REVISION LIST

CHAPTER 2: HORIZONTAL STAB. AND ELEVATOR

The following list of revisions will allow you to update the Legacy 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 shows and "R" to remove the pages.

PAGE(S) AFFECTED	REVISION # & DATE	ACTION	DESCRIPTION
2-1 through 2-7	0/02-15-02	None	Current Revision is Correct
2-8	1/09-18-02	R&R	Corrected Fig. 2:C:2
2-9 through 2-14	0/02-15-02	None	Current Revision is Correct
2-1	2/06-30-04	R&R	Part number change
2-2	2/06-30-04	R&R	Part number change
2-11	2/06-30-04	R&R	Part number change
2-1	3/12-15-04	R&R	New table of contents with page numbers.
2-13, 2-14	6/08-10-07	R&R	Hysol/Jeffco changes.

Chapter 2: Horizontal Stabilizer and Elevator

Contents

1. INTRODUCTION 2-1

2. PARTS LIST 2-1

3. CONSTRUCTION PROCEDURES 2-3

A. Building the Horizontal Stabilizer Assembly Cradle 2-3

B. Horizontal Stabilizer Hinge Brackets 2-6

C. Elevator Hinge Installation 2-7

D. Elevator Trim Tab 2-10

Setting the Trim Tab 2-10

E. Couterbalancing the Elevators 2-11

F. Closing the Horizontal Stabilizer and Elevator 2-12

Closing the Elevators 2-13

G Elevator Travel Stops 2-14

1. INTRODUCTION

In this chapter we will be assembling the final components and installing them in the horizontal stabilizer (H. Stab.) and elevators. Then we will complete the chapter by closing the H. Stab and elevators.

The horizontal stabilizer is comprised of two structural skins and an internal structure consisting of spars and ribs. These internal components have been pre-assembled in the bottom stabilizer skin at the factory. The H. Stab is a symmetrical airfoil, which means the shape of the upper surface is the same as the lower surface. The H. Stab is also tapered, meaning that it is thicker in the center than it is at the tips.

The elevator consists of two halves. The internal structure of the elevators has been completed at the factory, including the trim tab.

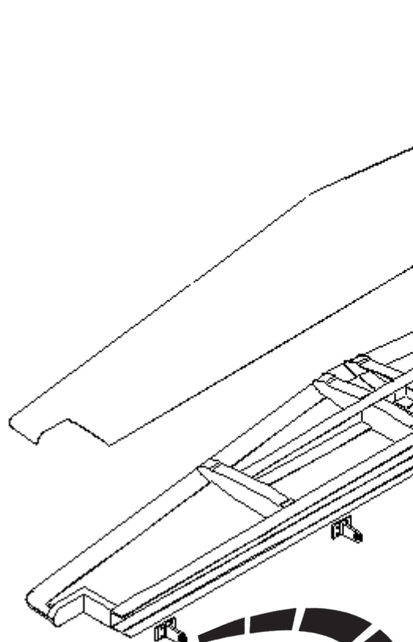
2. PARTS LIST

#	PART NO. (P/N)	QTY	DESCRIPTION	OPTIONAL ITEM *(not included with kit)*
H. Stab and Elevator				
1)	4100-01	1	Upper H. Stab Skin	
2)	4100-02	1	Lower H. Stab Skin with premolded Structure	
3)	4130-01L	1	Upper Left Elevator Skin	
4)	4130-01R	1	Upper Right Elevator Skin	
5)	4130-02L	1	Lower Left Elevator Skin with premolded structure	
6)	4130-02R	1	Lower Right Elevator Skin with premolded structure	
7)	4138-01	1	Upper Trim Tab Skin	
8)	4138-02	1	Lower Trim Tab Skin	
9)	4461	1	Trim Tab Cover	
10)	4450	5	The following are factory installed parts: 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.)	
11)	4457-01	2	Elevator Counterweights, Left & Right	
12)	9-020016	1	Elevator Control Horn (Note: refer to the following figure for mounting hardware)	
13	REH-053-U	4	The following are factory installed parts: 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.	
14)	S6A	1	The following are factory installed parts Trim Tab Servo. Servo may be listed as T2-10A. (Not shown: (6) MS24693-S28 screws, (6) K2000-06 nutplates, and (12) AN426A3-4 rivets to secure it)	
15)	MS20001	2	Trim Tab Hinge (Not shown: Trim tab activator arm, (4) hard rivets to secure it.)	
16)	AN365-1032A	3	Locknut	

Note:

Optional Parts available through :
(*) Lancair Avionics
(**) Kit Components, Inc.

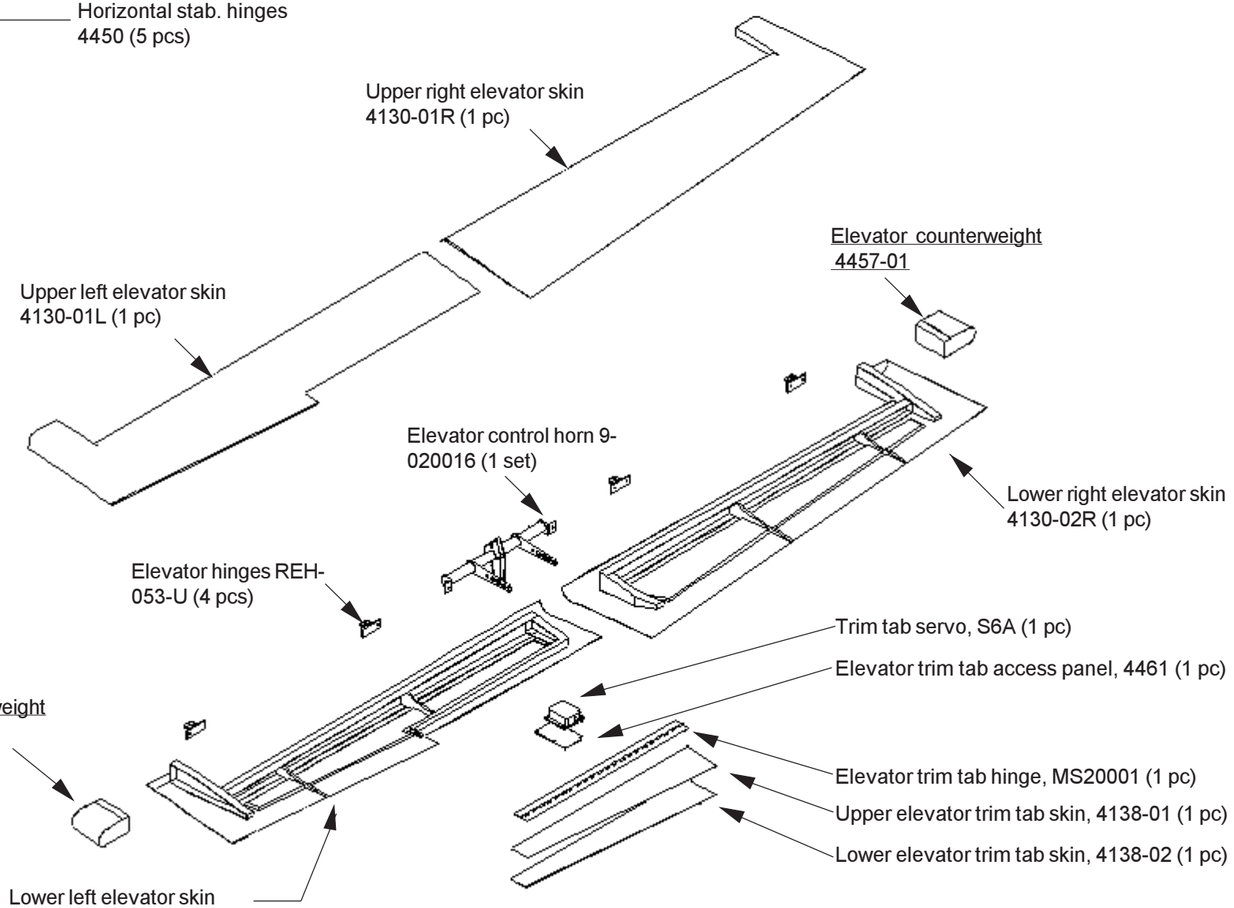
Horizontal Stab. & Elevator Exploded View
Fig. 2:A:1



Upper horizontal stab. skin
4100-01 (1 pc)

Lower horizontal stab. skin
4100-02 (1 pc)

Horizontal stab. hinges
4450 (5 pcs)



Upper right elevator skin
4130-01R (1 pc)

Elevator counterweight
4457-01

Upper left elevator skin
4130-01L (1 pc)

Elevator control horn 9-020016 (1 set)

Lower right elevator skin
4130-02R (1 pc)

Elevator hinges REH-053-U (4 pcs)

Trim tab servo, S6A (1 pc)

Elevator trim tab access panel, 4461 (1 pc)

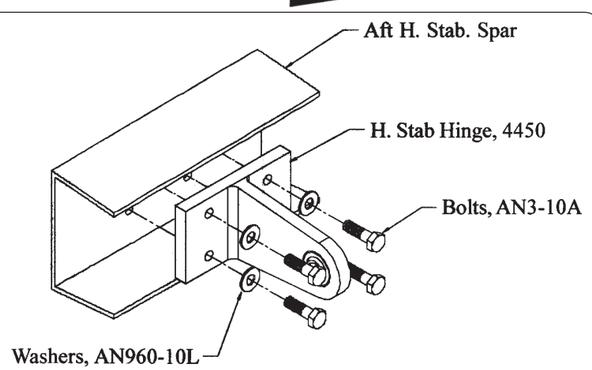
Elevator counterweight
4457-01

Elevator trim tab hinge, MS20001 (1 pc)

Upper elevator trim tab skin, 4138-01 (1 pc)

Lower elevator trim tab skin, 4138-02 (1 pc)

Lower left elevator skin
4130-01L (1 pc)



Note: Always check bolt lenghts going through composite parts.

3. CONSTRUCTION PROCEDURES

A. Building the Horizontal Stabilizer Assembly Cradle

The assembly cradle is needed to ensure that a "true" airfoil for the horizontal stabilizer with no twists or warps can be constructed. You can make or purchase these simple airfoil cradles. Using a flat, level tabletop is ideal, and it is essential that the airfoil cradles be properly aligned.

To make the cradles yourself:

1. Use blueprint patterns 4420, 4421, 4422.
2. Check the blueprints for proper scale:

Location	Chord Length	Tolerances	Blueprint Number
BL 0	28.00"	± 1/8"	4420
BL 21	23.55"	± 1/8"	4421
BL 46.75	18.00"	± 1/8"	4422

3. Use spray adhesive and glue 1 copy of 4420, and 2 copies each of 4421 and 4422 to 1/2 particleboard. We like the 3M brand.

4. Using a Sabersaw we cut along the outside of the cradle lines and then sand up to them.

A 1. Construct a table for your jig 100" x 36", 30"- 34" tall. We suggest a box-frame structure as shown. The table should be relatively level, but it is not necessary to spend great amounts of time on making it "perfect." The final leveling is done to only the cradles, and not the table. Secure to floor with Bondo.

A 2. Draw a straight line 14" from the backside of the table. Draw perpendicular centerlines to this at BL0, BL 21, and BL 46.75 (BL# stands for Baseline, or the center of the aircraft on the longitudinal (roll) axis, ie. BL21 = 21" from centerline.

A 3. Install the 2" x 4" cradle supports on one side of the centerlines only. Allow 1/4" each side of the centerlines so the cradles will be centered on the lines. (1/4" is equal to half the thickness of the cradles provided you did use 1/2" wide material. If not, adjust this reference accordingly.

A 4. Install and align the cradles using the following procedure:

INTENTIONALLY LEFT BLANK

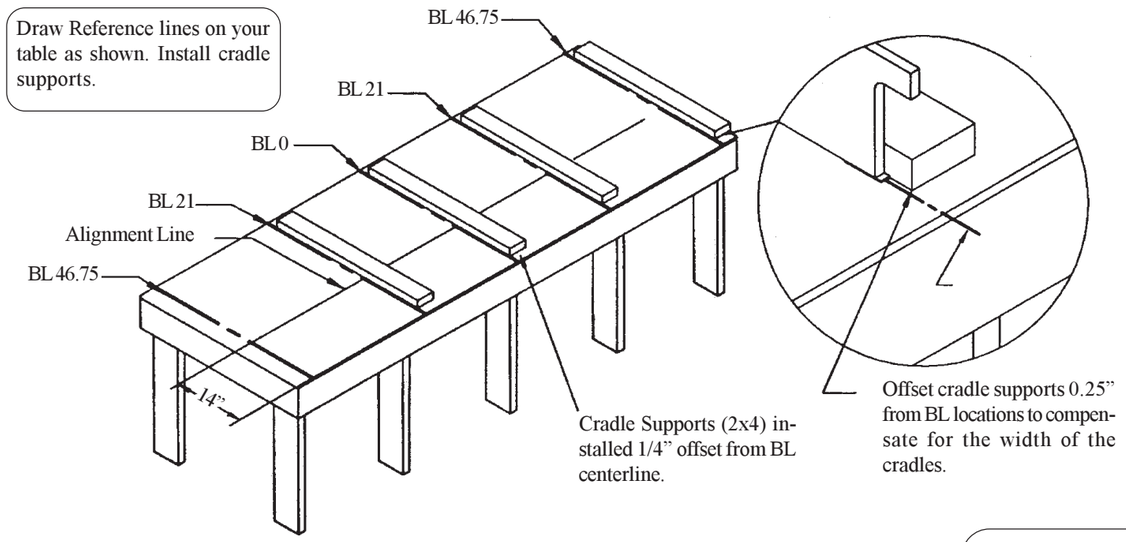
Horizontal Assembly Jig Construction

Fig 2:A:2

STEP (1)

Alignment Procedure

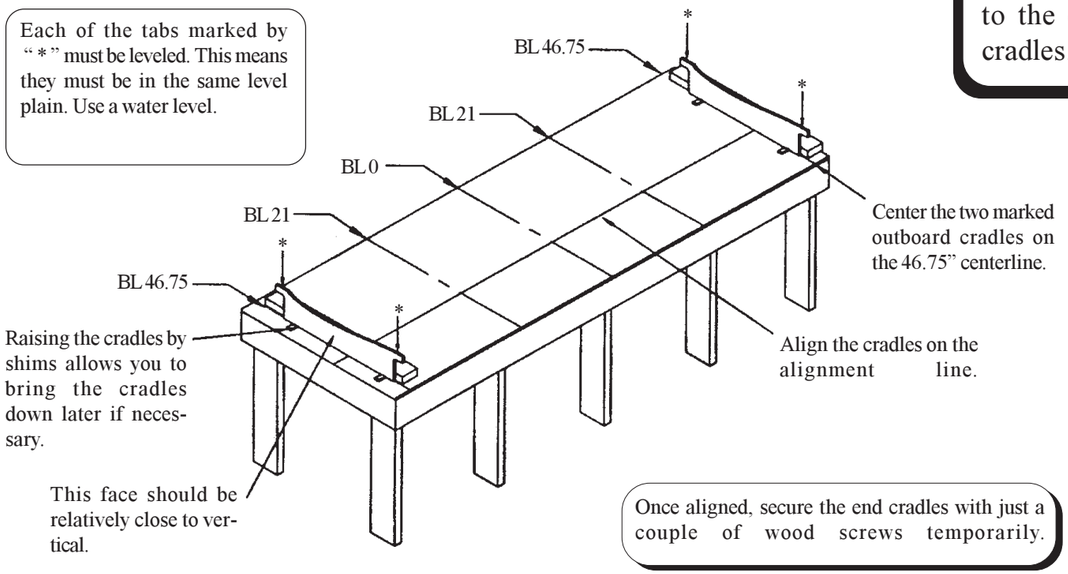
Draw Reference lines on your table as shown. Install cradle supports.



STEP (2)

Align the two outboard cradles

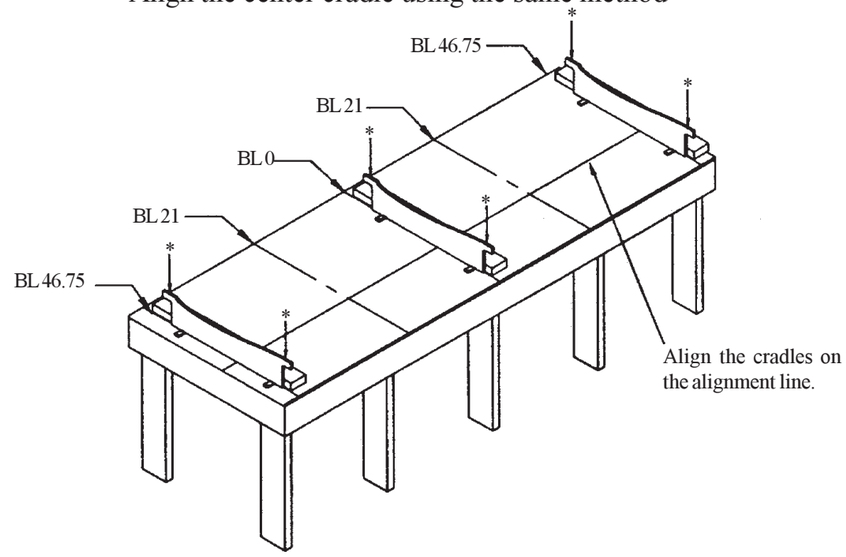
Each of the tabs marked by " * " must be leveled. This means they must be in the same level plain. Use a water level.



Once aligned, secure the end cradles with just a couple of wood screws temporarily.

STEP (3)

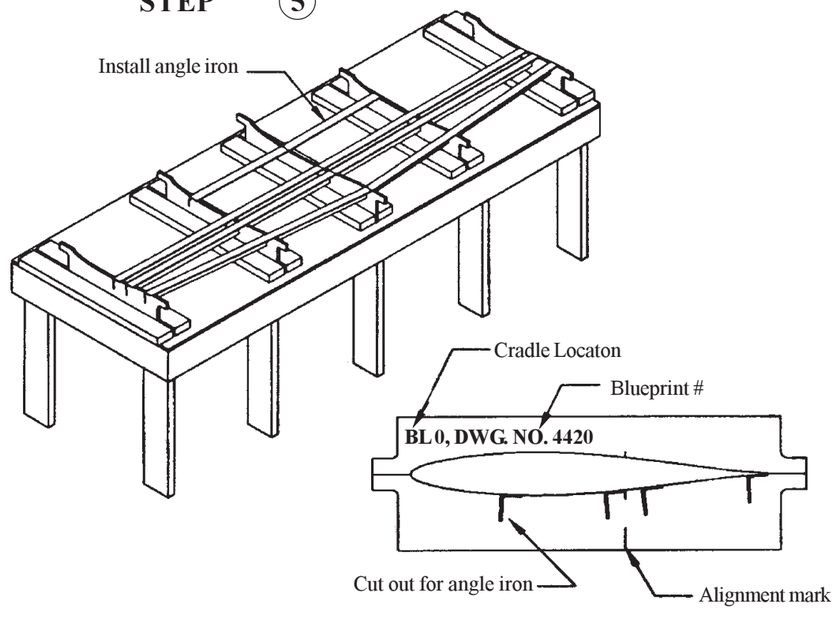
Align the center cradle using the same method



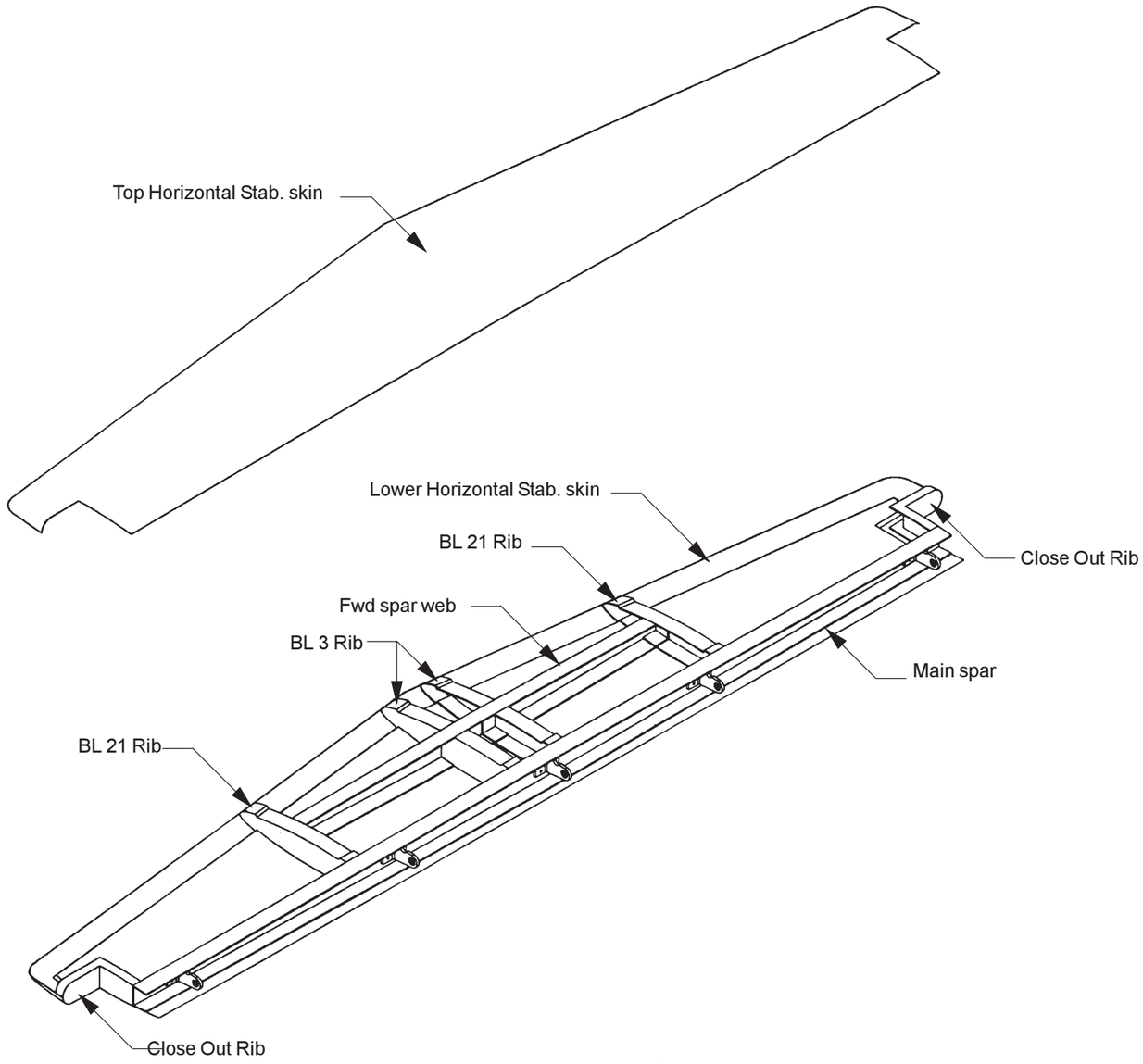
STEP (4)

Install the two remaining cradles. Align with a stringline to the center and outboard cradles.

STEP (5)



Horizontal Detail View
Fig 2:B:1



B. Horizontal Stabilizer Hinge Brackets

With the horizontal stabilizer table complete, you can now begin building the horizontal stabilizer.

B 1. Position the lower horizontal stabilizer assembly in the cradles.

-The stabilizer should be centered.

-The stabilizer should be pushed forward and fit well in the cradles. Look underneath it to make sure the stabilizer conforms to the cradle shape. Use some weight if necessary. Weight down and apply a few dabs of bondo to secure in place.

WARNING: STRUCTURAL BONDS *CANNOT* BE MADE OVER PEEL PLY. BE SURE TO REMOVE ALL PEEL PLY FROM BONDING AREAS. FAILURE TO DO SO WILL RESULT IN STRUCTURAL FAILURE OF THE BOND.

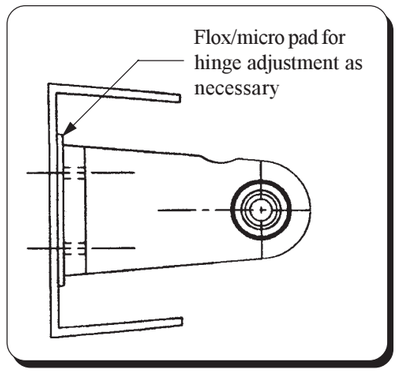
B 2. Check the hinge alignment. The alignment was done at the factory but must be double-checked to ensure a proper fit. The horizontal stabilizer must be weighted down in the cradle for this step.

-Install the five 4450 hinges on the rear spar and hold in place with clecoes.

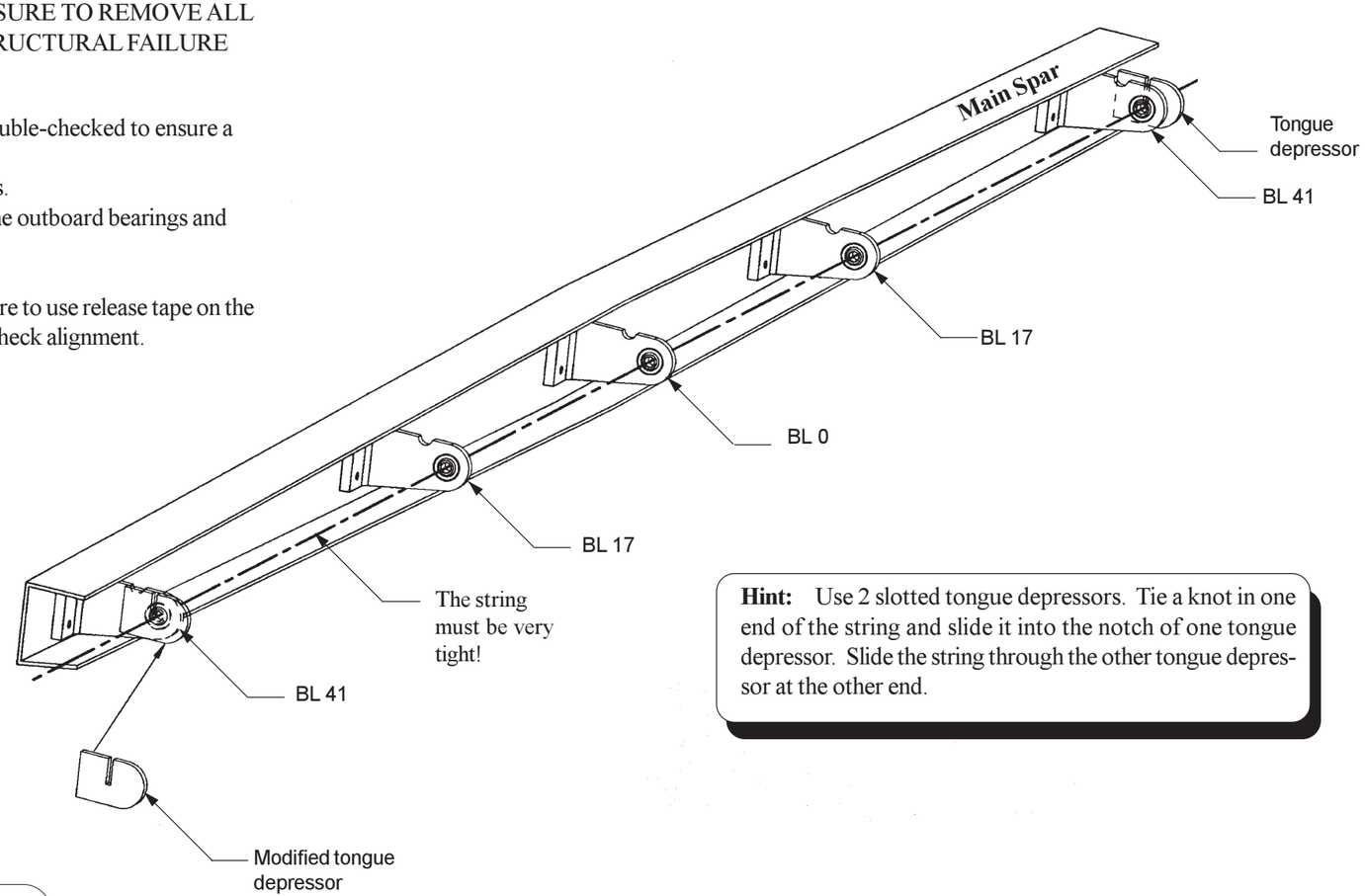
-Pull a string through the bearings, making sure the string is centered on the outboard bearings and that it is tight. Refer to the figure

To adjust fwd/aft alignment:

Apply a layer of 50/50 micro/flox mix between the web and bracket . Be sure to use release tape on the hinge, or you might not be able to remove it when the micro/flox cures, recheck alignment.



Hinge Alignment
Fig. 2:B:2



Hint: Use 2 slotted tongue depressors. Tie a knot in one end of the string and slide it into the notch of one tongue depressor. Slide the string through the other tongue depressor at the other end.

Note: Adjustments should not be necessary. If you think they are necessary we suggest talking it over first with a Lancair technical representative.

C. Elevator Hinge Installation

The 4550 hinges and the 9-020016 elevator control horn must be installed before the elevators can be fitted.

C 1. Install the 9-020016 elevator control horn, long end down. Cut a slot in the BL 0 cradle to accommodate the control horn.

C 2. Position the elevators.

1. Apply 3 layers of duct tape to the inboard side of the inboard elevator ribs. This is to compensate for a 2 BID installed later on.
2. Install AN4-10A pivot bolts through the 4450 and REH-053-U hinges.

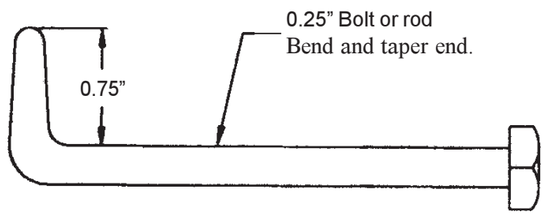
C 3. Move the elevator through its full travel range. Make sure the notches for the hinges will clear the hinges by 1/8" at full down travel. (See Fig. 2:C:3)

C 4. Expand the notches you made in the lower elevator skin for the hinges 3" - 4" in length, to allow you to get a wrench and needle-nose pliers to the bolts.

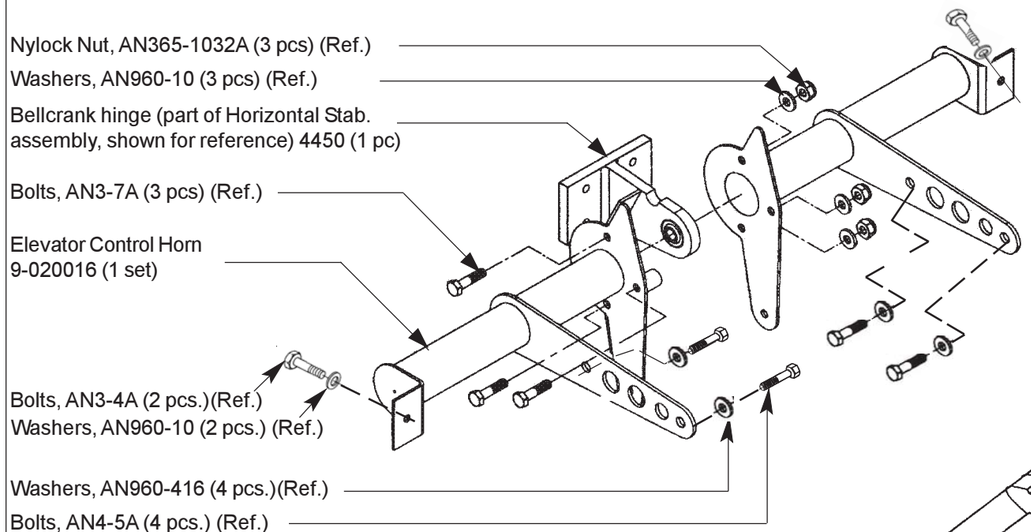
> **Hint:** Remove just enough carbon so you can get to the bolts with needle-nose pliers. Installing the elevators can be a frustrating process, especially when you are bent over backwards, holding the elevator and aligning the bolts as a bead of sweat is running down your forehead and into your eyes so you can't see what you are doing. Make a hinge alignment tool as shown in Fig. 2:C:1. Use it to align the hinge, then push it out with the bolt from the other side.

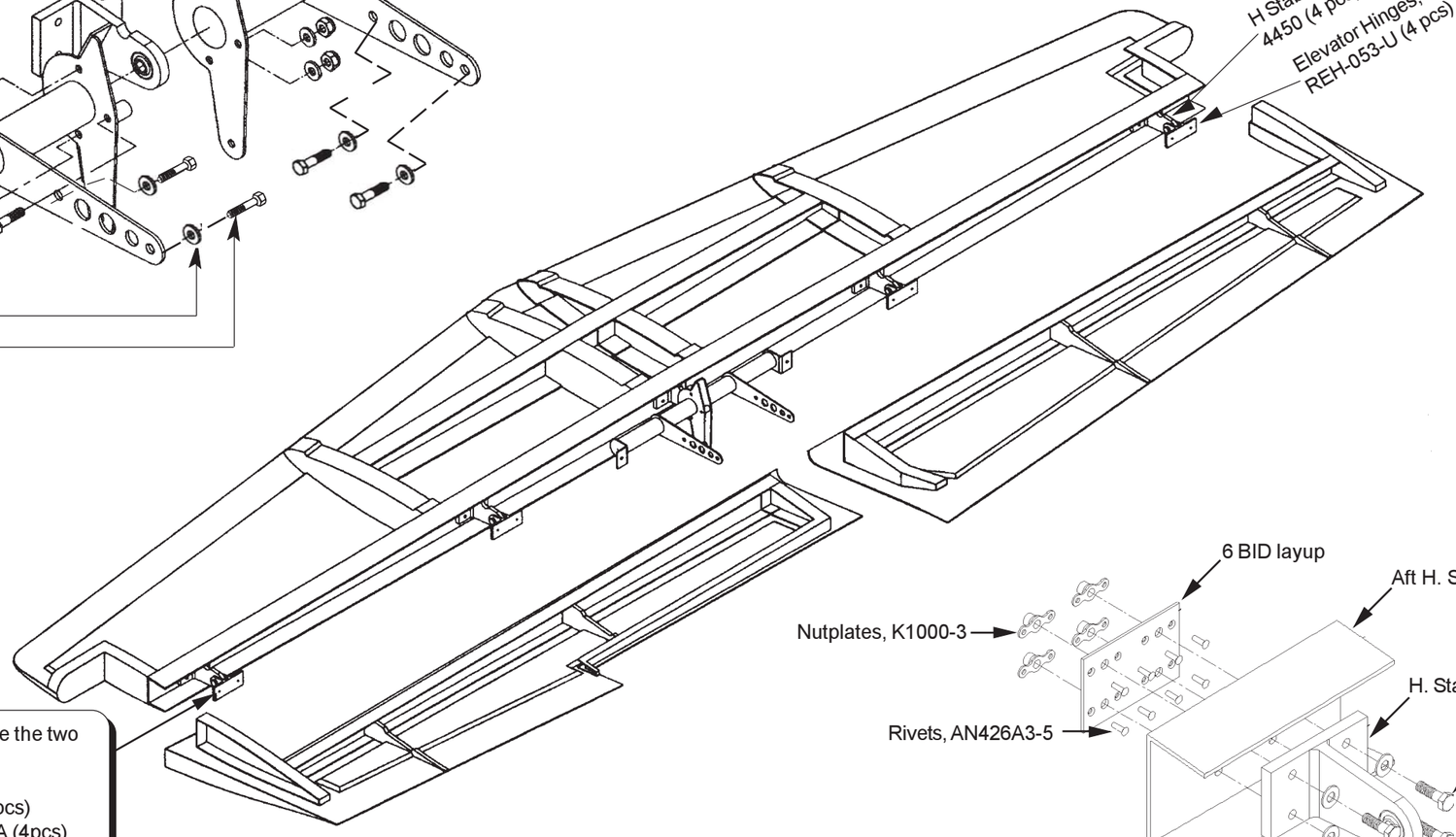
C 5. Check the gap between the horizontal stabilizer and the lower elevator skin It should be roughly 0.05 ". You will fine tune this later when you do the body work.

Hinge Alignment Tool
Fig. 2:C:1



Horizontal Assembly
Fig. 2:C:2

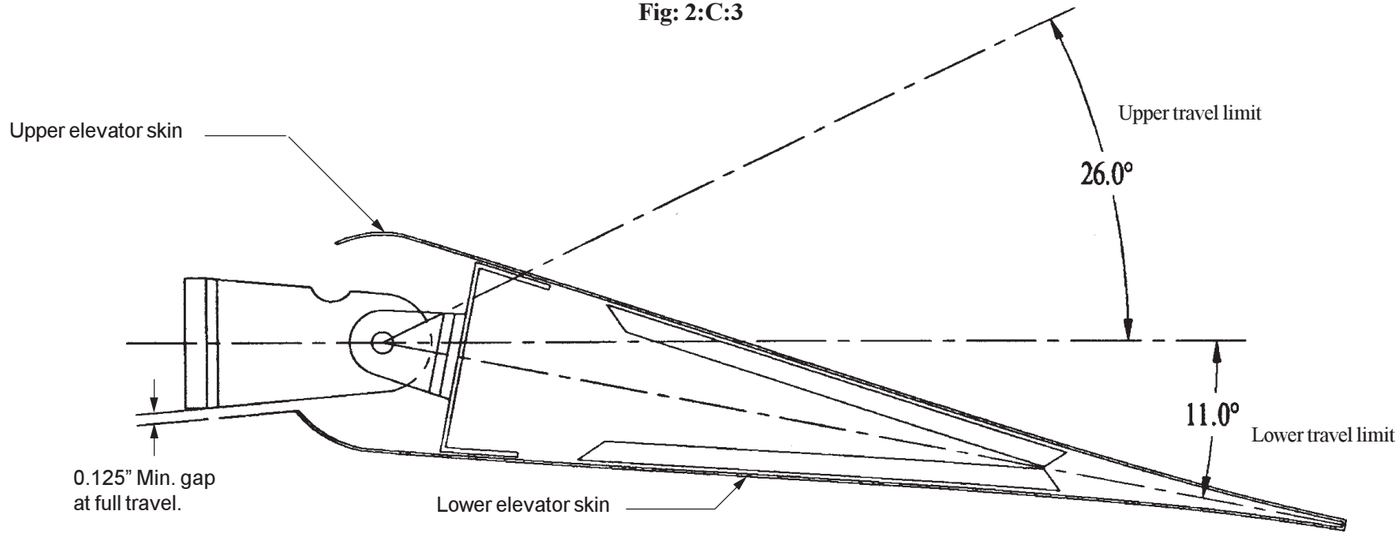


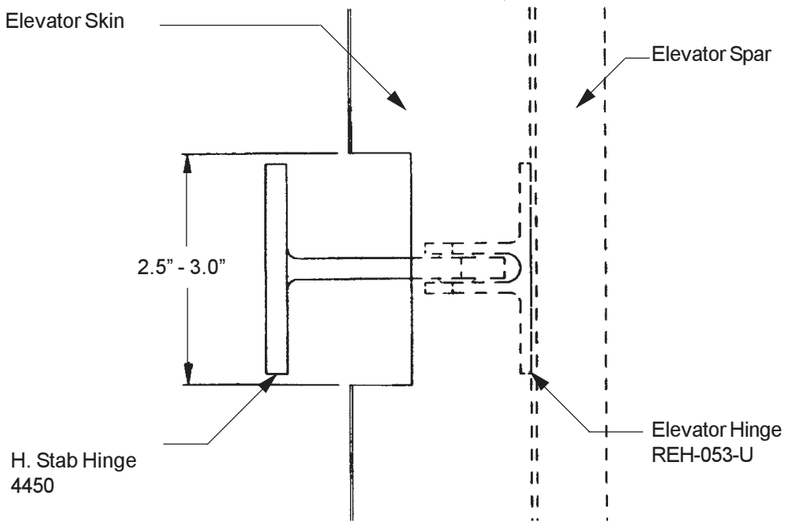


Hardware used to secure the two hinge halves together:
Bolt, AN 4-10A (4 pcs)
Washer, AN960-416 (4 pcs)
Nylock Nut, AN365-428A (4pcs)

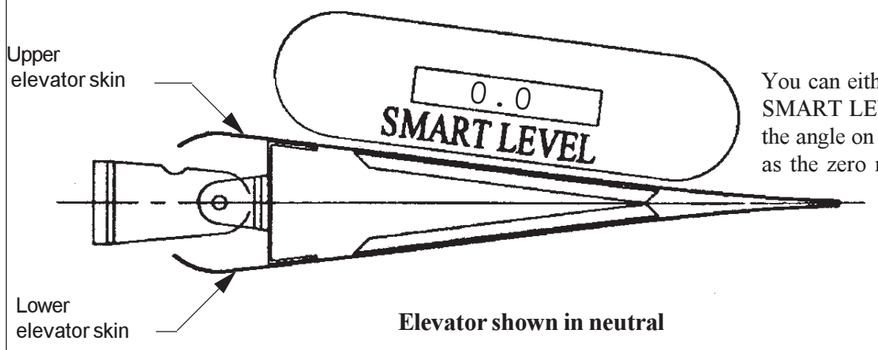
Note: Always check length of bolts as they may vary.

Elevator Travel and Clearance
Fig: 2:C:3





Carefully open slot as required to allow for any tools needed to install bolts. We recommend the Gear Wrench™ for installation of the locknuts.



You can either set the SMART LEVEL to 0° or use the angle on SMART LEVEL as the zero reference.

Elevator shown in neutral

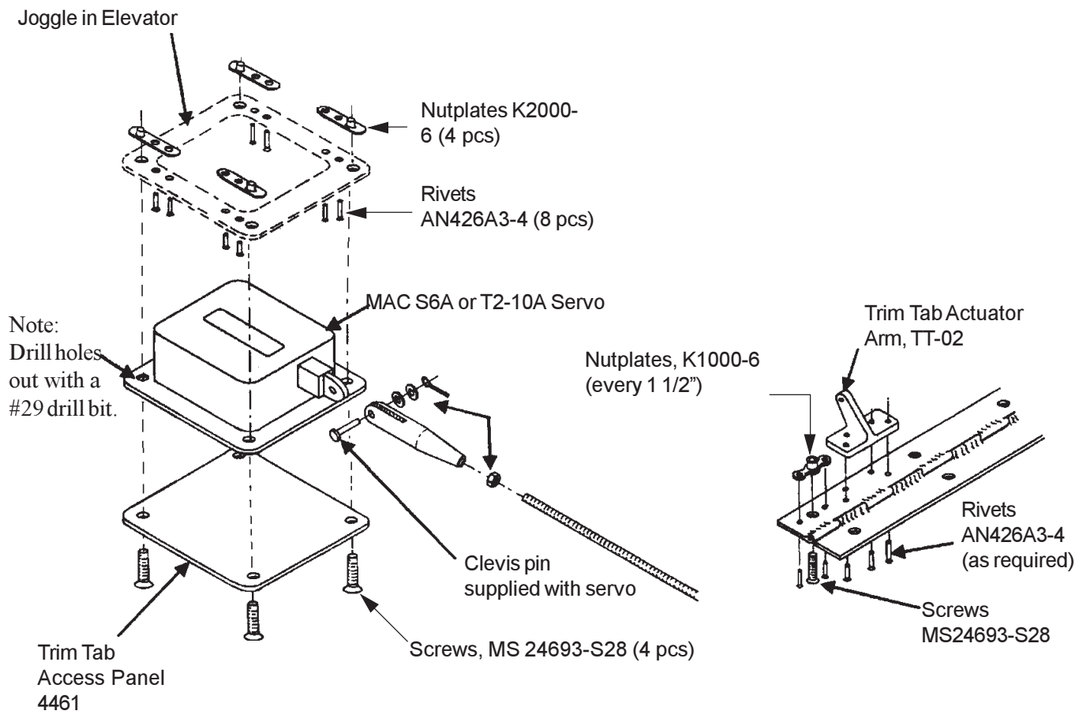
Recomended method for finding elevator travel

1. Zero the SMART LEVEL in neutral position. The neutral position is defined by the counter weight flange being flushed with the horizontal stabilizer.
2. Set the travel using the SMART LEVEL. The elevator deflection is 26° up and 11° Down.

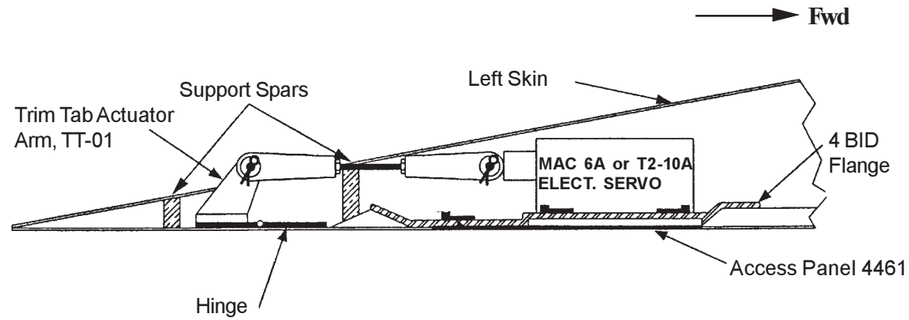
D. Elevator Trim Tab

The elevator trim tab is preassembled. This selection is primarily for reference of part number and the installation for your reference. The trim tab uses an 6A or T2-10A servo.

Trim Tab Exploded View
Fig 2:D:1



Trim Tab Installation
Fig 2:D:2



Setting the Trim Tab

1. Neutral: The trim tab is aligned to the elevator.
2. Pitch Up: The trim tab moves down. This causes the elevator to go up.
3. Pitch Down: the trim tab moves up. This causes the elevator to go down.

The travel is set such that the trim tab moves an equal distance up and down.

E. Couterbalancing the Elevators

The elevators on the Legacy 2000 are 100% mass balanced. The elevators will be closed with the premolded lead counterweights in position. Any excess weight will be drilled out. You must be able to rotate the elevators freely on the hinges in order to balance them. You CANNOT properly balance an elevator that is not free floating.

E 1. Drop the premolded counterweights (P/N 4457-01) in place. Check the fit of the upper skin to the lead weight. The lead weight should not be holding the skin up.

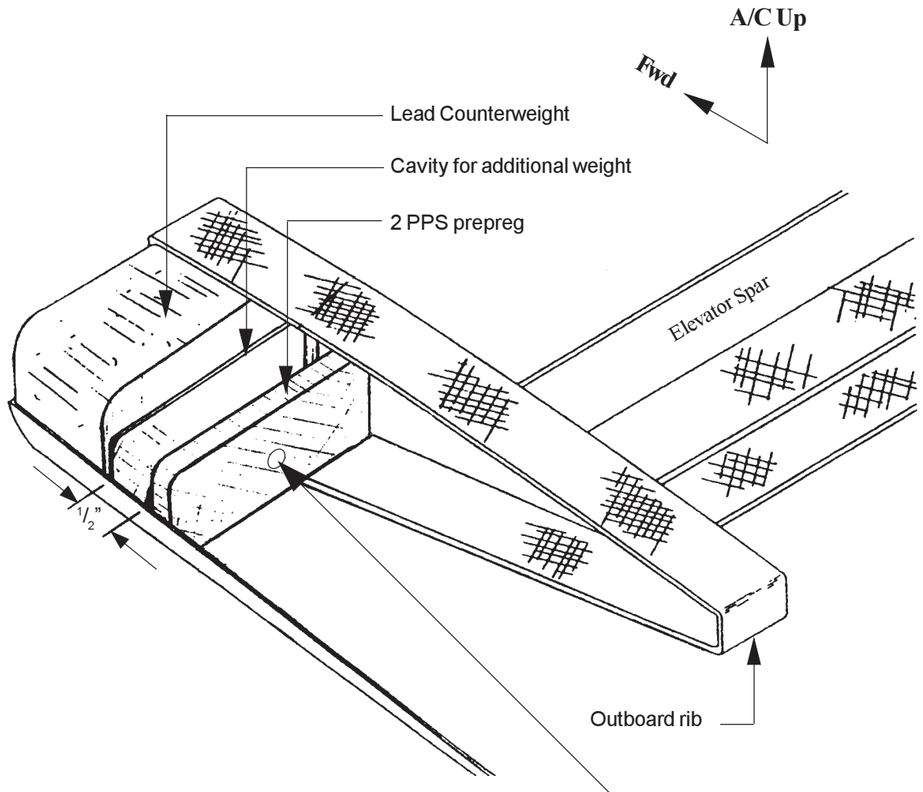
E 2. Bond the lead weight in place with epoxy/flox.

E 3. Cut and fit a piece of 2 PPS prepreg 1/2" aft of the lead weight. Bond in place.

E 4. Install the 2 Bid from the counterweight to the elevator skin and back onto the rib.

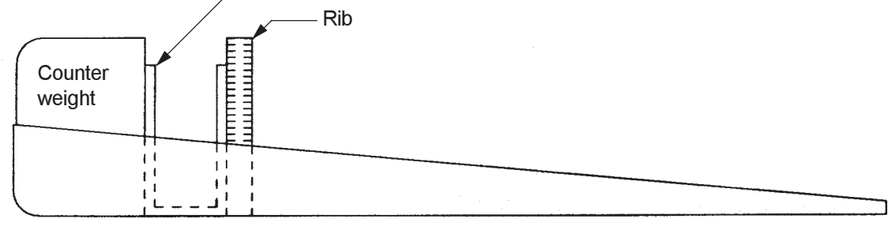
E 5. After curing and body work, balance the elevators individually and remove weight as necessary.

Elevator Counterweight Installation
Fig. 2:E:1



Install a vent hole in the closeout rib. The purpose of the small cavity formed between the lead and rib is to allow you to add weight should it be necessary.

2 BID Reinforcement
Fig. 2:E:2

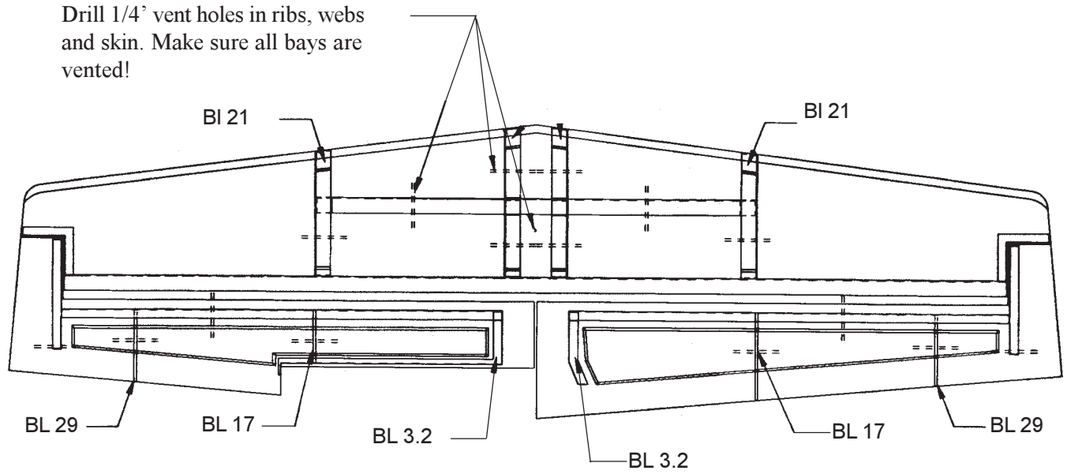


F. Closing the Horizontal Stabilizer and Elevator

F 1. Drill vent holes in ribs, webs, and the skin as shown in the figure.

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

Horizontal Stab. and Elevator Vent Hole Locations
Fig. 2:F:1



F 2. Verify the fit of the upper horizontal stabilizer and elevator skins.
Procedure:

1. Place pieces of clay every 6" on the spars, ribs, etc.
2. Place the skin and clamp down on the cradles. Place weight on the stabilizer and elevators as if you are closing them.
3. Look over the horizontal stabilizer and elevators. There should be no bumps or irregularities, and it should fit well in the cradles. Adjust weight if necessary.
4. Remove the weights and cradles. Confirm that the pieces of clay are .05 or thinner. If they are taller, perform an epoxy/flox release.

Note: Make sure the horizontal stabilizer and the elevators are positioned correctly in the cradles, and the hinges and control horn are bolted in place.

Epoxy/Flox release (Only if necessary):

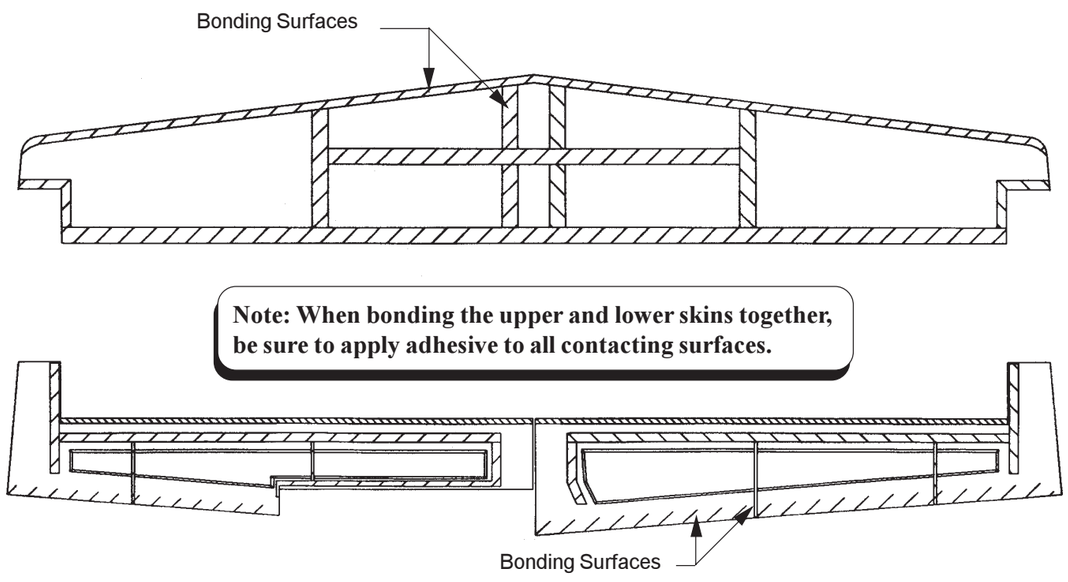
1. The areas to be released must be sanded and cleaned following approved bonding procedures.
2. Use 2 layers of duct tape in the bonding areas to release the upper skin. (This allows room for the resin in the final closing process.)
3. Paint a thin layer of pure epoxy on the spars and ribs.
4. Apply the epoxy/flox mixture to the spars and ribs- don't forget to form it into a triangle shape.
5. Place the upper skin and clamp the cradles down. Add weight as if you are closing. Let cure.
6. Take note of the fit of the upper skin in each area. Look for any gaps, bumps, warps, etc.
7. After cure, remove the weights and cradles. Carefully peel the upper skin away. Remove the tape. Fill any major holes or divots with epoxy/flox.

F 3. Practice the closing a couple of times to make sure you have everything you will need- weights, clamps, clecoes, straight edges, etc. Decide what you will use to hold the leading edge joggles together during bonding (screws, clecoes, duct tape?)

F 4. De-wax all ribs, spars, and joggles using Acetone. Apply a generous amount with a clean rag or paper. Follow with another clean rag.

F 5. Sand all bonding surfaces (upper and lower) with 80-grit sandpaper.Closing the Elevators

Elevator Bonding Areas
Fig. 2:F:2



Note: When bonding the upper and lower skins together, be sure to apply adhesive to all contacting surfaces.

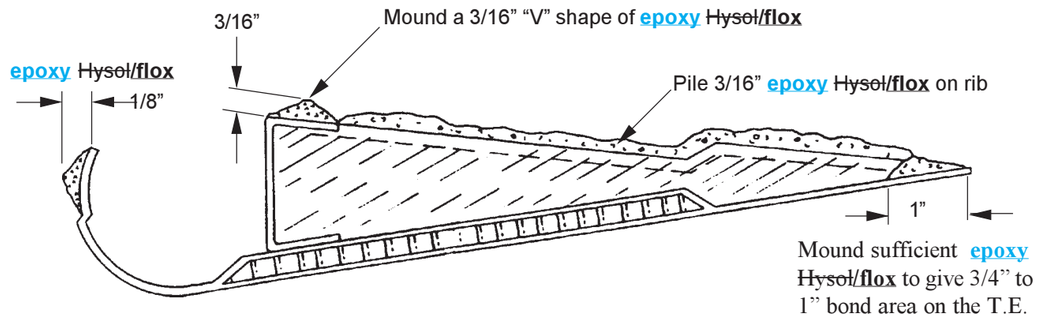
Closing the Elevators

F 6. Brush pure epoxy ~~Hysol~~ on all bonding surfaces.

F 7. Mix in 1 tablespoon of flox per 2 ounces of epoxy ~~Hysol~~. Mound epoxy ~~Hysol~~on all bonding surfaces in a "V" shape.

F 8. Position the upper skins. Clamp down the cradles and add weight bags. Check visible bonding areas for squeeze out (excess resin).

Elevator Cross Section @ BL 29
Fig. 2:E:3



NOTE: Once again you must use a straight edge to check for any warped or bowed areas. It's okay to shuffle weights around to allow for this check. This is for all the marbles, so check and double-check. Readjust your weights if necessary.

F 9. After the Hysol has cured, sand the outboard joggles on the elevators and clean with acetone. Apply 2 BID by 2" wide strips in the joggles.

F 10. Follow the same procedure for the horizontals as for the elevators. Insert the bolts into the hinges to locate the closed elevators and open horizontal into the cradles. Use masking tape to protect the leading edge of the elevators from possible dripping from the trailing edge of the horizontal spar.

F 11. Trim the trailing edge of the top horizontal spar skin so that it rest **flush** with the top of the elevators, not on the top of the elevators. The gap between the two parts can be increased later.

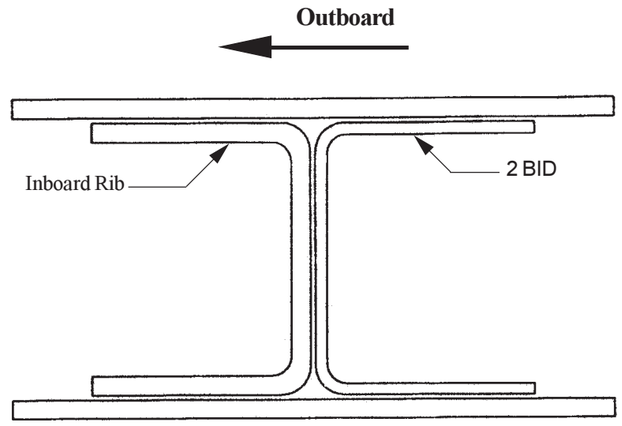
F 12. Set up to close with 2 straight edges about 48" long to rest on the top skin above the aft spar. These will extend out and rest on the elevators to keep the skins at the same level.

F 13. Position the upper skin. Place straight edge on top of the spar and add weight bags. Use clecoes, screws or duct tape every 3" -5" along the leading edge. Let cure.

Note: No additional lay-ups required for the horizontal stabilizer, however, an additional 1 BID may be used on the leading edge to cover the cleco holes.

F 14. Remove the elevator control horn assembly. Remove the three (3) layers of duct tape on the control horn arms. Sand the inboard side of the BL 3.2 elevator rib. Vacuum and clean with acetone. Apply 2 BID to the ribs, rolling onto the skins at least 1 1/2".

Inbd Rib 2 BID Reinforcement
Fig. 2:E:4



Hint: Use modeling clay, Silly Putty, etc. to prevent resin from clogging the threads in the bolt holes. Trim around the holes when the resin is in the green cure state, and then remove the clay plugs.

Note: Make sure the surfaces that the elevator control horn rests against are absolutely flat.

G. Elevator Travel Stops

G 1. Raise the elevator to its full up travel limit of 26° (use a smart level, the blueprint pattern gauge, etc.). You will have to notch the trailing edge of the H. Stab (don't cut too deep) to attain full elevator travel. Repeat for the lower travel limit of 11°.

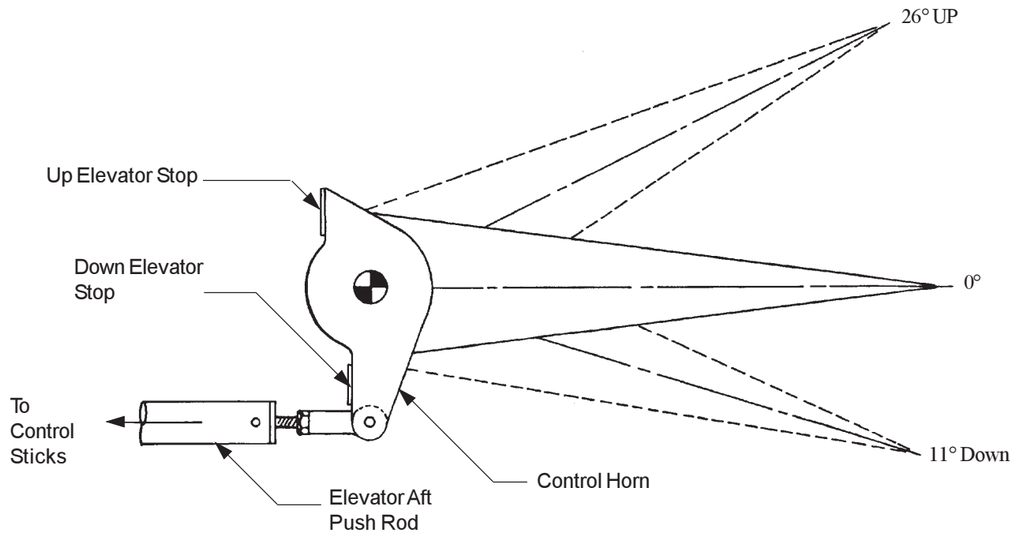
G 2. Cut a 1/4" x 3" x 2" piece of phenolic. Sand both sides of the phenolic and the bonding surfaces of the H. Stab with 40 grit sandpaper. Clean with acetone.

G 3. Install the phenolic with **Lancair approved** ~~Hysol~~ or epoxy/flox. Form a fillet around the block for a 4 BID lay-up. Let cure.

G 4. Sand the H. Stab surface and the radius around the phenolic block and clean with acetone. Install the 4 BID lay-up and let cure.

G 5. Set the up and down travel by grinding a notch in the phenolic.

Elevator Travel
Fig. 2:G:1



Elevator Travel Stops
Fig. 2:G:2