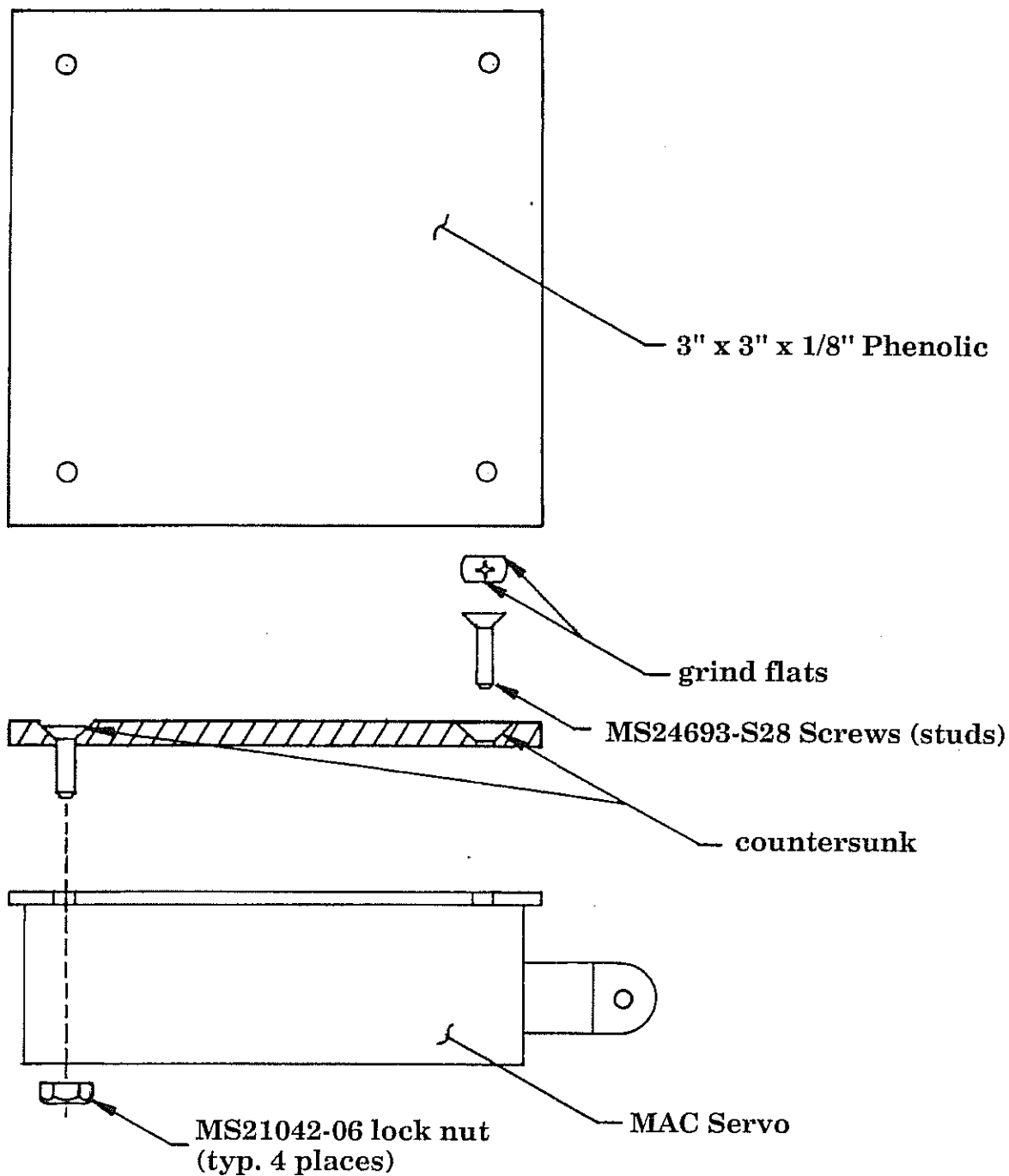
Elevators

- G11. 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.
- G12. Sand the excess Clark foam from the inside of the tab. Lay 1 BID onto the inside surface of the bottom tab skin, lapping it around the foam L.E. and onto the outside surface previously glassed.
- G13. 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.
- G14. 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.
- G15. Trim the inspection panel flange to 5/16".
- G16. Drill four #29 holes through the panel and the flange for the MS24693S26 mounting screws. Countersink the panel to fit the screws.
- G17. Mount four MK1000-06 nutplates to the flange using AN426A3-5 rivets.
- G18. With 40 grit, sand the inside surface of the top elevator skin in the inspection panel area.
- G19. Cut a 3" x 3" piece of 1/8" thick phenolic to be used as a servo mount.
- G20. Center the servo on the phenolic. Use the servo as a guide to drill four #29 mounting holes in the phenolic.
- G21. Countersink the holes on the underside of the phenolic to accept MS24693-S28 screws. Trim the screw heads so they can be potted into the phenolic. See Figure 3:G:5.



Trimming screw heads

Figure 3:G:5

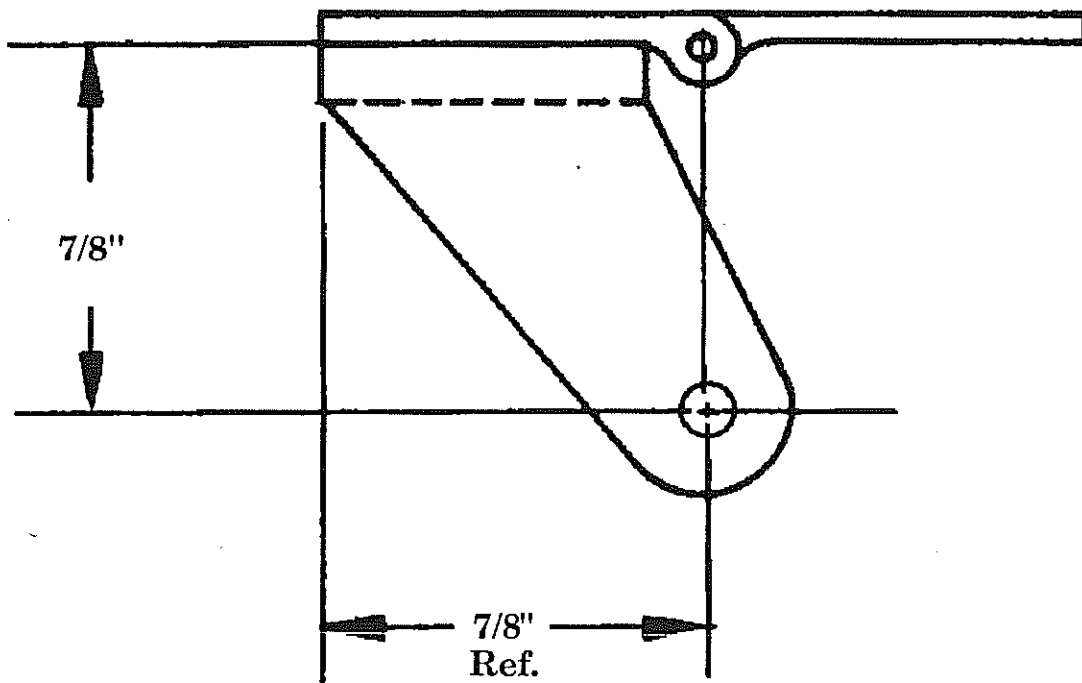
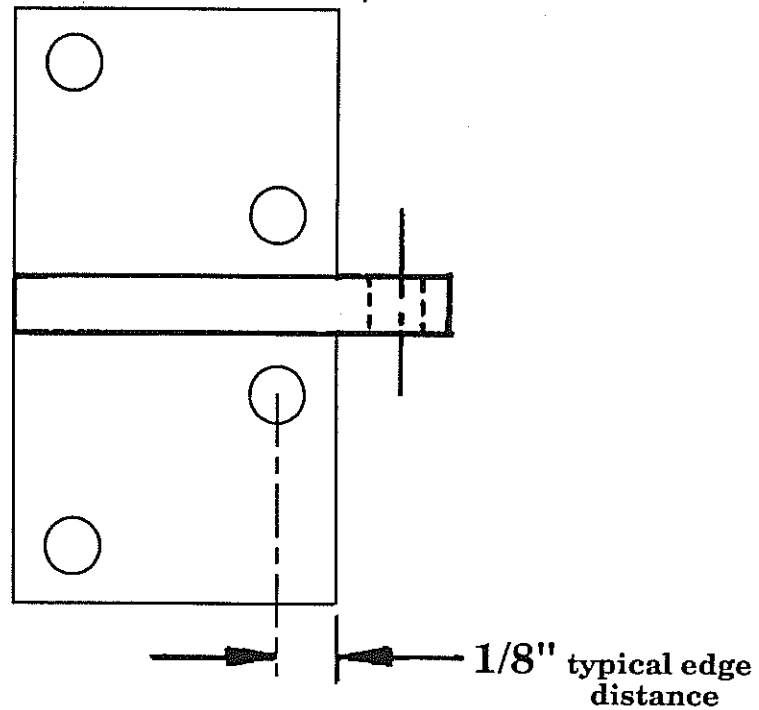


- G22. Using epoxy/flox, pot the screws into the phenolic. Use the servo to align the screws (now referred to as "studs") while the epoxy/flox cures. Wipe off excess epoxy/flox before setting servo into position to avoid gluing the servo permanently.
- G23. After the epoxy/flox has cured sand the flat face of the phenolic with 40 grit and clean with MC.
- G24. Using Hysol, bond the phenolic servo mount to the inside of the top elevator skin. Position the mount so the servo actuator arm is perpendicular to the trim tab hinge line and so you can access all four studs through the inspection panel.
- G25. Align the hinge arm with the servo actuator arm. Locate the hinge arm on the trim tab hinge as shown in Figure 3:G:6. Notice that you must slot the foam trim tab L.E. for the hinge arm to slide into position on the hinge.



Trim tab hinge arm

Figure 3:G:6:a



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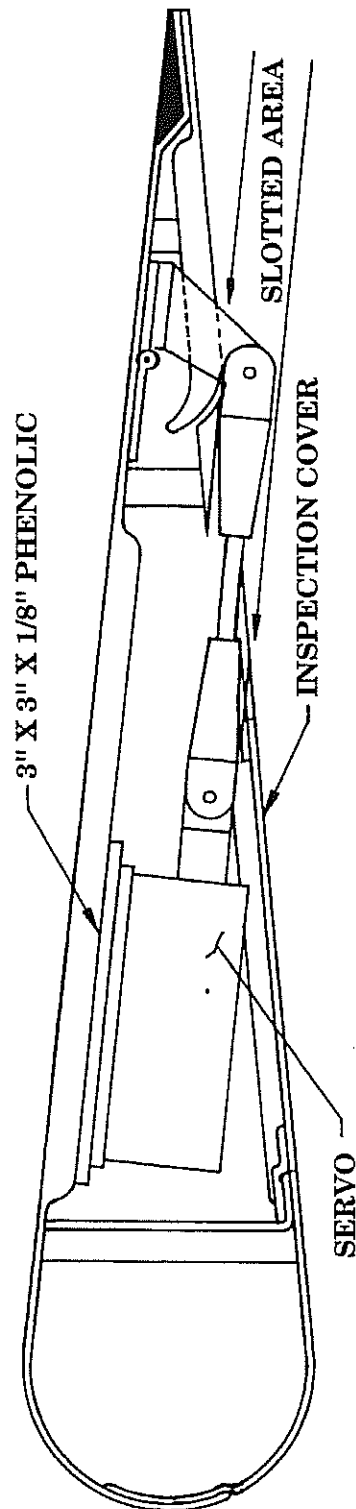
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Trim tab hinge arm

Figure 3:G:6:b



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- G26. Mount the hinge arm to the trim tab hinge using MS24693-S26 screws. Use M21042-06 lock nuts.
- G27. 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.
- G28. 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 T.E. of the tab should deflect 7/8" up and down, measured at the outboard edge of the tab, at BL 19.
- G29. 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.



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Elevators



H. COUNTER BALANCING THE ELVATORS

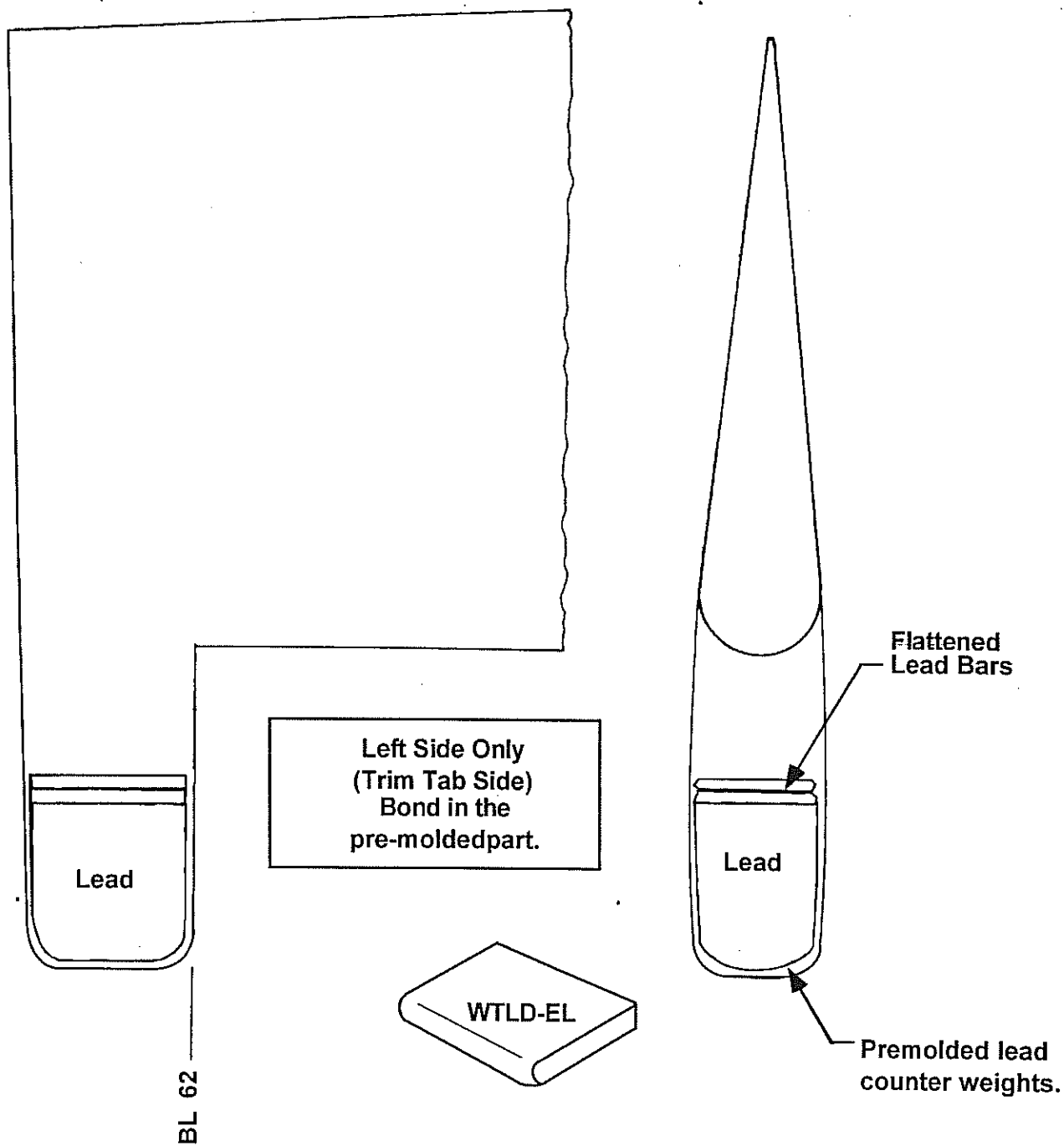
Brief summary on balancing the elevator. We have determined that the average amount of weight needed for the right side is approximately 5.5 pounds. The correct amount for the left side is about 6.5 pounds. In this section, we recommend that you bond the elevator premolded weights into position prior to bonding the two halves together. The elevator will be checked for 100% balance once it is completed.

- H1. Fit the premolded WTLD-EL into the forward areas of the elevator counterweight arms, tap the WTLD-EL into shape with a hammer. Leave as much material on the weight as possible. A coarse file works well for the final trimming of the lead.
- H2. The left side of the elevator will require two half round weights that are flattened with a hammer. These weights will butt up tight to the aft side of the WTLD-EL. Remember, this is the side with the trim tab.
- H3. Check the fit of the elevator to the horizontal counter balance area. Make sure that it fits prior to bonding the two halves together. The elevator counter balance area should be .020" below the top and bottom surfaces of the horizontal stabilizer. This is for the 2 BID of glass that will be applied later.
- H4. When satisfied with the fit. Pot the WTLD-EL into the counter balance arm with an epoxy/flox mixture.
- H5. Close out the edges of the horizontal stab in the counter weight area with 2 BID, 2 ply per side fiberglass prepreg. Keep about .050" gap between the horizontal stab and the counter weight, and be sure that gap doesn't close up or open up when the elevator is moved up and down. The Horizontal Stab., BL 61.625 rib is probably very close to being flush in the counter weight 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, use a piece of 1/4" prepreg with the inside skin and core trimmed to slip into the cavity. See Figure 3:H:2 & 3:H:3.



Sealing in Counterweights

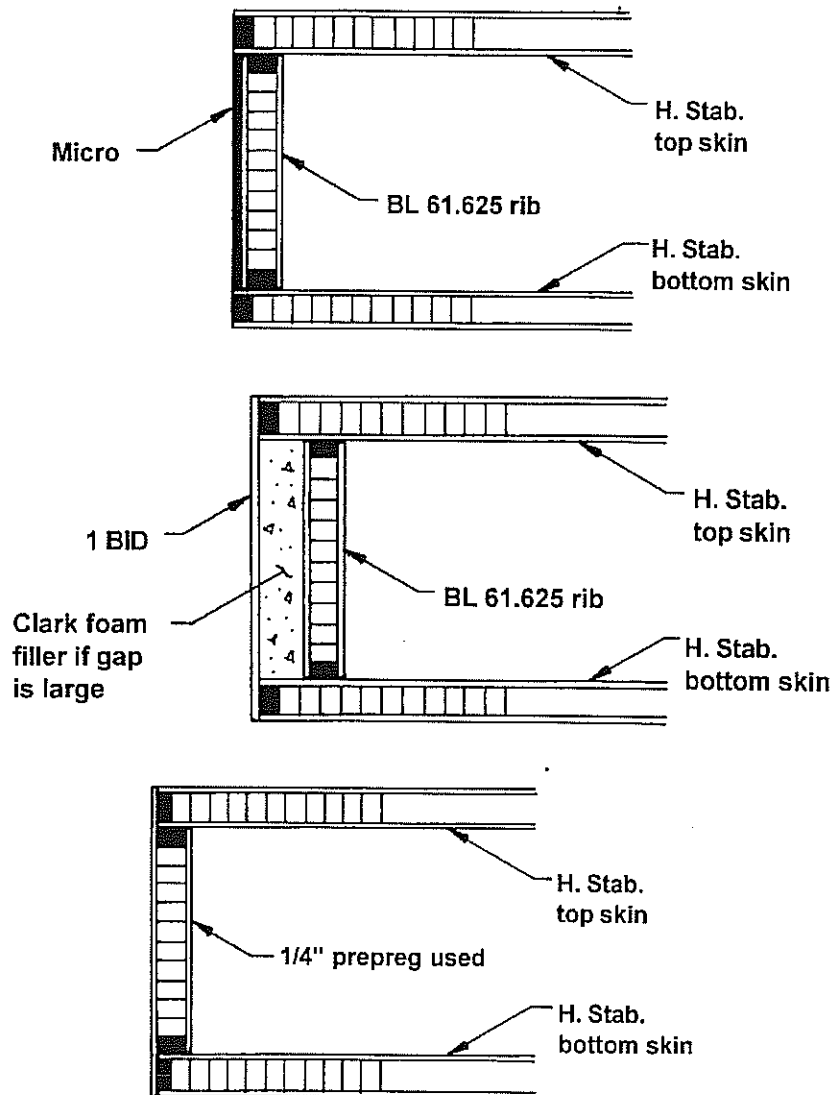
Figure 3:H:1



- H6. Close out the edges of the horizontal stab in the counterweight area with 2 BID, 2 ply per side fiberglass prepreg. Keep about 0.050" gap between horizontal stab and counterweight, and be sure that gap doesn't close up or open up when the elevator is moved up and down. The Horiz. Stab. BL 61.625 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 use a piece of 1/4" prepreg with inside skin and core trimmed to slip into cavity. See Figure 3:H:2 & 3:H:3.

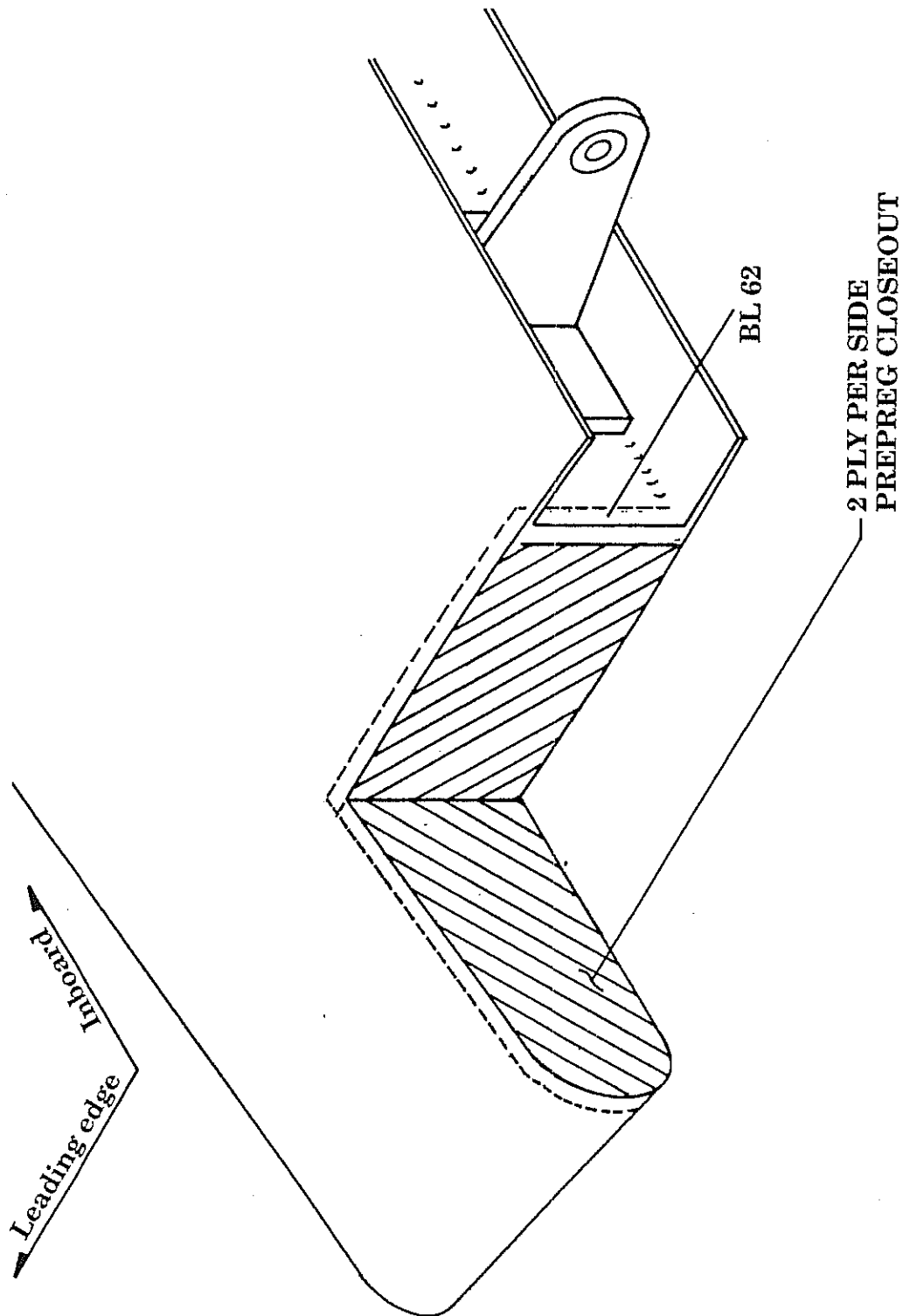
Flushing Out Face

Figure 3:H:2



Closeout of horizontal stabilizer

Figure 3:H:3



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- H7. 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.
- H8. The elevator counterweight should now hang about 3/4" lower than the H. Stab. Final balancing will be described in a later chapter.



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Elevator

I. ELEVATOR TRAVEL STOPS

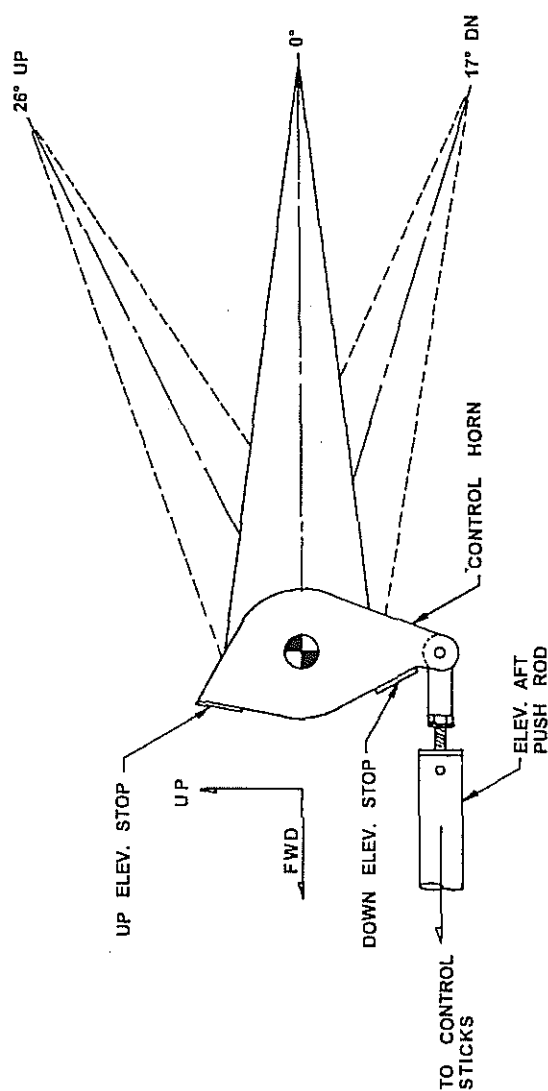
To provide positive stops for the elevator, you must install a piece of phenolic which will serve as a travel stop.

- I1. Raise the elevator to it's full up travel limit of 26 degrees. A Smart Level or dial type protractor is handy to check control throws, or you can use the Blueprint pattern gauge.

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

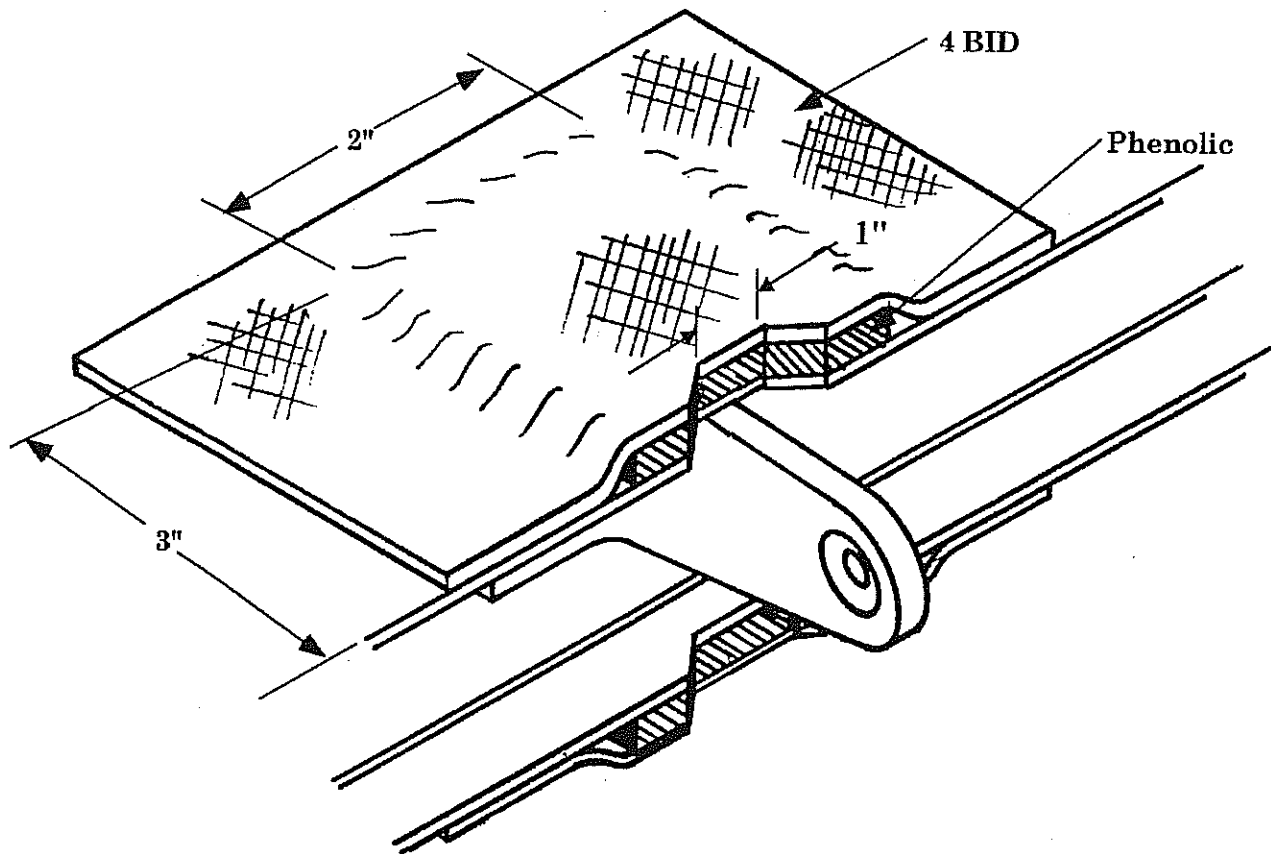
Elevator Travel Stop Profile

Figure 3:I:1:a



Forming the Elevator "Up Stop"

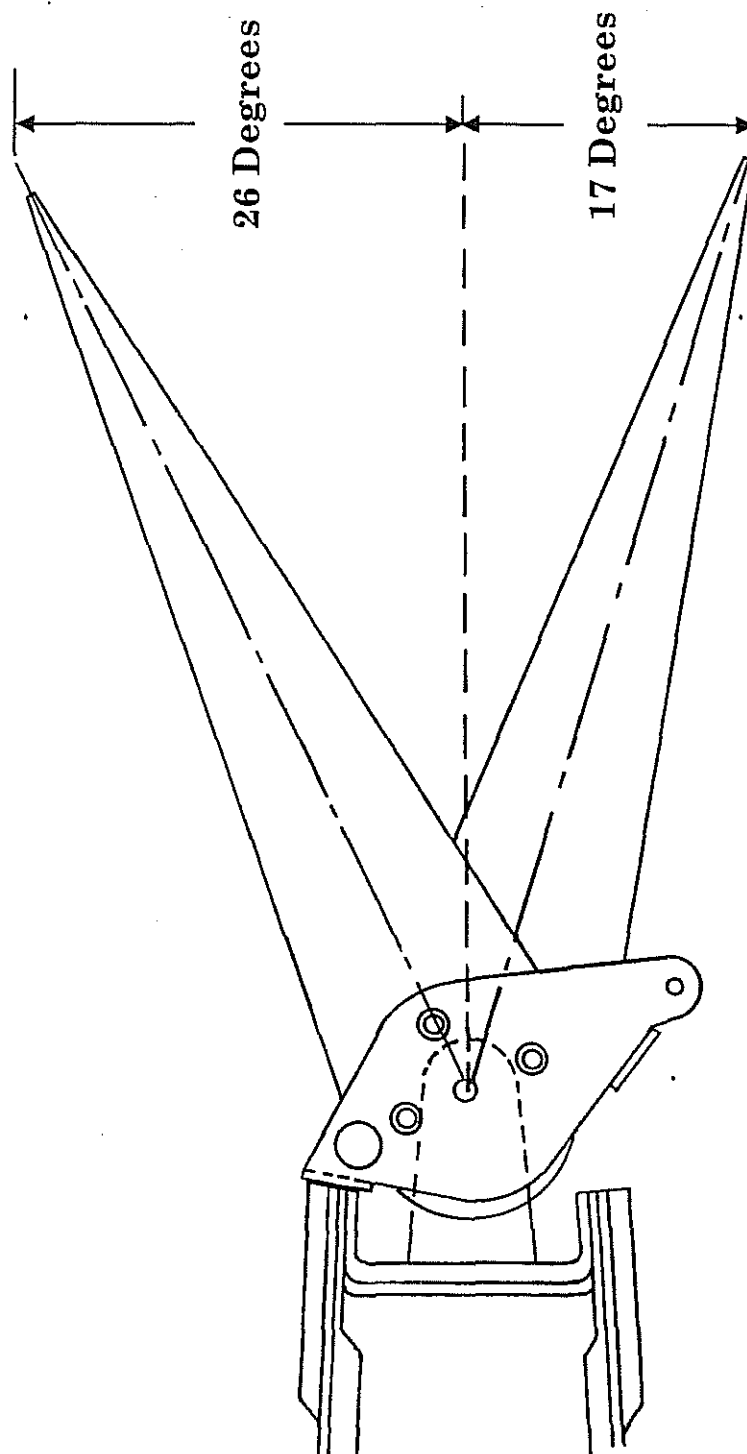
Figure 3:I:1:b.



- I2. 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 surfaces of the Horizontal Stab.
- I3. 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.
- I4. Install the 4 BID to secure the phenolic.
- I5. Set the travel by grinding a notch in the phenolic.
- I6. Rotate the elevator to its full down position of 17 degrees.

Setting the Elevator Stops

Figure 3:I:1:c



- I7. Form the elevator "down stop" exactly as you did the "up stop".

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Elevator

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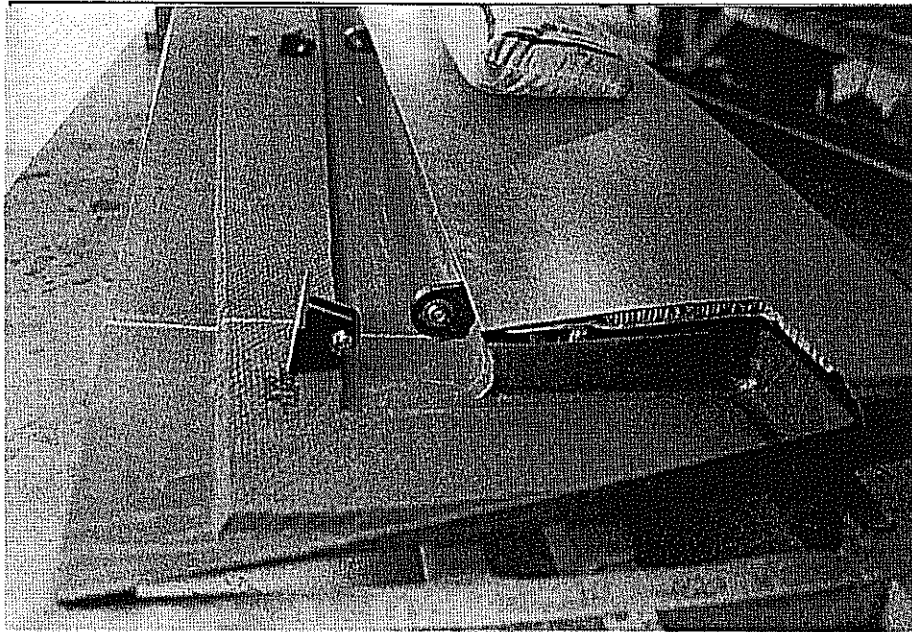
Chapter 3

REV.

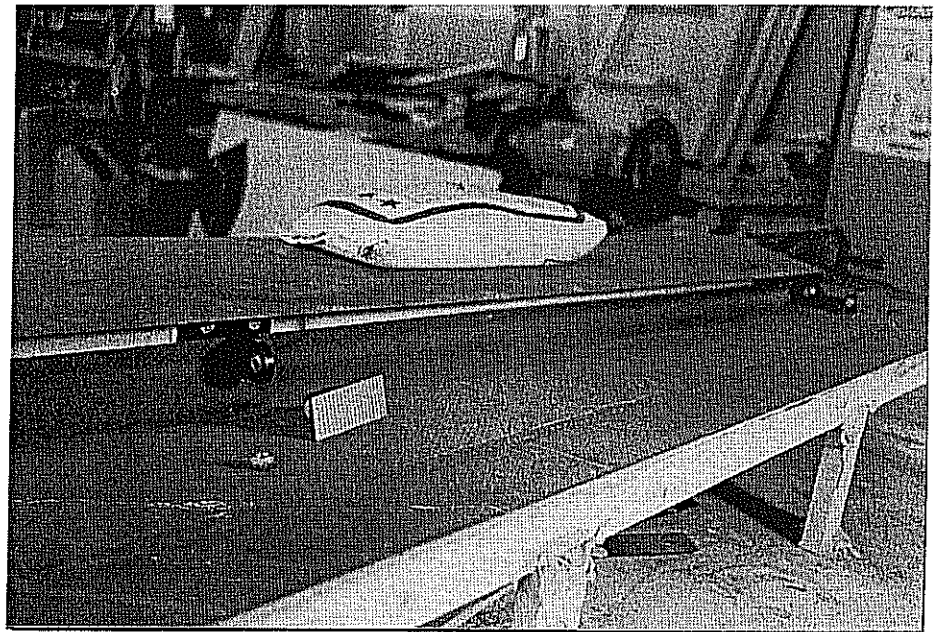
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Elevators

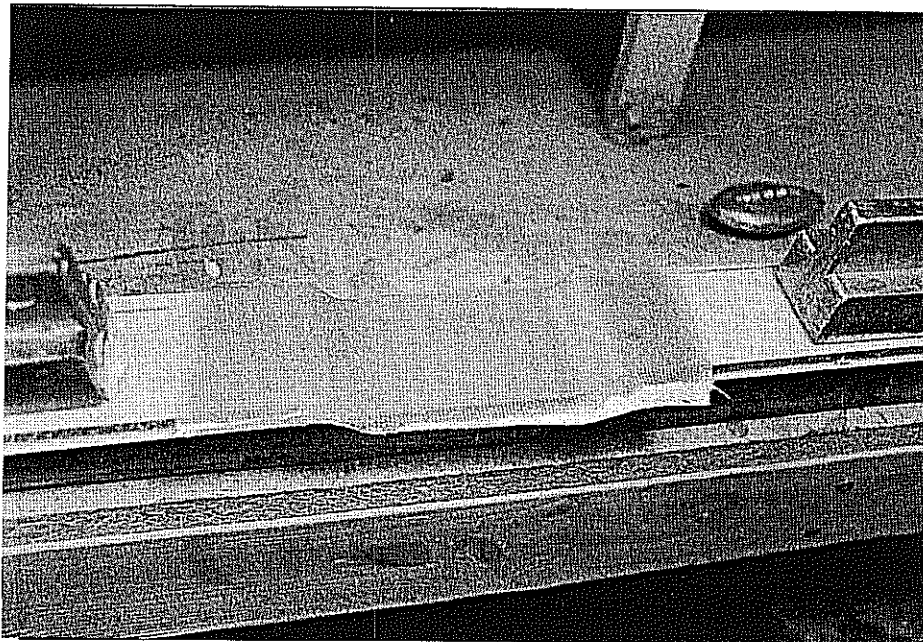




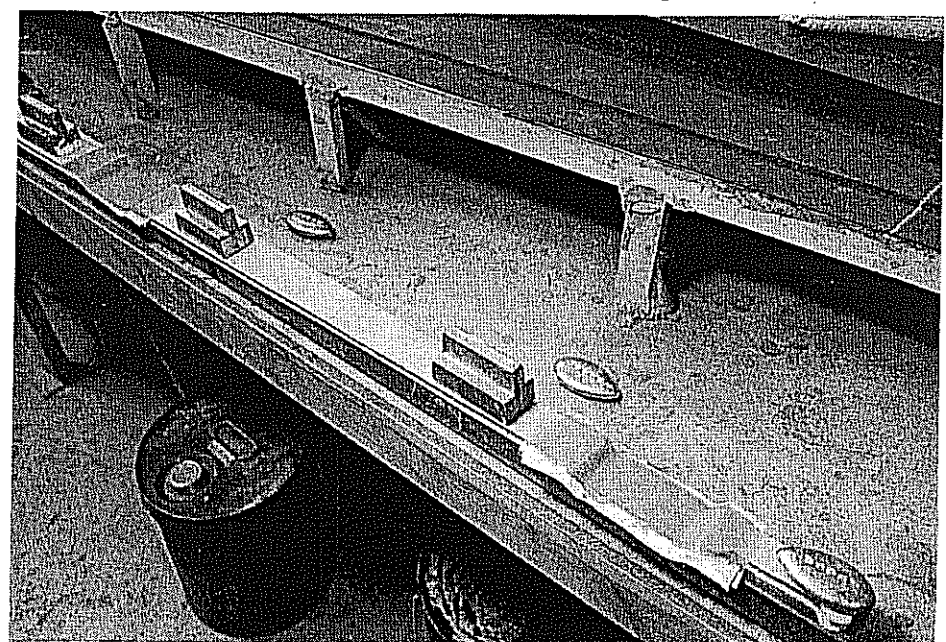
The elevator skin has been positioned and the horizontal stab has been notched for the counterweight arm.



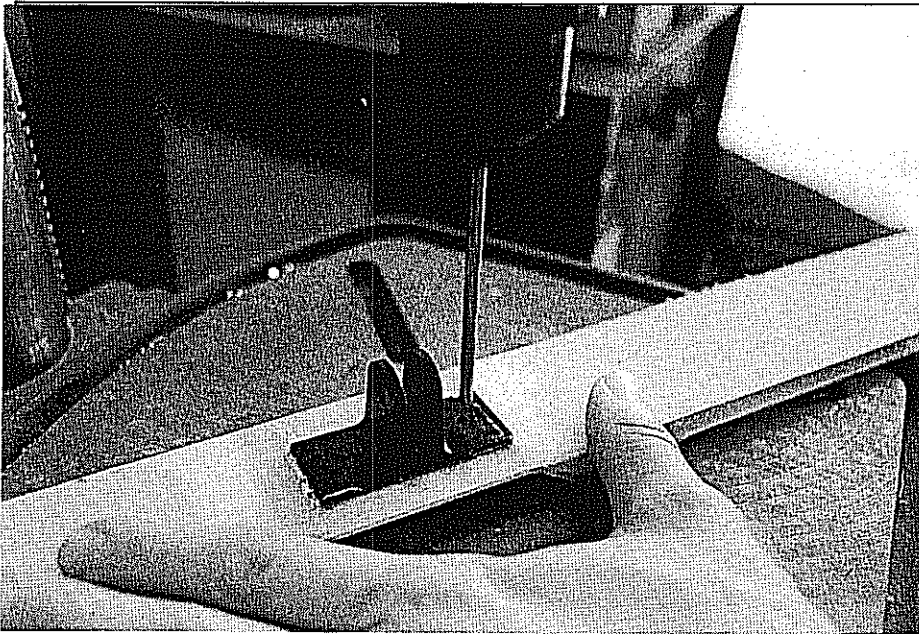
The elevator skin must be notched for the horizontal stab hinges. Notice the temporary duct tape spacer that has been applied to the aft face of the elevator hinge for proper alignment of the elevator spar.



The core and aft laminates are removed from the elevator spar in the hinge areas. The spar is then reinforced with 6 BID in these areas.



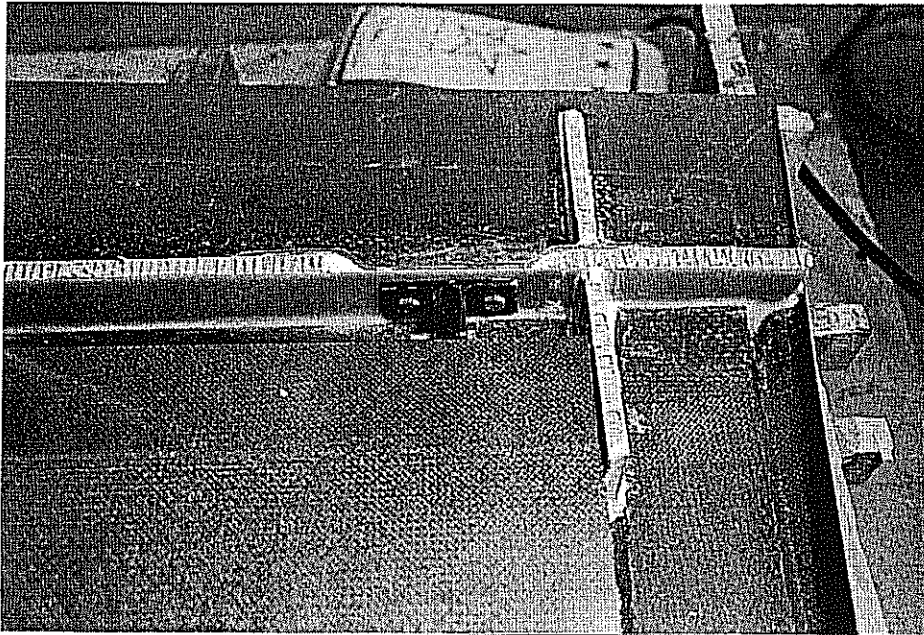
While the 6 BID hinge area reinforcements are curing, the elevator spar should be weighted on a flat surface to prevent warping.



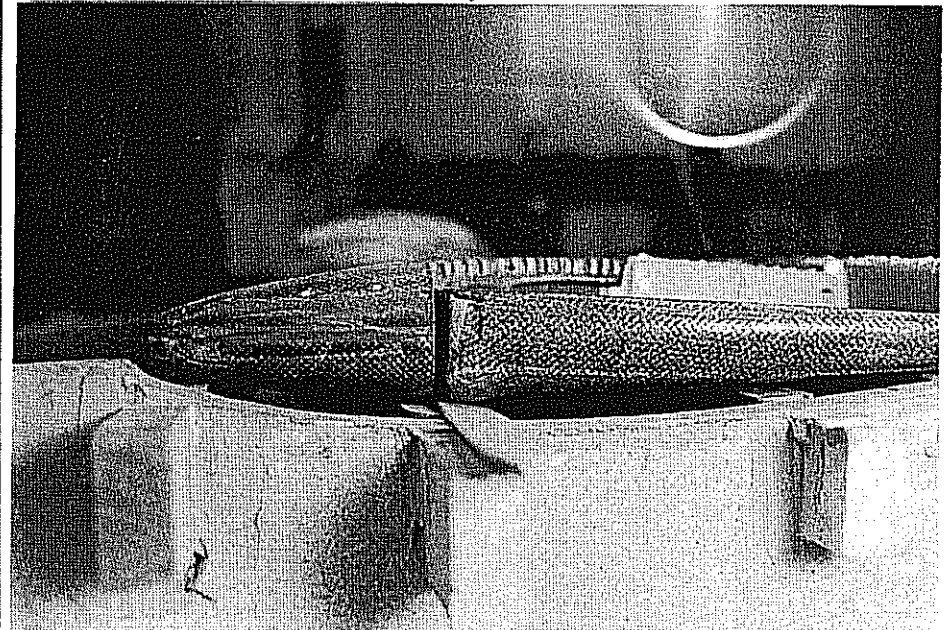
The elevator hinges are temporarily bonded to the elevator spar with instant glue. The spar is removed and the pilot holes are enlarged to 3/16".



The elevator spar has been glassed in and the hinge nutplates installed. The BL34 elevator rib is bonded in with micro and ready to be glassed. Those lead shot bags sure are handy.



Looking aft at the BL60 elevator hinge area, you can see the BL62 elevator ribs fore and aft of the spar. When bonding spars and ribs into the elevator, always use hinge bolts to maintain elevator/stab alignment.



We always kept about 15 pounds in the counterweight arm to keep the skin against the jig. We also raised the L.E. of the counterweight about .020" for a 2 BID counterweight closeout. See Chap. 3, steps D1 & H7.