

CHAPTER 15

REVISION LIST

(Pressurized Version)

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
15-1	PB8	R&R	Revised
15-2 thru 15-6	0	None	
15-7 thru 15-8	PB3	R&R	Corrected Step A1 Corrected Step A6
15-9	PB4	R&R	Corrected Step A9
15-10	PB3	R&R	Revised Figure 15:A:6.
15-11 thru 15-32	0	None	
15-33	PB3	R&R	Corrected Step E14.
15-34	0	None	
15-35	PB11	R&R	Edited Figure 15:E:7 and paragraph E19.
15-36 thru 15-41	0	None	
15-42	PB8	R&R	Revised Fig. 15:G:1.
15-43 thru 15-51	0	None	
15-52	PB18	R&R	Changed 1 part # & added 1 part #
15-53	PB13	R&R	Changed part no. in Figure 15:I:5.
15-54	PB18	R&R	Changed tubing in paragraph, Added note for fast build to figure
15-55	0	None	
15-56 thru 15-58	PB4	R&R	Corrected Figure 15:J:3. Corrected Step J7. Changed Figure 15:J:5.
15-59	PB11	R&R	Added parts to Fig. 15:J:6.
15-60	PB4	R&R	Added Figure 15:J:7.
15-61 thru 15-62	PB4	Add	Renamed Figure 15:J:7, to 15:J:8 Changed Steps J14-16 Renamed Figure 15:J:8, to 15:J:9
15-63 thru 15-65	PB2	Add	Added Section K.



CHAPTER 15

RUDDER

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 When such revisions are made, you should immediately replace all outdated pages with the revised pages.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/CUP" 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 assembly step. However, time goes on and changes are made, so careful attention should be paid to the orientation arrows.

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2. SPECIAL PARTS, TOOLS, AND SUPPLIES LIST
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4. PHOTO PAGES



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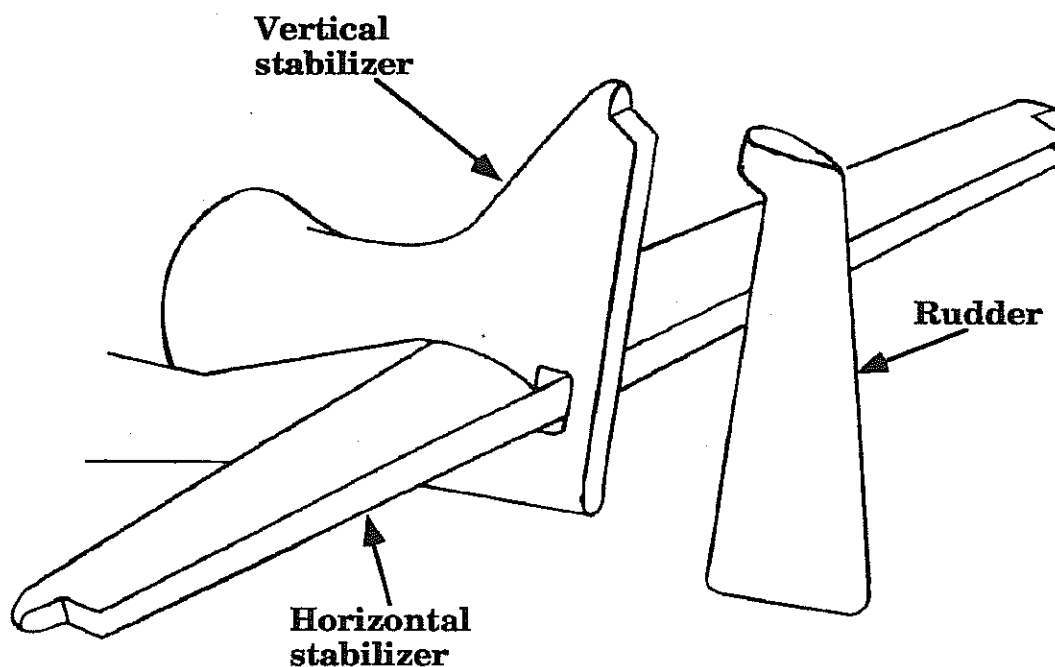
RUDDER

1. INTRODUCTION

Construction of the Lancair IV rudder is similar to the other flying surfaces of the airplane. The rudder is hinged with spherical bearings, as were the ailerons, which help the builder with proper hinge alignment.

Lancair IV rudder

Figure 15:i:1



The rudder is balanced with lead to prevent flutter. You may not think that a vertical surface needs balancing but that's not the case. We dislike the thought of adding lead to our airframes as much as you do, but when you're flying 300 knots, the peace of mind is worth the weight.

The rudder is made of fiberglass so as not to interfere with antennas mounted in the vertical stabilizer.

2. SPECIAL PARTS, TOOLS, AND SUPPLIES LIST

A. PARTS

- 1 Right rudder skin
- 1 Left rudder skin
- 1 2 ply per side fiberglass prepreg panel
- 3 Rudder bearing blocks
- 2 Rudder hinges (mid & upper)
- 1 Rudder control horn
- 1 Bottom rudder hinge bracket
- 1 Lead counterweight
- 1 MAC S-4 servo
- 1 Rudder pedal crossover (left)
- 1 Rudder pedal crossover (right)
- 2 Rudder cables (factory swaged ends)
- 2 Rudder crossover end mounts (plastic)
- 1 Rudder crossover center mount (plastic, 2 pcs.)



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B. TOOLS

Dremel tool
Drill
Various clamps
Cleco pliers
Clecoes
Pop rivet tool
Rivet squeezer



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C. SUPPLIES

Microballoons
Flox
Epoxy
Hysol
Fiberglass
Bondo
Mixing cups
Mixing sticks
40 grit sandpaper
Paper towels
1" x 2" wood stock



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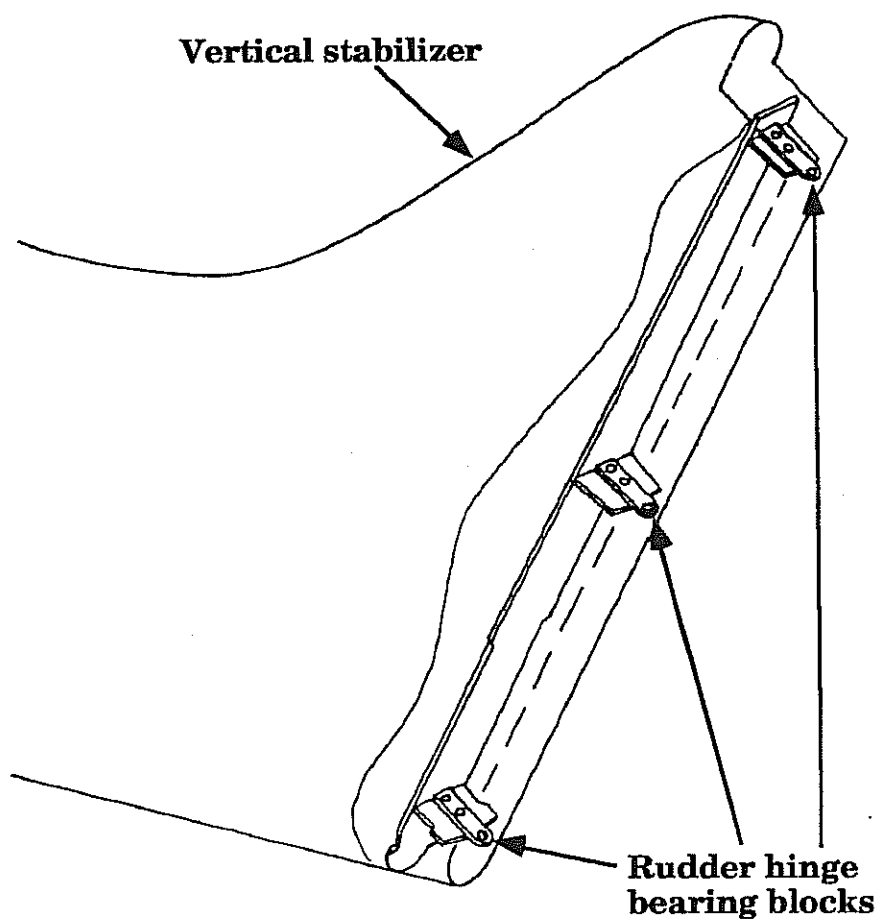
3. CONSTRUCTION PROCEDURE

A. HINGE MOUNTING

The hinges of the rudder are very similar to the aileron hinges. Spherical bearings, pressed into bearing blocks, are mounted on phenolic supports in the vertical stabilizer. The rudder hinges connect to these bearing blocks. The phenolic supports do not have to be aligned perfectly because the spherical bearings can compensate for errors.

Rudder hinges

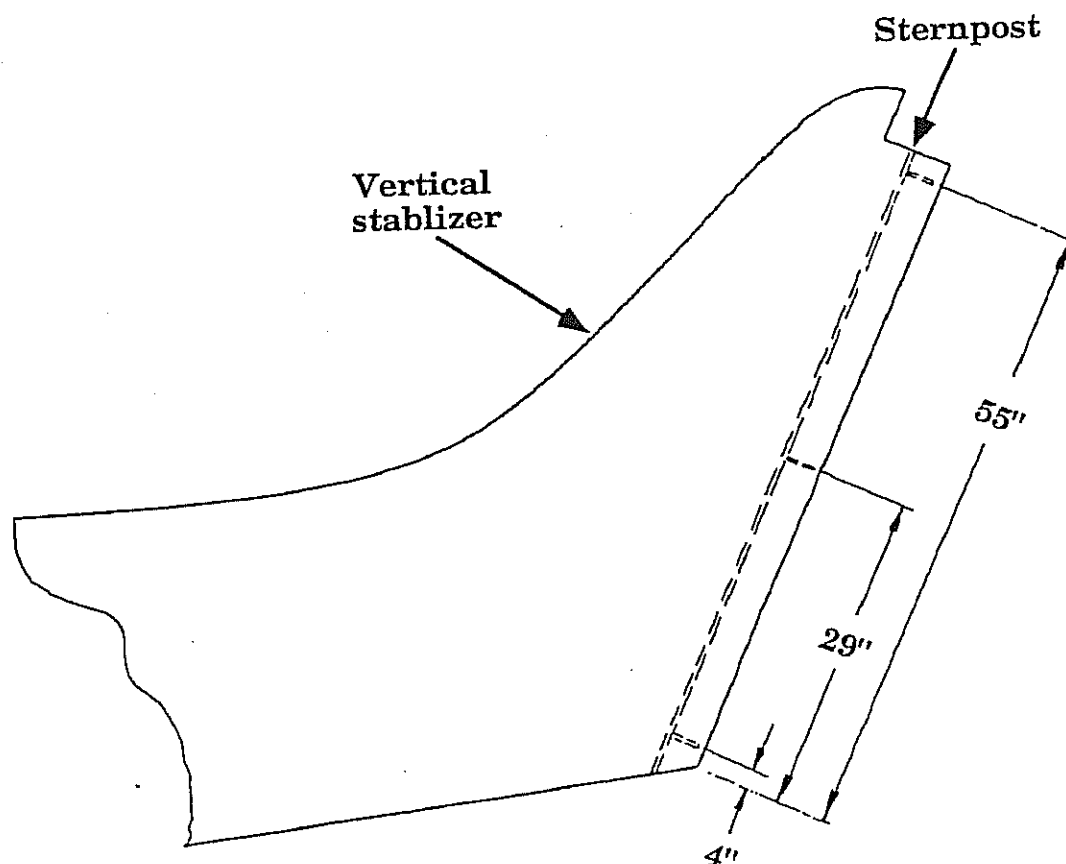
Figure 15:A:1



Each hinge bearing block is mounted on a phenolic support.

- A1. Use the templates provided on Blueprint A-308 to cut the three, 1/4" thick phenolic, bearing block supports that will be mounted to the aft face of the sternpost.
- A2. Fit the phenolic bearing block supports at the locations given in Figure 15:A:2. The supports should be perpendicular to the sternpost and vert. stab. trailing edge.

Phenolic bearing block support locations
Figure 15:A:2



- A3. Sand both faces of each phenolic bearing block support with 40 grit. Also sand the areas of the vertical stabilizer where the supports will be mounted. Clean these areas with MC.
- A4. Bond the phenolic bearing block supports into the vertical stabilizer with a thick epoxy/flox mixture. Masking tape works well to hold the supports in position while curing.

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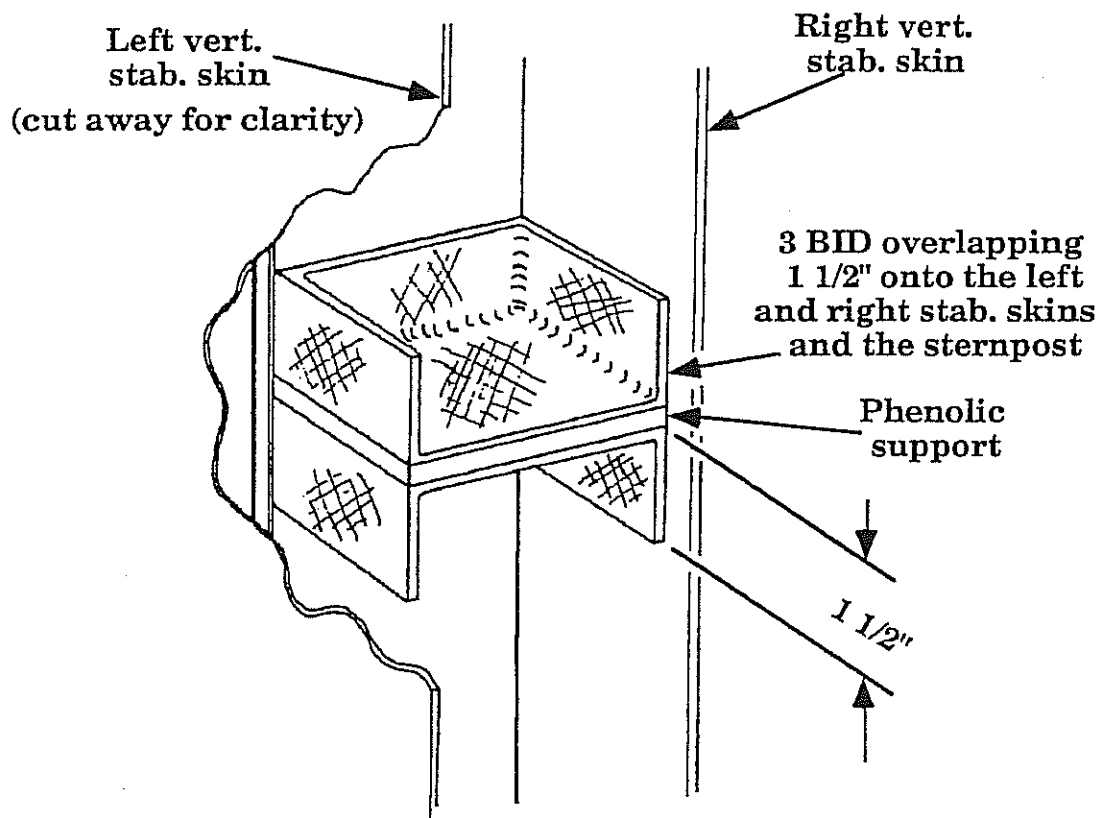
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- A5. After the supports have cured in position, reinforce them with 3 BID, overlapping onto the sternpost and the vert. stab. skins by 1 1/2". See Figure 15:A:3.

Securing phenolic bearing block supports

Figure 15:A:3

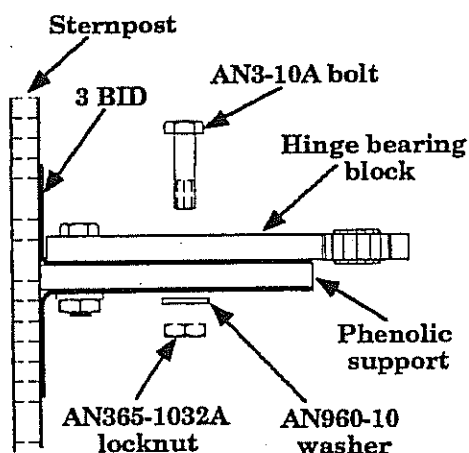


- A6. Place the bearing blocks in position on their supports and center the spherical bearings between the vert. stab. skins (fuselage centerline). The bearings should all be centered 3 1/4" aft of the sternpost (about 1/4" aft of the vert. stab. skin T.E.). A stringline should be used to check that the centers of the three bearings are aligned. Use a few drops of instant glue to temporarily secure the bearing blocks to their supports.
- A7. Use the predrilled holes in the hinge bearing blocks as guides to drill through the phenolic supports. Use a #12 drill. An angled drill motor attachment is very helpful in this step.

- A8. Secure the hinge bearing blocks to their supports with AN3-10A bolts, AN960-10 washers and AN365-1032A locknuts.

Securing hinge bearing blocks to supports

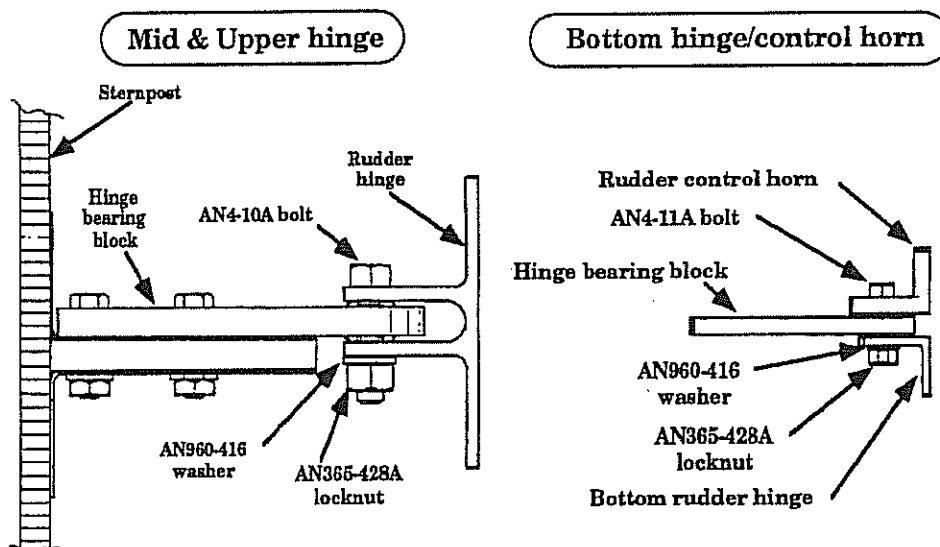
Figure 15:A:4



- A9. Bolt the rudder hinges to the hinge bearing blocks. The bottom hinge also acts as the rudder actuator arm. Don't use the elastic locknuts at this point, you'll be removing and installing these hinges a few times before you're done with the rudder. No sense in wearing out the elastic before you're finished, use a castle type nut until final assembly later in construction. Drill out the two outboard holes in the rudder control horn (where the rudder cables will connect), to a 1/4" dia. These holes are predrilled to 3/16" dia.

Connecting rudder hinges

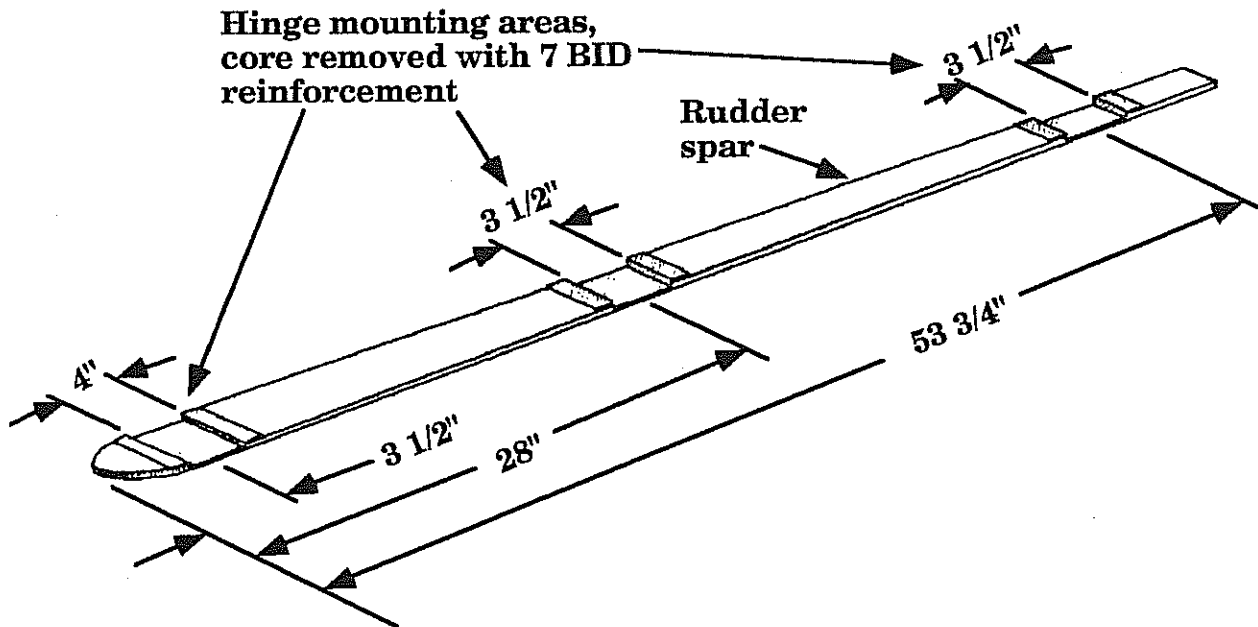
Figure 15:A:5



- A10. Cut out the rudder spar from the 2 ply per side, fiberglass prepreg panel. Mark a centerline on the rudder spar for easy alignment on the hinges.

Rudder spar

Figure 15:A:6

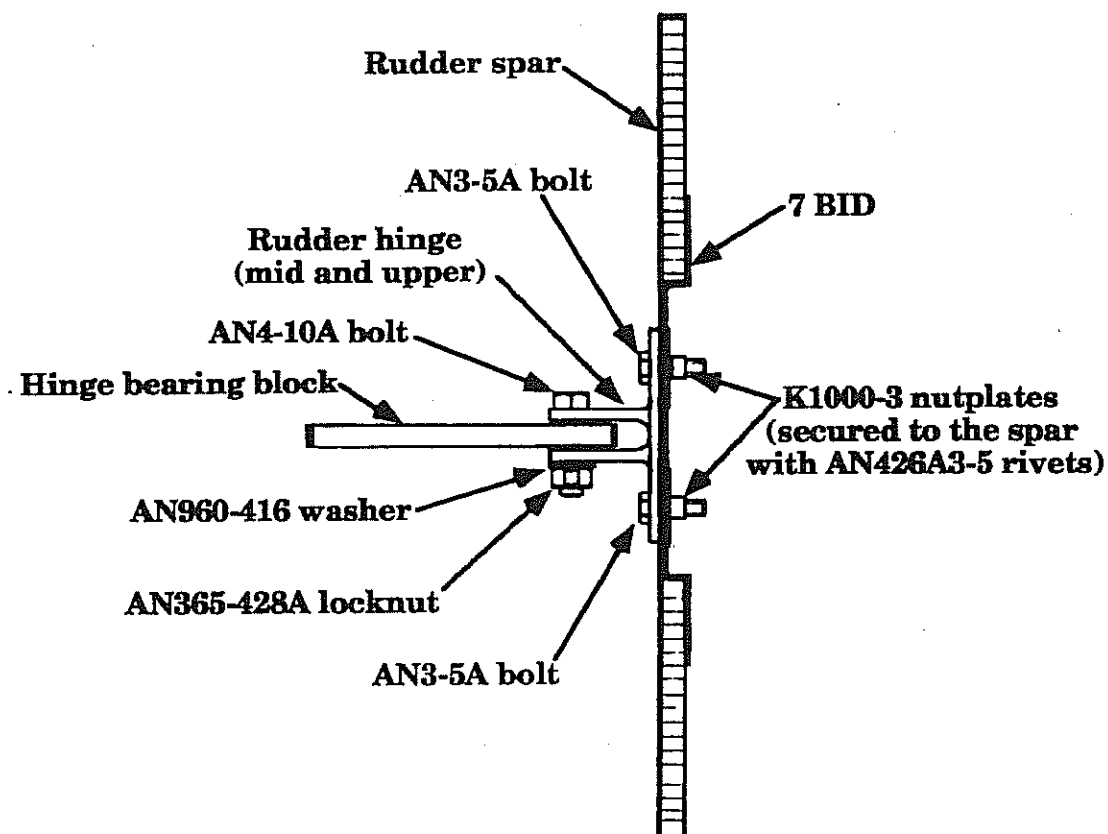


- A11. Cut and remove the aft laminate and core of the rudder spar as shown in Figure 15:A:6. Reinforce these areas with 7 BID, overlapping onto the original aft laminate by 1".
- A12. Place the rudder spar flat against the rudder hinges. The coreless areas of the spar should be aligned with the hinges. The spar centerline should be centered on all hinges. A 1/8" thick phenolic spacer is needed to space the the rudder control horn and bottom hinge away from the spar. The aft face of the phenolic spacer should be sanded and bonded to the rudder spar with Hysol. No BID is required to secure the phenolic to the spar. Use a few drops of instant glue at each hinge to hold the rudder spar in position. See Figure 15:A:8 for control horn/bottom hinge details.
- A13. Carefully remove the hinge bolts without breaking the bond between the hinges and the rudder spar. Use the predrilled mounting holes in the hinges as guides to drill #12 holes through the rudder spar.

- A14. Remove the rudder hinges from the spar and use AN426A3-5 rivets to secure K1000-3 nutplates to the aft face of the spar at each mounting hole location. See Figure 15:A:7 & 8.

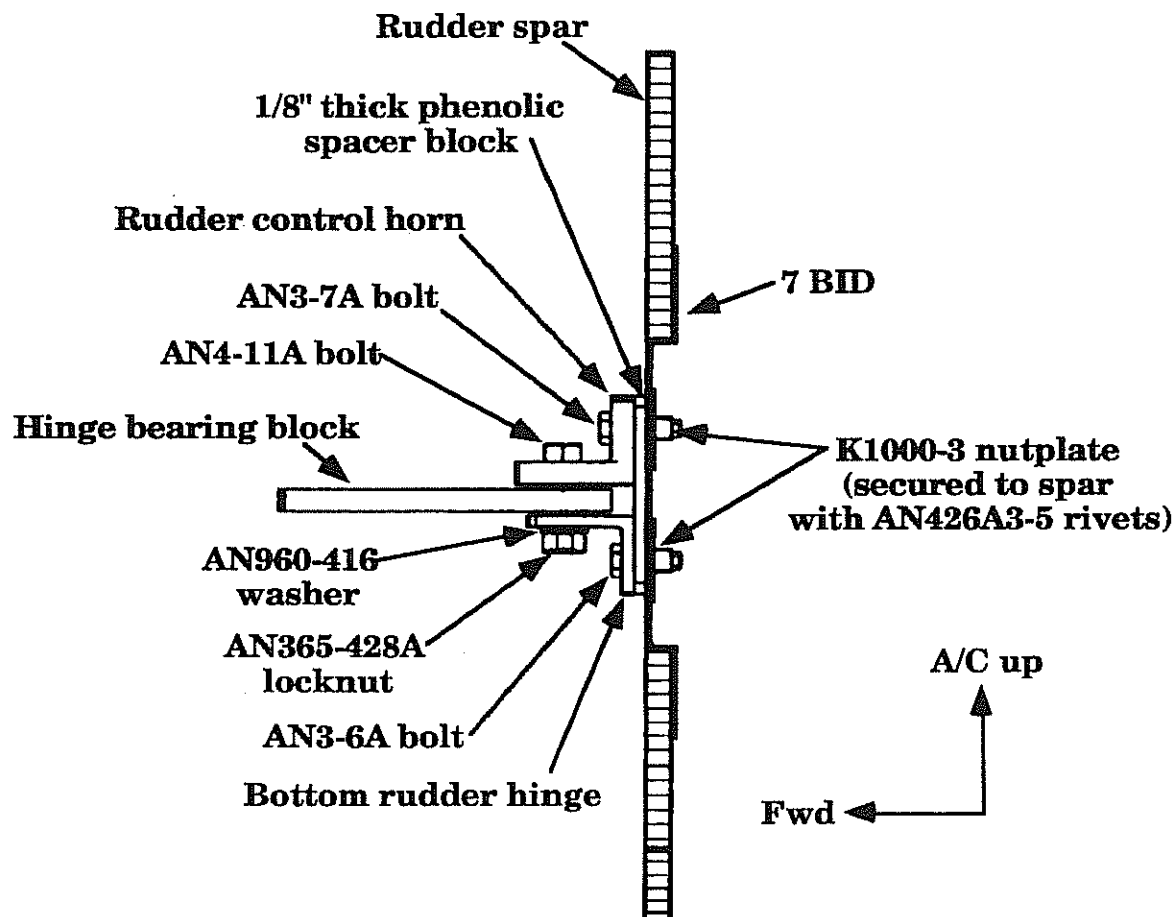
Securing rudder hinges (mid & upper) to rudder spar

Figure 15:A:7



Securing rudder control horn & bottom hinge to spar

Figure 15:A:8

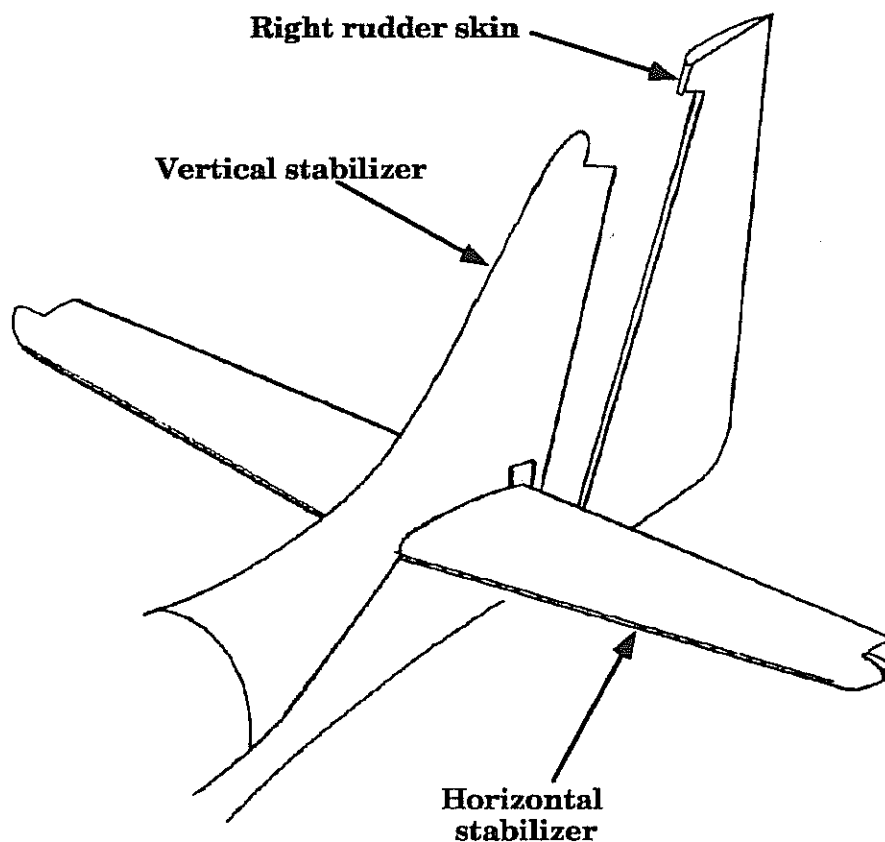


B. FITTING RIGHT RUDDER SKIN

The right rudder skin must be held flush to the vert. stab. with wood braces while the the rudder spar is bonded to it.

Right rudder skin

Figure 15:B:1



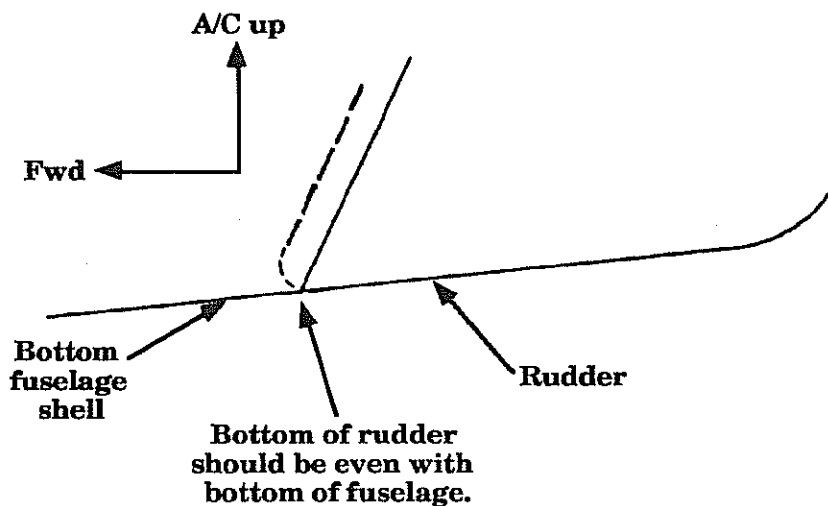
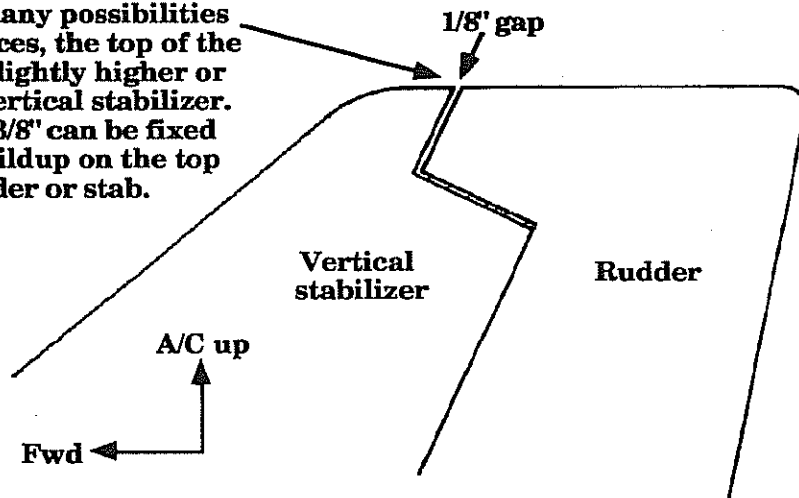
- B1. Trim the vertical stabilizer so the rudder counterweight fits as shown in Figure 15:B:2. The top of the rudder should be level with the top of the vert. stab.. In this condition, the bottom of the rudder should be even with the bottom of the fuselage. If there is a mismatch, it is easier to match the bottom of the rudder to the fuselage and do a bit of filling later on the top of the rudder (or the top of the vert. stab.). Don't worry about filling the mismatch until the rudder has been closed.

You'll also have to cut slots in the rudder skin to allow for the hinge bearing blocks.

Fitting right rudder skin

Figure 15:B:2

Because of the many possibilities for builder variances, the top of the rudder may be slightly higher or lower than the vertical stabilizer. Errors of up to 3/8" can be fixed with a micro buildup on the top of the rudder or stab.



- B2. Cut four 1 x 2 x 5" wood blocks to use as skin positioning braces.
- B3. Use instant glue to bond the wood blocks to the right side of the vertical stabilizer and the fuselage. One block should keep the counterweight area of the rudder flush with the vert. stab. surface. The other three blocks can be used to secure the lower part of the rudder.

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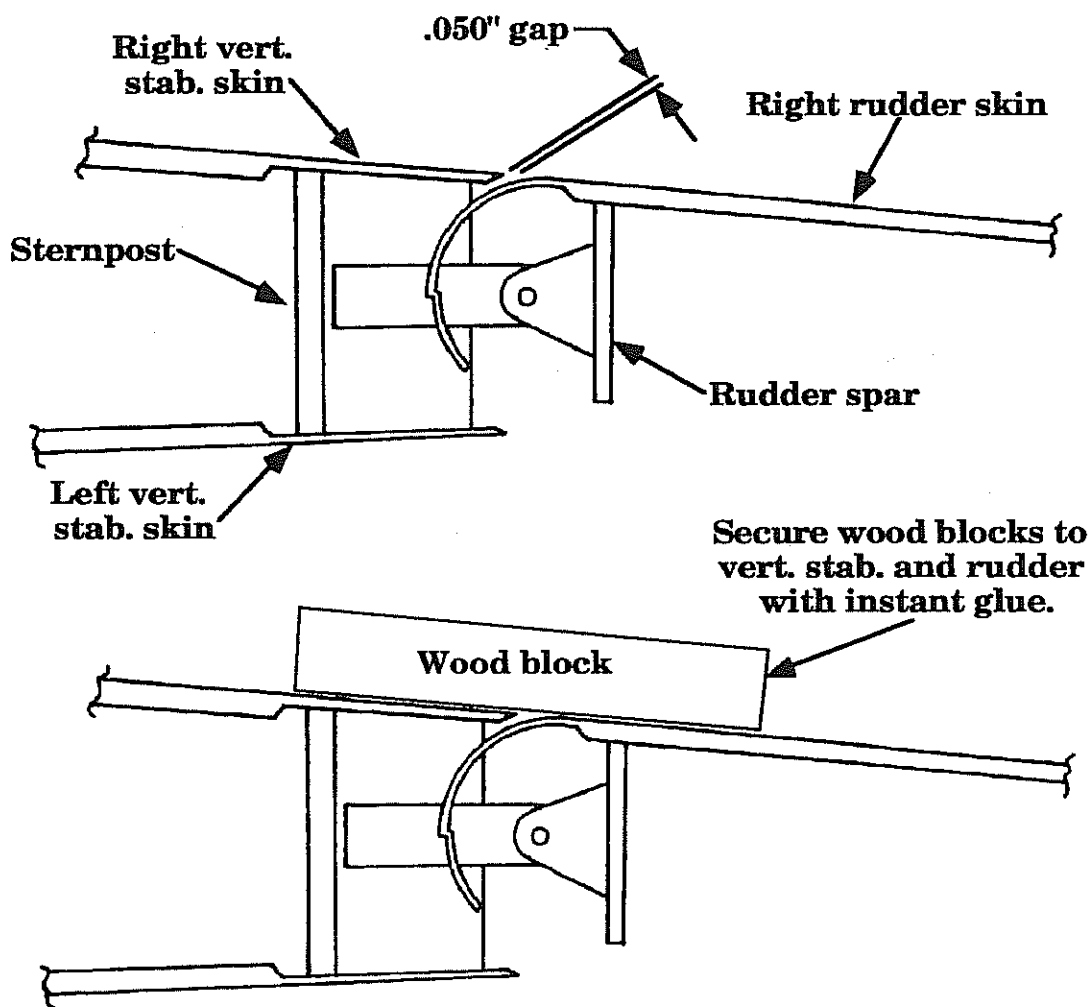
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- B4. Rest the right rudder skin against the wood blocks. The blocks will hold the rudder skin flush with the vertical stabilizer and bottom fuselage shell. Use instant glue to temporarily secure the rudder skin to the wood blocks.

Securing right rudder skin in position

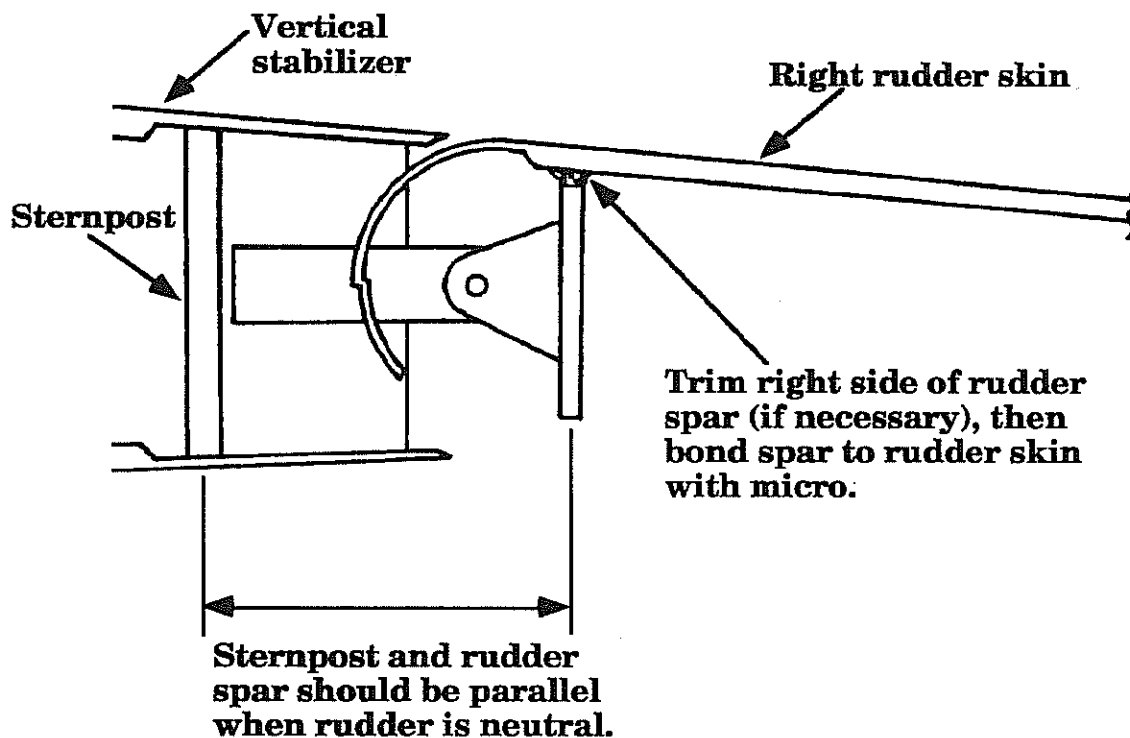
Figure 15:B:3



- B5. Bolt the rudder spar to the rudder hinges. The forward face of the rudder spar should be parallel with the vertical stabilizer sternpost. Trim the right side of the rudder spar (where it contacts the right rudder skin) if needed to achieve the parallel condition.

Bonding rudder spar to right skin

Figure 15:B:4

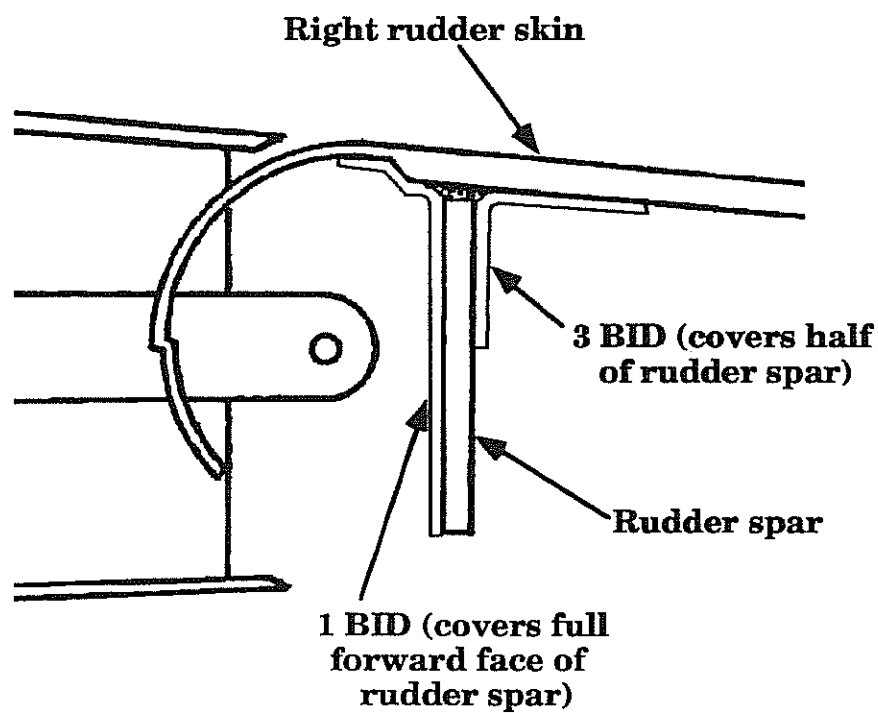


- B6. Remove the core along the right edge of the rudder spar to form a 1/8 - 1/4" deep trough.
- B7. Sand the right rudder skin where the rudder spar will be bonded. Clean this area with MC.
- B8. Bond the rudder spar to the right rudder skin with a thick epoxy/micro mixture.

- B9. After the micro has cured, remove the rudder hinges. Sand both faces of the rudder spar and the inside of the right rudder skin where the BID tapes will be applied. See Figure 15:B:5. Clean these areas with MC.
- B10. Secure the rudder spar to the right rudder skin with 3 BID on the aft face and 1 BID on the forward face as shown in Figure 15:B:5. Notice that the 3 BID only covers the right half the of the spar and the 1 BID covers the entire forward face of the spar.

Securing rudder spar to skin

Figure 15:B:5



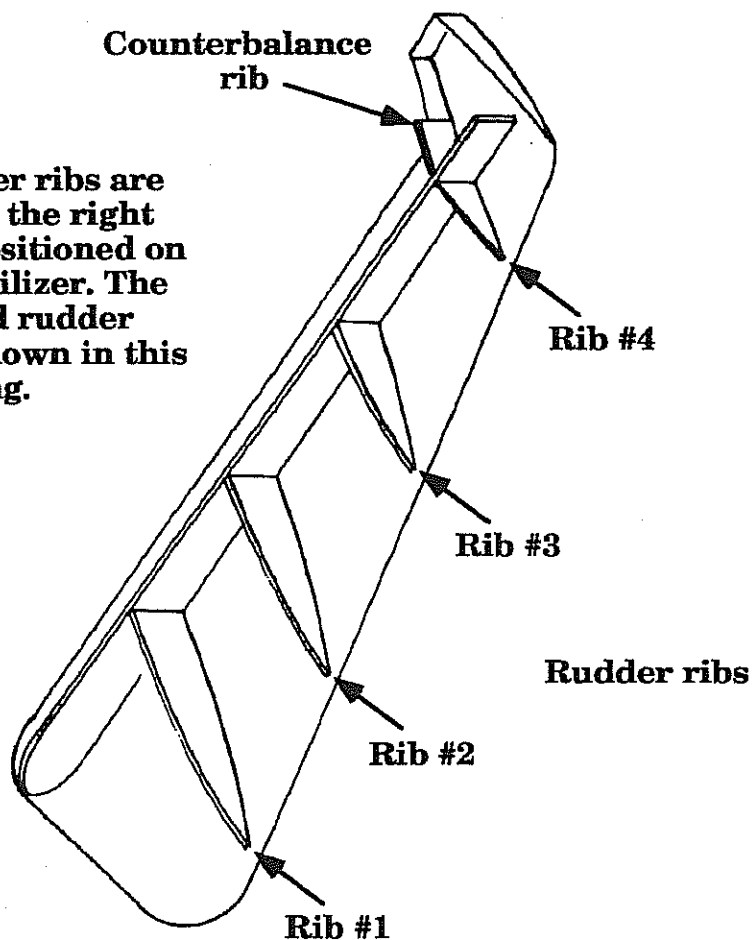
C. RUDDER RIB INSTALLATION

Installation of the rudder ribs is similar to the installation of ribs in other control surfaces. A simple brace for the rudder's trailing edge is needed to keep the rudder twist-free during construction.

Rudder ribs

Figure 15:C:1

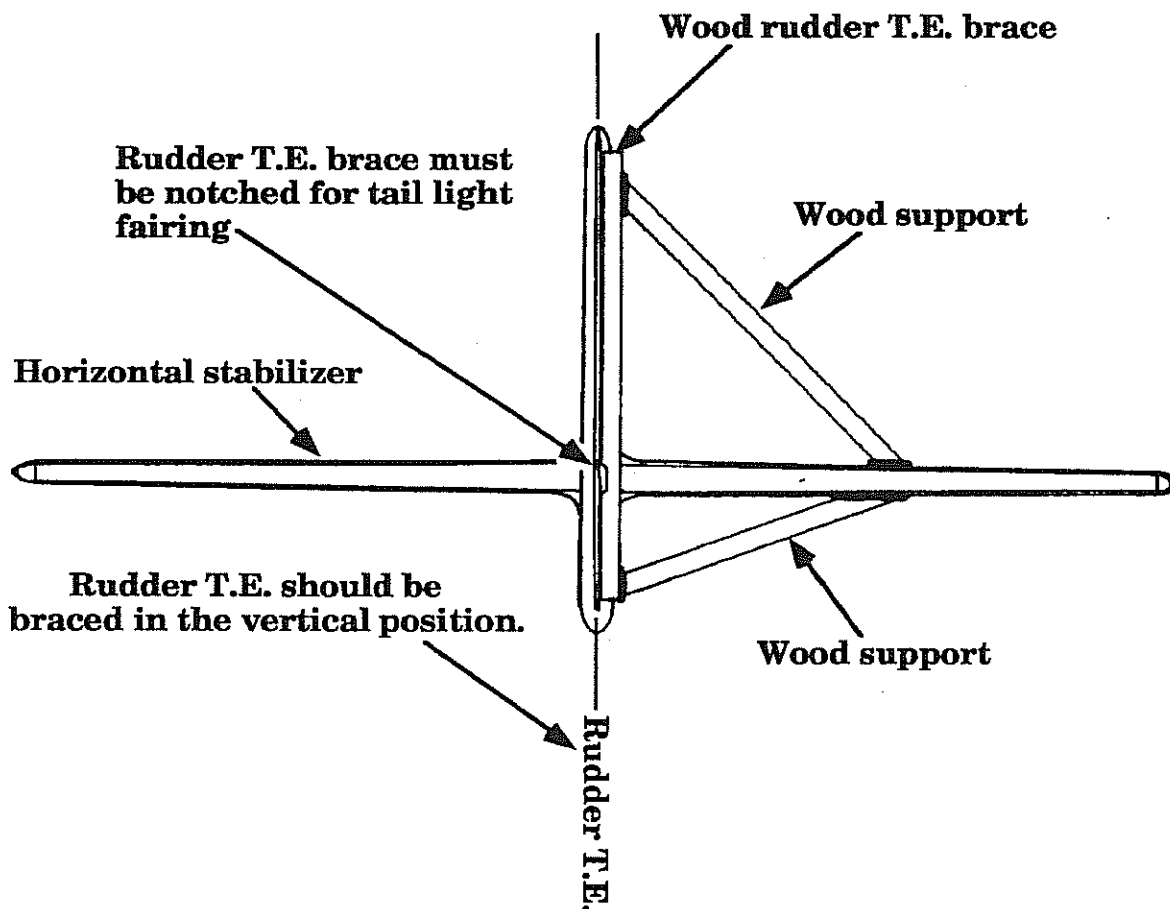
Note: The rudder ribs are installed while the right rudder skin is positioned on the vertical stabilizer. The vert. stab. and rudder braces are not shown in this drawing.



- C1. Cut and fit a straight piece of wood to the rudder's T.E. as shown in Figure 15:C:2. The size of the wood can vary, but the surface that is placed against the rudder T.E. must be straight. A notch must be cut into the wood to accommodate the molded tailight fairing.

Rudder T.E. brace

Figure 15:C:2

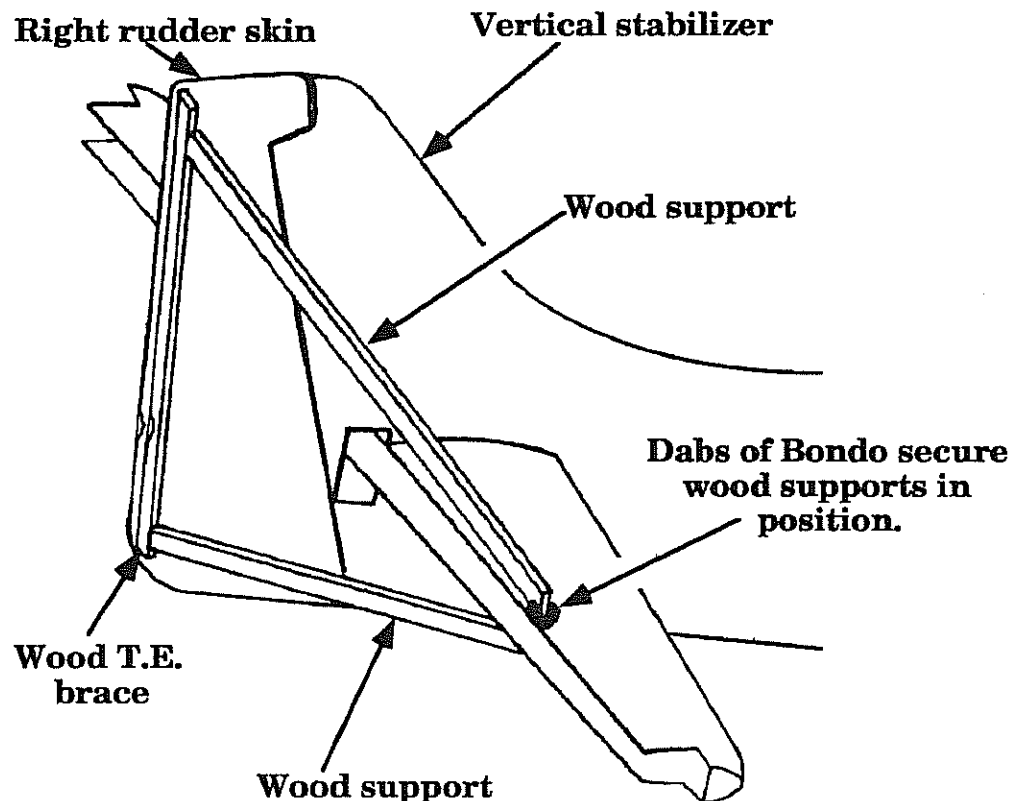


- C2. Clamp the T.E. of the right rudder skin flat against the brace and secure it with a few blobs of Bondo. Remove the clamps and the T.E. should still be attached to the brace.
- C3. To hold the rudder T.E. brace vertical, Cut two lengths of 1 x 2 wood that will support the brace off the horizontal stabilizer. See Figure 15:C:3.

- C4. Use a plumb bob to align the T.E. of the rudder vertically. The T.E. should also be plumbed directly over the fuselage centerline you have marked on your shop floor. Two plumb bobs come in handy for this step, one for the bottom edge of the rudder and one for the top. Look ahead to Figure 15:G:2 to see how plumb bobs are used to align the rudder.
- C5. Use blobs of Bondo to secure the 1 x 2 pieces to the T.E. brace and the horizontal stabilizer. These supports will keep the rudder T.E. vertical during it's construction. See Figure 15:C:3.

Supporting rudder T.E. in vertical position

Figure 15:C:3

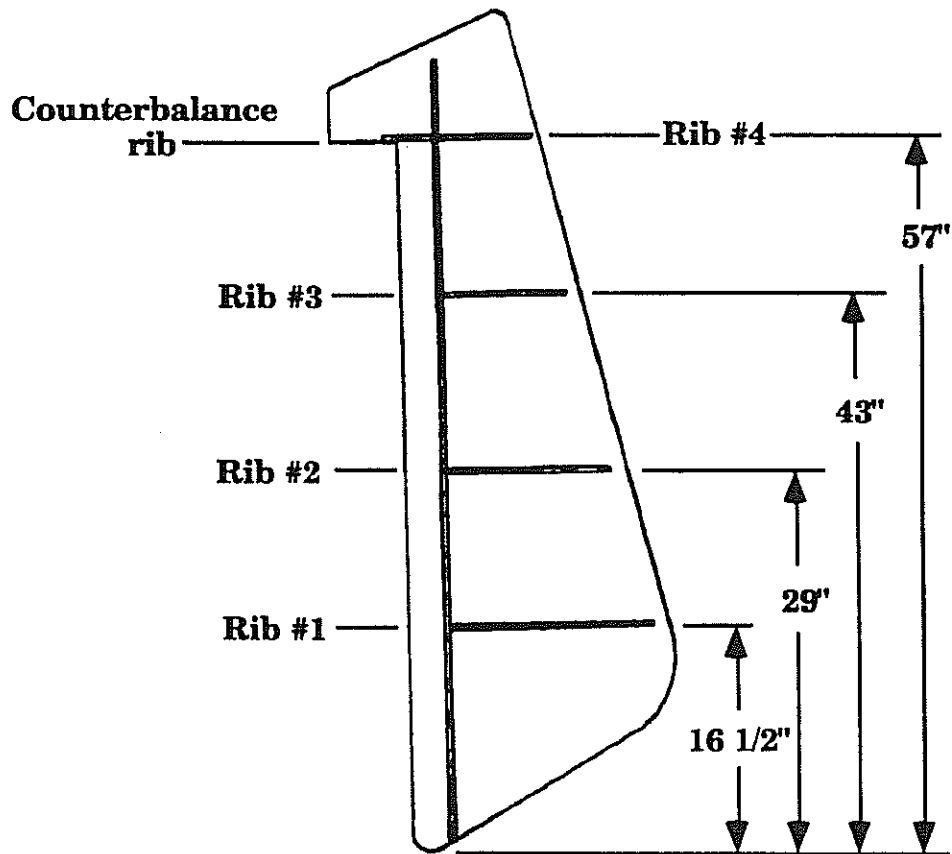


- C6. Use the templates on Blueprint A-360 to cut the rudder ribs from 2 ply per side, fiberglass prepreg panel. As usual, cut the ribs a bit big so you can custom fit them to your rudder.

C7. Fit the rudder ribs at the locations shown in Figure 15:C:4.

Rudder rib locations

Figure 15:C:4

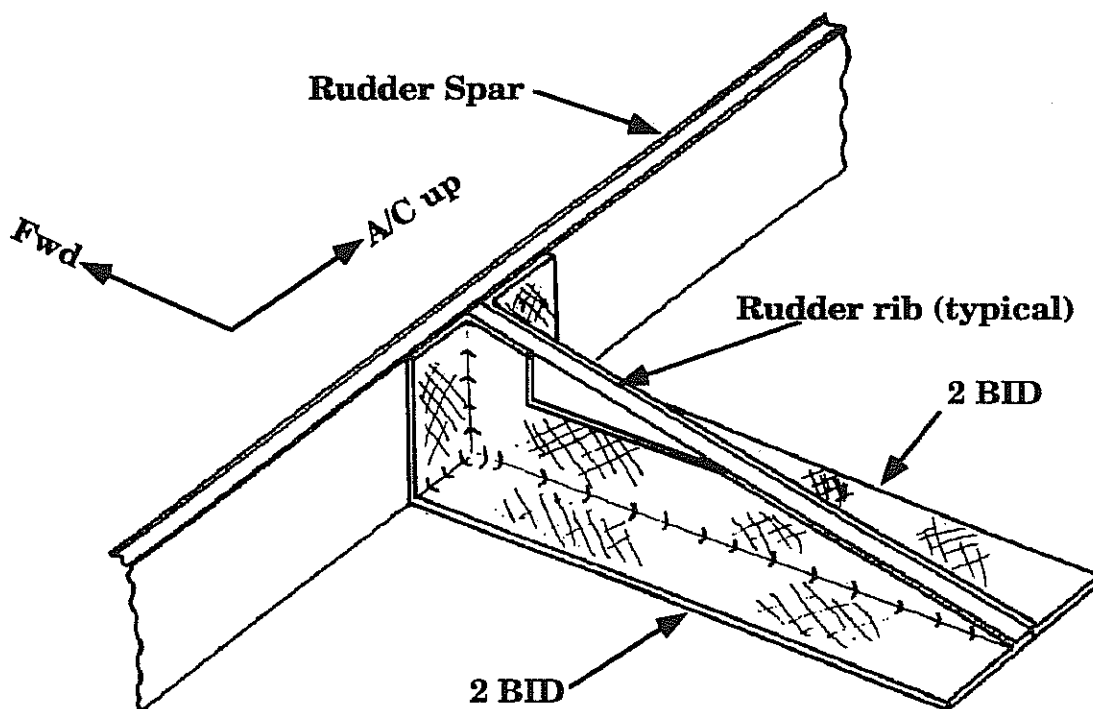


- C8. Form a 1/8 - 1/4" deep trough in the core of the rudder ribs where they will be bonded to the right rudder skin and the rudder spar.
- C9. Sand the areas of the right rudder skin and rudder spar where the ribs will be bonded. Clean these areas with MC.
- C10. Bond the rudder ribs in position with a thick epoxy/micro mixture.

- C11. Sand the areas of the rudder ribs, right rudder skin, and spar where BID tapes will be applied to secure the ribs in position. Clean these areas with MC. See Figure 15:C:5.

Securing rudder ribs in position

Figure 15:C:5



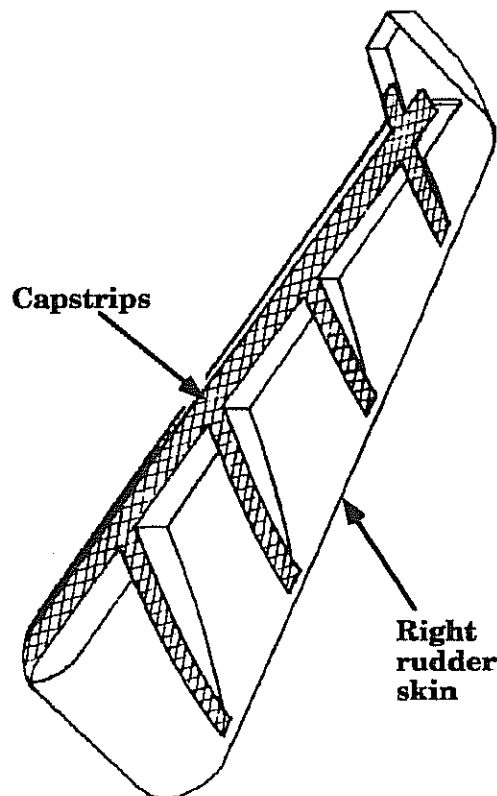
- C12. Apply 2" wide, 2 BID laminates to secure the rudder ribs to the right rudder skin and the rudder spar.

D. FORMING RUDDER CAPSTRIPS

Capstrips are required on the rudder ribs and spar to provide extra bonding area for closeout.

Rudder capstrips

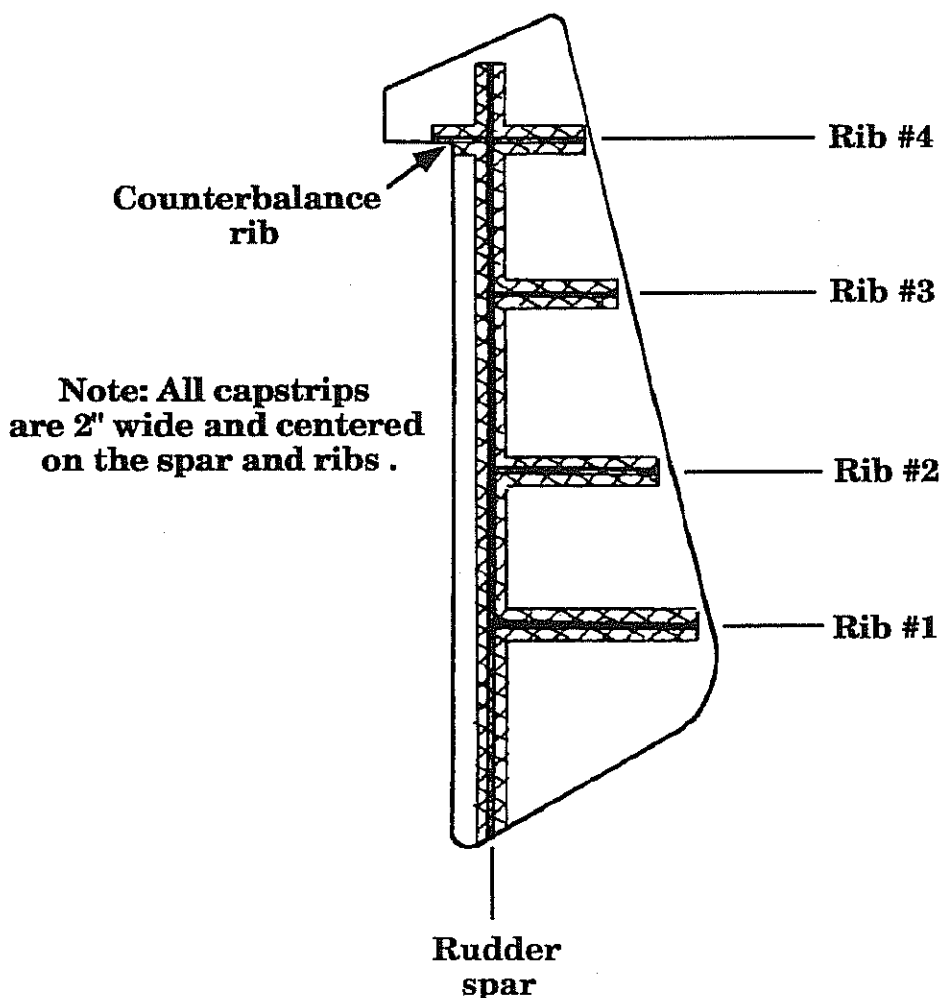
Figure 15:D:1



- D1. Fit the left rudder skin to the right. Trim the rudder spar and ribs if necessary until the left rudder skin is flush with the vertical stabilizer T.E.. You will have to notch the L.E. of the left rudder skin to fit over the phenolic hinge supports. The T.E. of the left rudder skin should fit flat against the right skin T.E. joggle.
- D2. When satisfied with the position of the left rudder skin, transfer and mark the locations of the ribs and spar to the inside surface of the skin. You will use these marks as a reference for laying up the capstrips.

Rudder capstrip locations

Figure 15:D:2



- D3. Form 1/8 - 1/4" deep troughs in the core of the rudder spars and ribs where the capstrips will be located.
- D4. Apply 3 layers of duct tape to the inside surface of the left rudder skin where the capstrips will be located.
- D5. Mound up a thick epoxy/micro mixture in the ribs and spar of the rudder. Place the left rudder skin in position and let the micro cure. Treat this step as you would treat closing out the rudder for good. The left rudder skin should be straight along the rudder spar and flush with the vert. stab. T.E..

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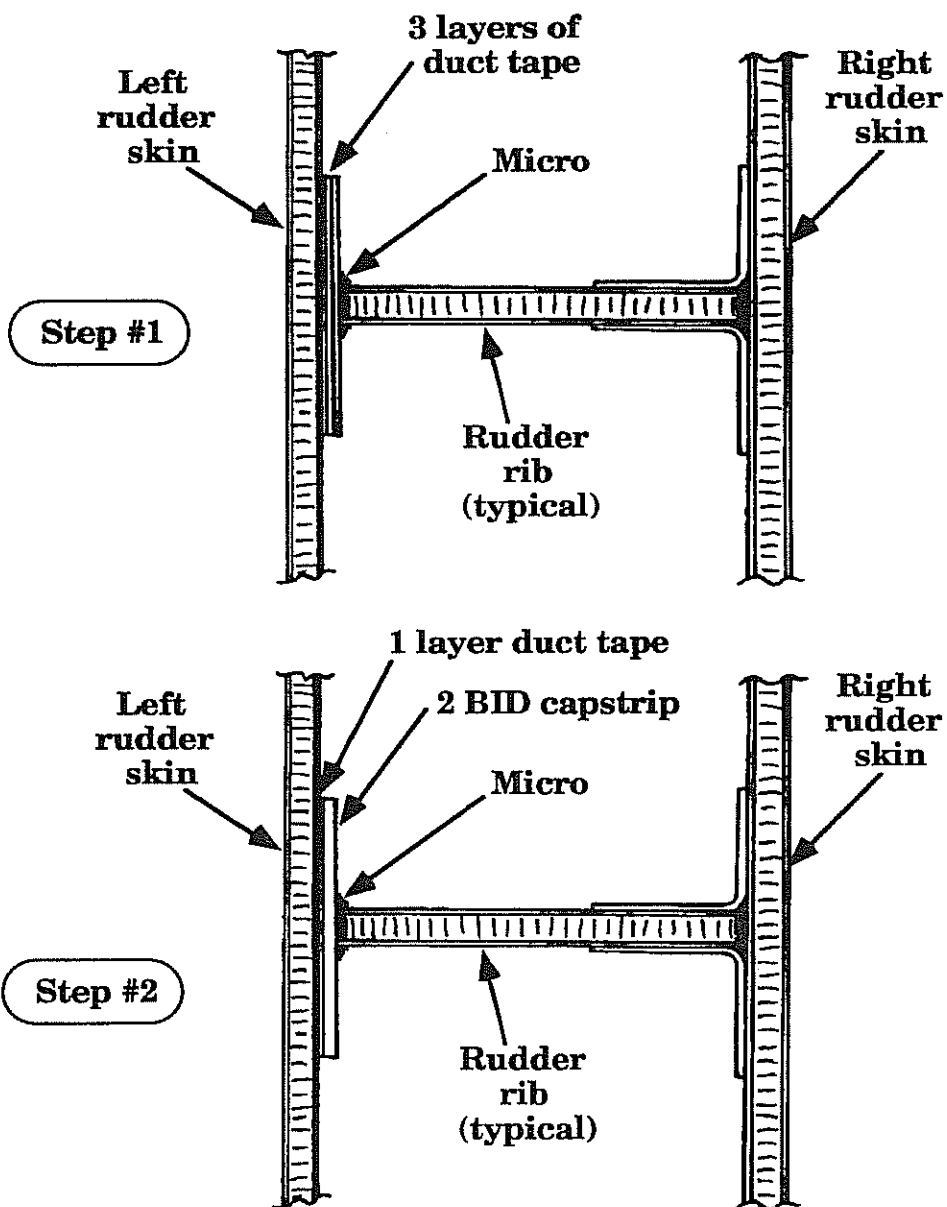
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- D6. When the micro has cured, remove the left rudder skin. Remove two of the three duct tape layers from the inside surface of the left rudder skin. With 40 grit, sand the edges of the ribs and spar where the capstrips will be bonded. Clean these areas with MC.

Forming rudder capstrips

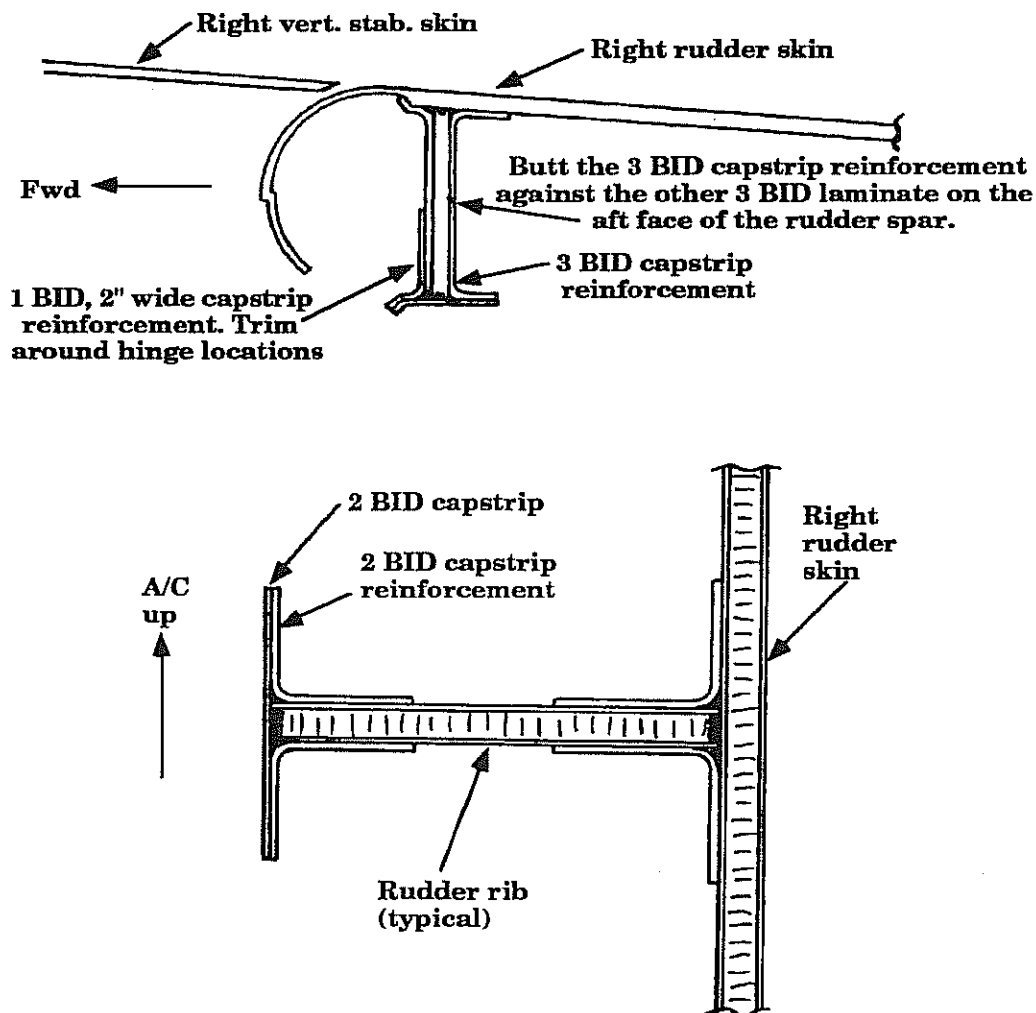
Figure 15:D:3



- D7. Apply 2 BID, 2" wide capstrips to the inside surface of the left rudder skin. Apply a thin layer of epoxy/micro to the edges of the rudder ribs and spar where the capstrips will be located. Place the left rudder skin in position and clamp as necessary so the surface is straight along the rudder spar and flush with the vertical stabilizer T.E.
- D8. When the micro has cured, carefully remove the left rudder skin, leaving the capstrips bonded to the ribs and spar.
- D9. With 40 grit, sand the rudder ribs, spar, and capstrips where the BID tapes will be applied to secure the capstrips. Clean these areas with MC.
- D10. Secure the capstrips to the rudder ribs with 2" wide, 2 BID laminates.

Securing capstrips to rudder ribs and spar

Figure 15:D:4



- D11. Secure the capstrip to the aft face of the rudder spar with 3 BID. Notice that this layup extends only to the centerline of the rudder spar and doesn't overlap onto the 3 BID that secured the spar to the right rudder skin. The capstrip is secured to the forward face of the rudder spar with 1 BID, 2" wide. Trim the 1 BID around the hinge mounting areas to keep these areas flat.



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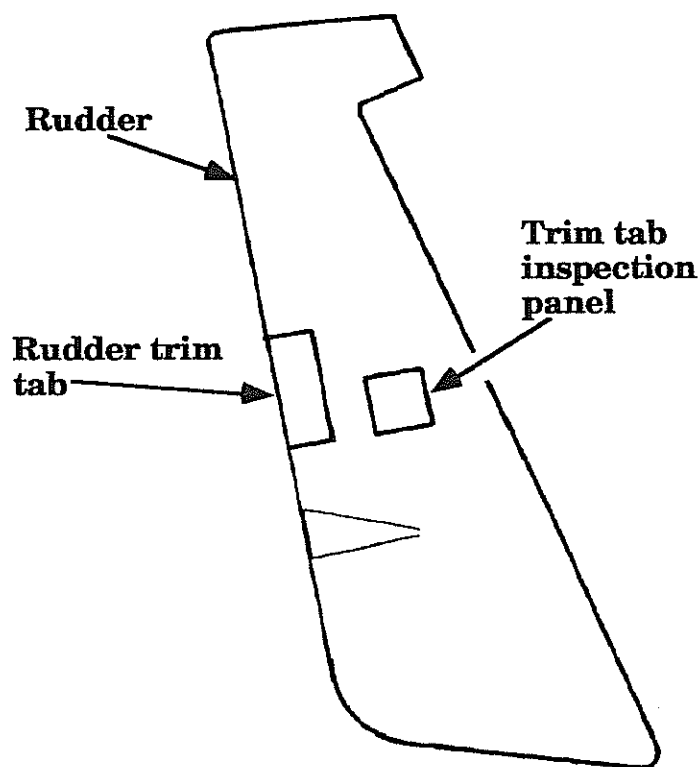
E. OPTIONAL RUDDER TRIM TAB

There are scribe marks on the outer surface of the right rudder skin to be used if you wish to add a rudder trim tab. One scribe mark shows the location of the trim tab and the other shows the location of the servo inspection panel. The tab would be actuated with a MAC S-4 electric servo.

NOTE: The hardware for installation of the rudder trim tab is not included in your kit. If you wish to install the tab, this hardware is available through Lancair or any of the large mail order parts suppliers.

Rudder trim tab

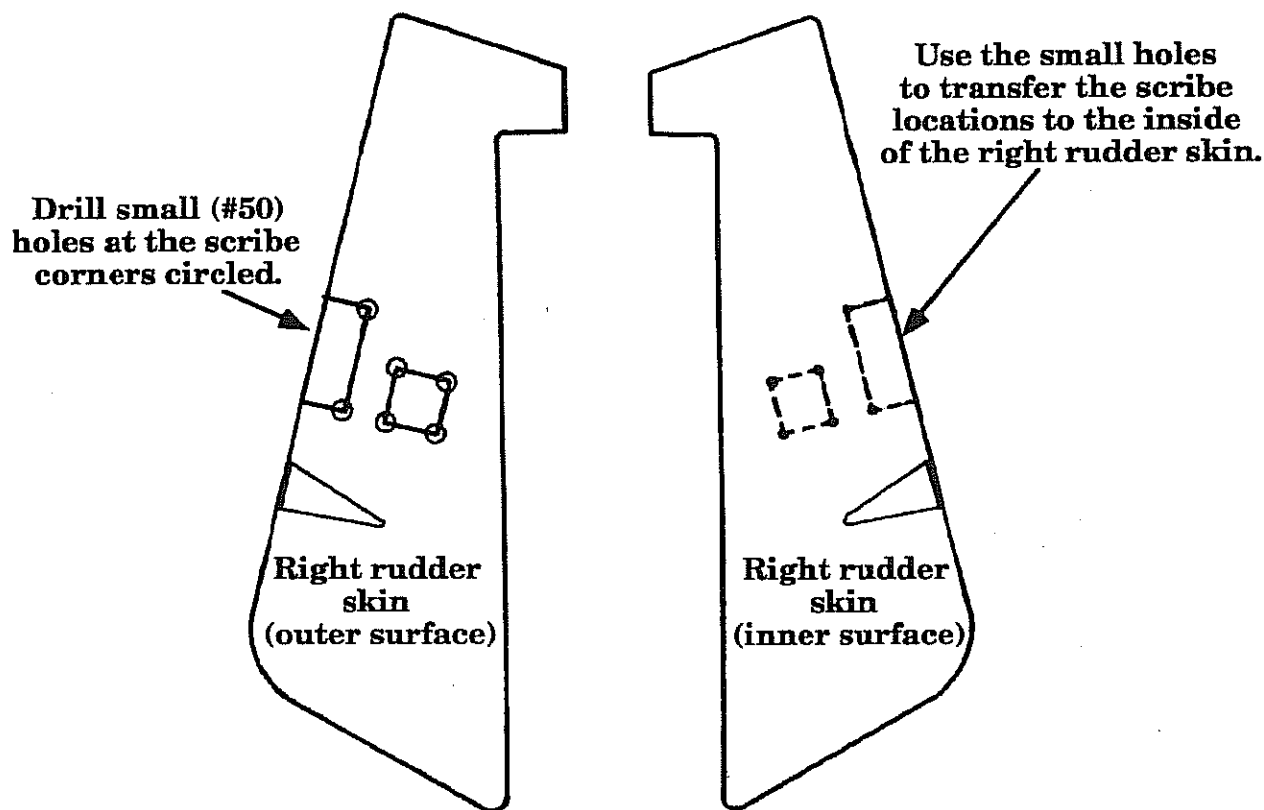
Figure 15:E:1



- E1. Drill six small (#50 drill) holes through the right rudder skin at the locations shown in Figure 15:E:2. This is to transfer the scribe mark corner locations to the inside of the skin.
- E2. Use a marker to connect the hole locations on the inside surface of the right rudder skin. The outlines should duplicate the scribe marks on the outer surface. Also transfer the trim tab location to the inner surface of the left rudder skin.

Transferring panel and tab locations

Figure 15:E:2

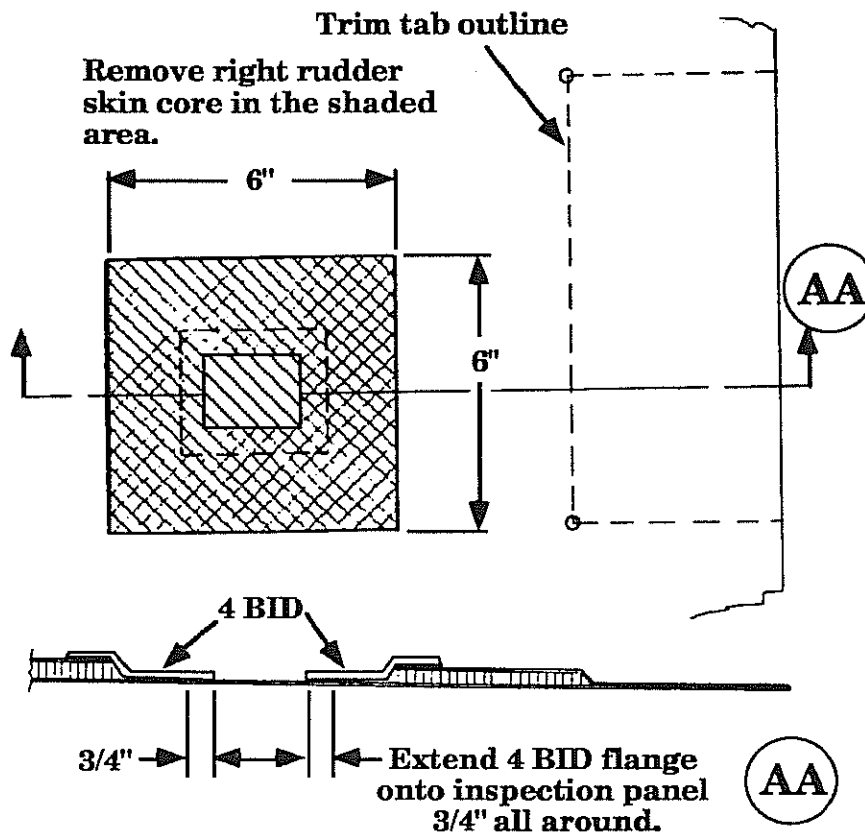


- E3. Remove the inner laminate and core of the right rudder skin as shown in Figure 15:E:3:a. This core removal area will accommodate the inspection panel flange.
- E4. Remove the inner laminate and core of the left rudder skin as shown in Figure 15:E:3:b. This core removal area will accommodate the trim tab hinge.

- E5. Do a segmented cut around the inspection panel area, leaving only the corners intact to hold this section in place.
- E6. Apply release tape where the inspection panel will be located.

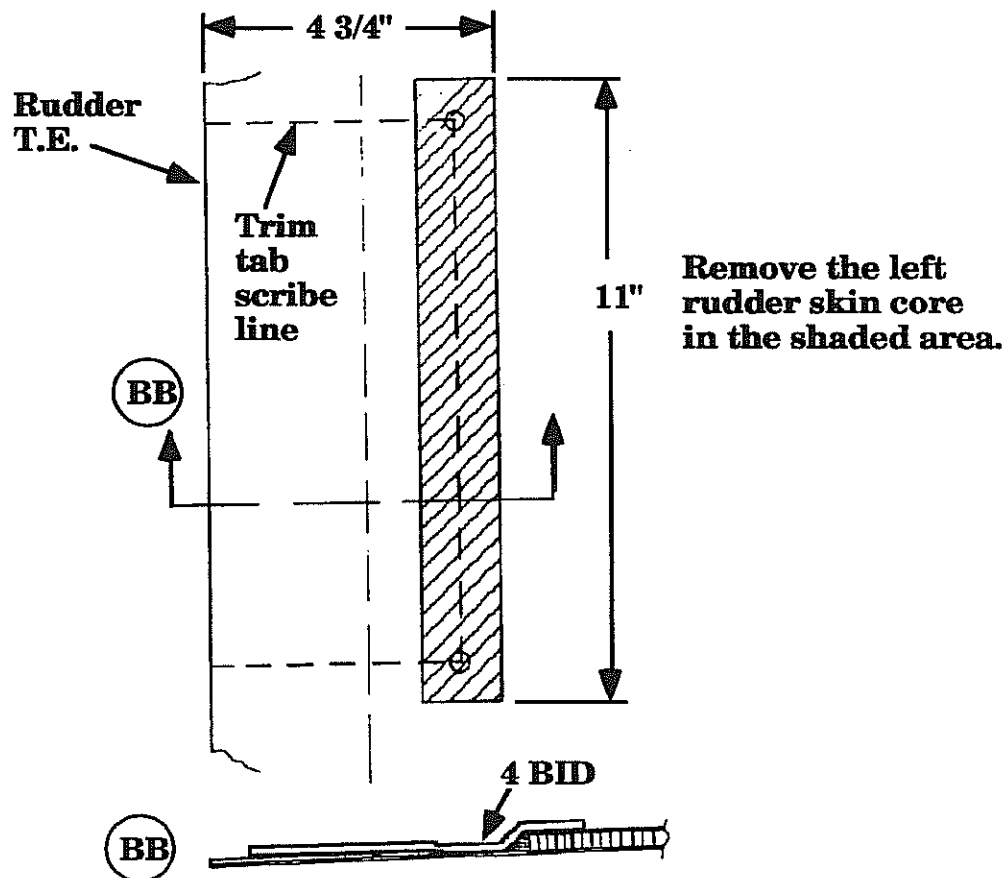
**Core removal for inspection panel
(Right rudder skin)**

Figure 15:E:3:a



Core Removal for trim tab hinge (left rudder skin)

Figure 15:E:3:b

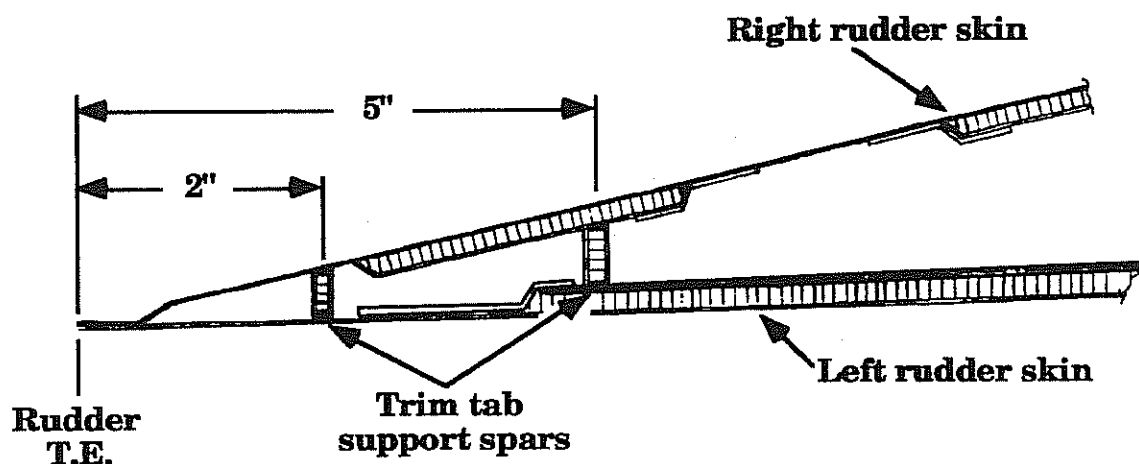


- E7. Apply 4 BID over the core removal areas, overlapping onto the inner laminate by 1". You don't have to cover the entire inspection panel area with 4 BID, just overlap onto the panel by 3/4".

- E8. Cut two small trim tab support spars from 2 ply per side, 1/4" thick fiberglass prepreg. Use a thick epoxy/micro mixture to bond the spars in the locations shown in Figure 15:E:4. Remember to sand and clean the areas where the spars are bonded.

Trim tab support spars

Figure 15:E:4

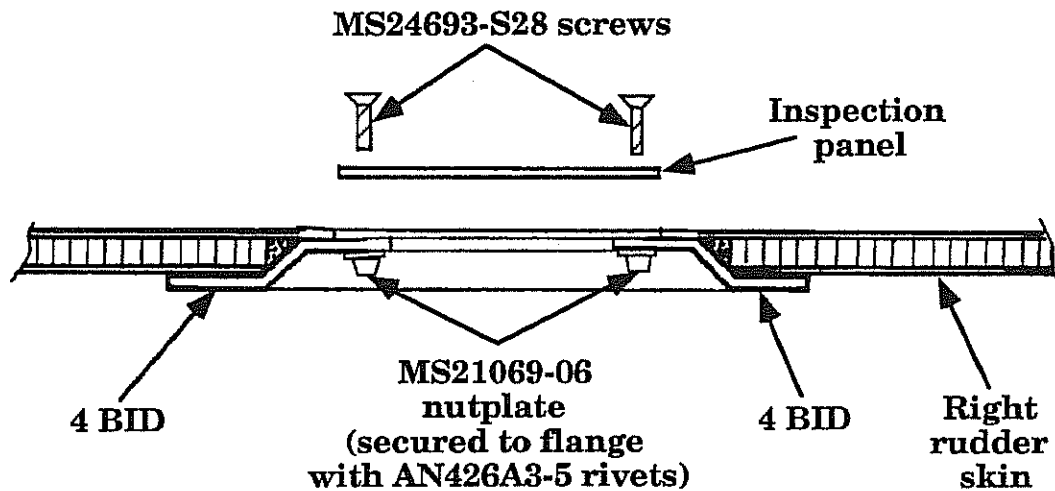


NOTE: At this point, skip to the next two sections, "RUDDER CLOSEOUT" and "TAIL LIGHT INSTALLATION". The instructions in the remainder of this section will assume that the rudder has been closed. This is done because the trim tab is much easier to handle and hinge if it is cut from the already closed surface.

- E9. Carefully cut out the trim tab from the rudder using the scribe lines on the right rudder skin.
- E10. Finish the segmented cut around the trim servo inspection panel and remove the panel from the rudder. Be careful when cutting not to slice into the 4 BID mounting flange.
- E11. For an inspection panel you can use either the fiberglass piece that you cut out of the right rudder skin or cut a similar sized piece of .050" aluminum. If you use the fiberglass piece, it is best to beef it up a bit with 2 extra BID.

Trim tab inspection panel

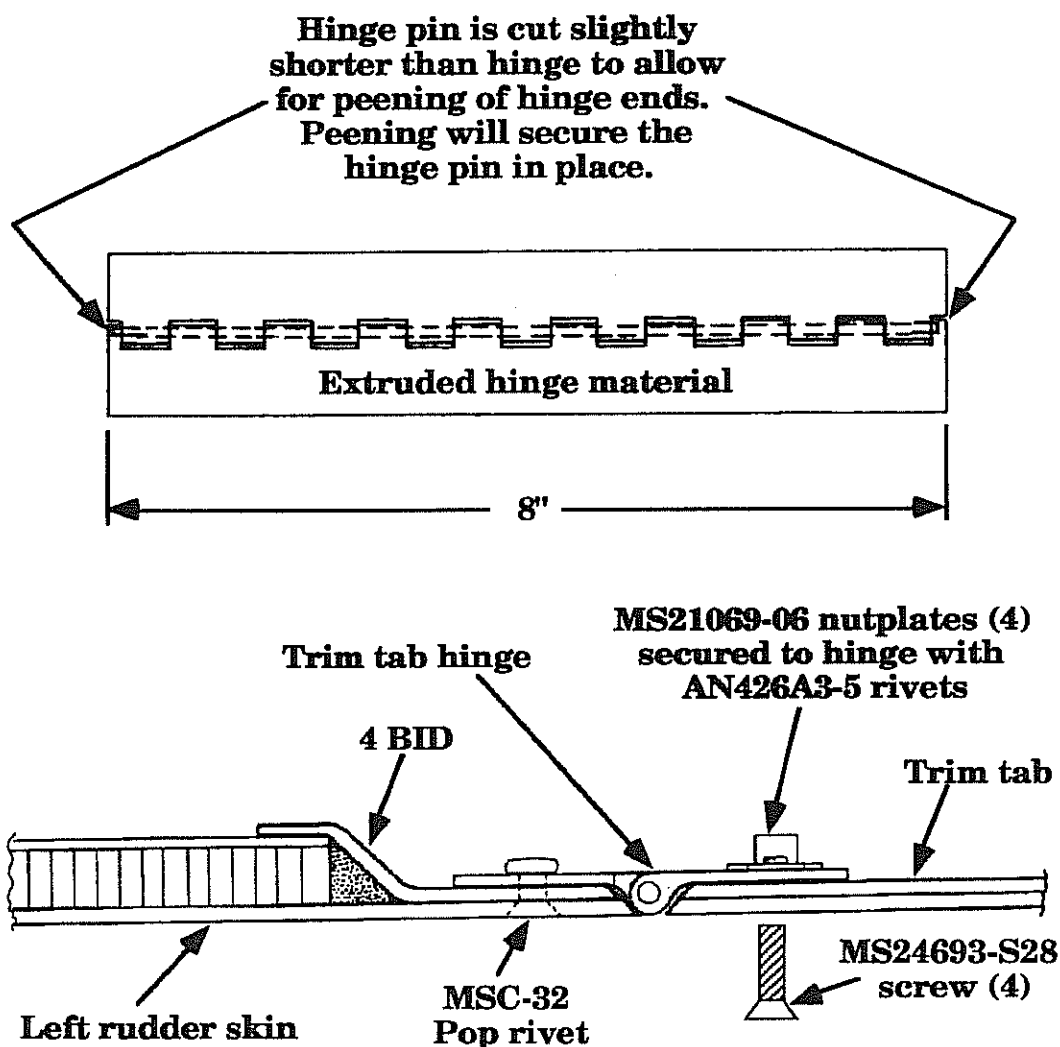
Figure 15:E:5



- E12. Place the inspection panel back in position and drill four #28 screw holes through it and the mounting flange as shown in Figure 15:E:5. Countersink the holes for MS24693-S28 screws.
- E13. Use AN426A3-5 rivets to mount MS21069-06 nutplates to the 4 BID flange at the screw locations.
- E14. The trim tab is hinged with MS20001-5 extruded hinge material. The hinge is mounted to the left rudder skin, on the coreless area you formed in Step E4. Cut an 8" section of hinge. Cut the hinge pin slightly shorter than the hinge. Insert the pin onto the hinge and peen the ends so the pin will not fall out. Use MSC-32 countersunk pop rivets to secure one side of the hinge to the rudder. Sanding a bevel into the rudder where the hinge mounts helps to keep the hinge gap tighter. See Figure 15:E:6.

Hinging trim tab

Figure 15:E:6

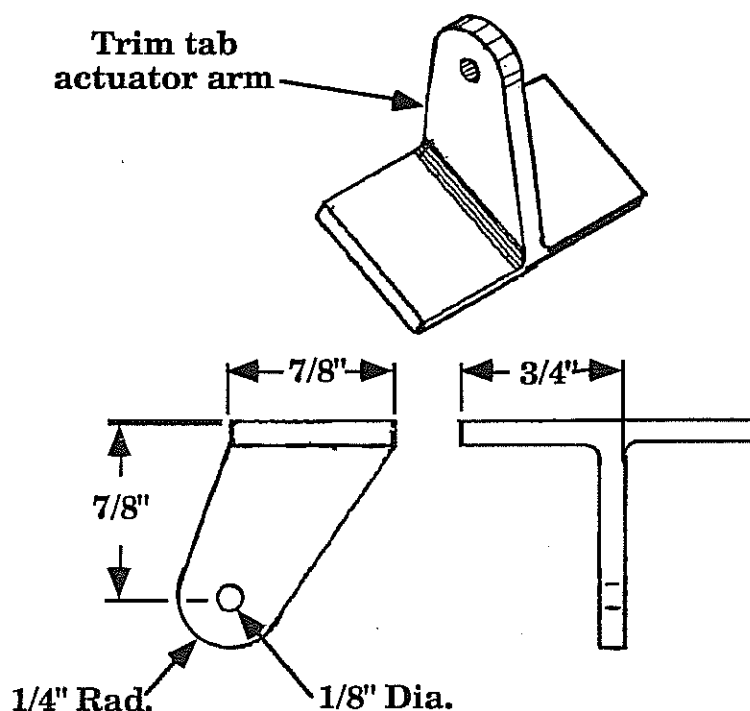


- E15. Place the rudder trim tab in position. The T.E. of the trim tab should line up with the T.E. of the rudder. Use a few drops of instant glue to hold the hinge to the trim tab.
- E16. Drill four #28 holes through both the trim tab and the hinge, as shown in Figure 15:E:6. Countersink the holes in the trim tab for MS24693-S28 screws.

- E17. Use AN426A3-5 rivets to secure MS21069-06 nutplates to the inner surface of the hinge. The trim tab can now be installed and removed using the MS24693-S28 screws.
- E18. Use a piece of Clark foam to form an aerodynamic gap seal. Bond the foam to the trim tab with epoxy/micro and radius the foam so it maintains an even gap throughout it's travel range. Secure the foam to the trim tab with 1 BID of lightweight fiberglass. Smooth and sand the radius with epoxy/micro. See Figure 15:E:8.
- E19. ~~PARAGRAPH DELETED~~ The trim tab actuator arm, TT-01, is now included in the kit.

Trim tab actuator arm

Figure 15:E:7

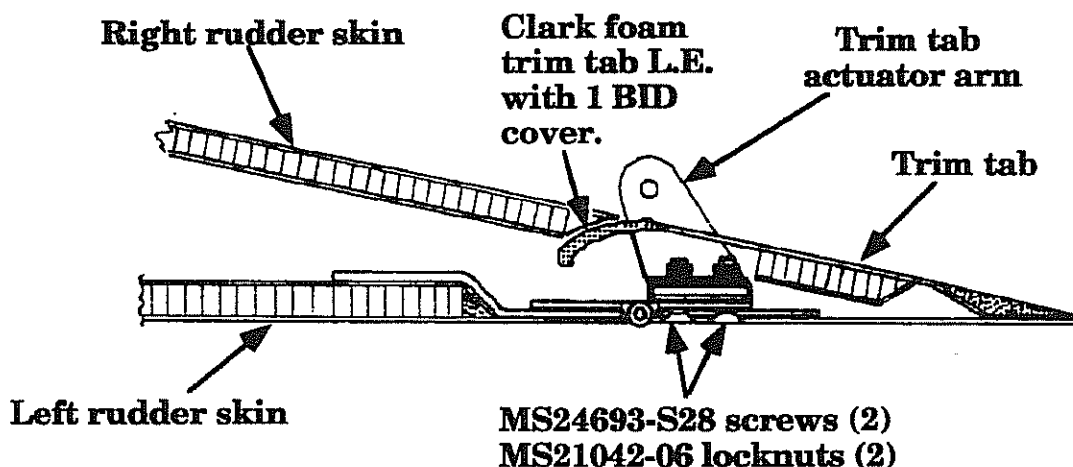


- E20. Drill two #28 holes for mounting the trim tab actuator arm in the position shown in Figure 15:E:8. Countersink the holes for MS24693-S28 screws. The trim tab will have to be notched for the actuator arm.

- E21. Secure the actuator arm to the trim tab with MS24693-S28 screws and MS21042-06 locknuts.

Mounting actuator arm to trim tab

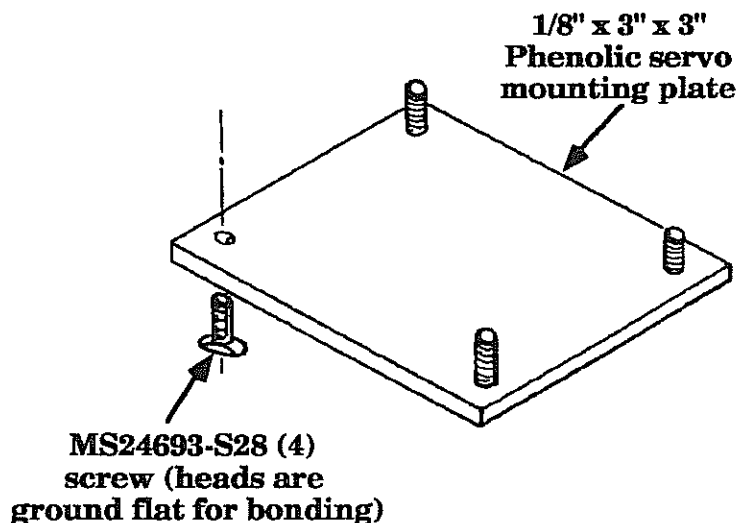
Figure 15:E:8



- E22. Mount the MAC S-4 trim servo into the rudder using the same method as you did for the elevator trim servo. A 3" x 3" piece of 1/8" thick phenolic is drilled using the mounting holes in the servo as guides. Use a #28 drill. Countersink the holes on the bottom side of the phenolic piece for MS24693-S28 screws.
- E23. Grind flats on the heads of four MS24693-S28 screws and use epoxy/flox to pot them into the phenolic as mounting studs for the servo.

Phenolic servo mounting plate

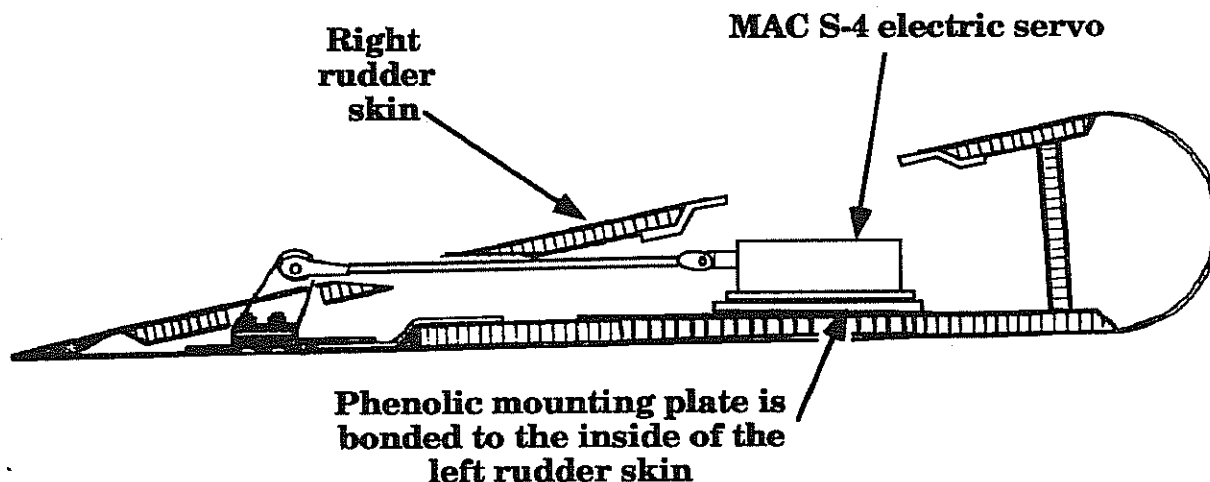
Figure 15:E:9



- E24. With 40 grit, sand the bottom face of the phenolic servo mount. Also sand the inside of the left rudder skin where the servo will be located. Clean these areas with MC.
- E25. Use epoxy/flox to bond the phenolic servo mount to the inside of the left rudder skin. Be sure that the servo is perpendicular to the trim tab hingeline and that you can access the servo mounting nuts for removal and installation.

Connecting servo to trim tab

Figure 15:E:10



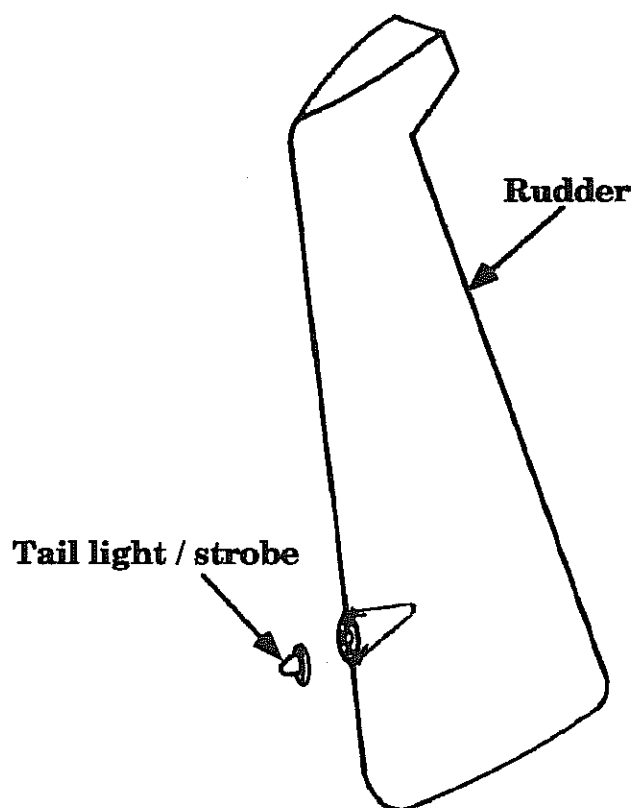
- E26. Connect the servo to the trim tab with the pushrod included in the MAC servo kit. You will have to slot the right rudder skin for the pushrod.

F. TAIL LIGHT INSTALLATION

Now is a good time to install the tail light in your rudder. Because the wingtip strobes are enclosed, they cannot be seen from aft of the aircraft. To be legal, the tail light must be a flashing unit, not just a white position light. The Whelen A500 Tail position/Strobe light is a good choice for the rudder of your Lancair IV. Get the vertical mount model.

Tail light mounted in rudder

Figure 15:F:1

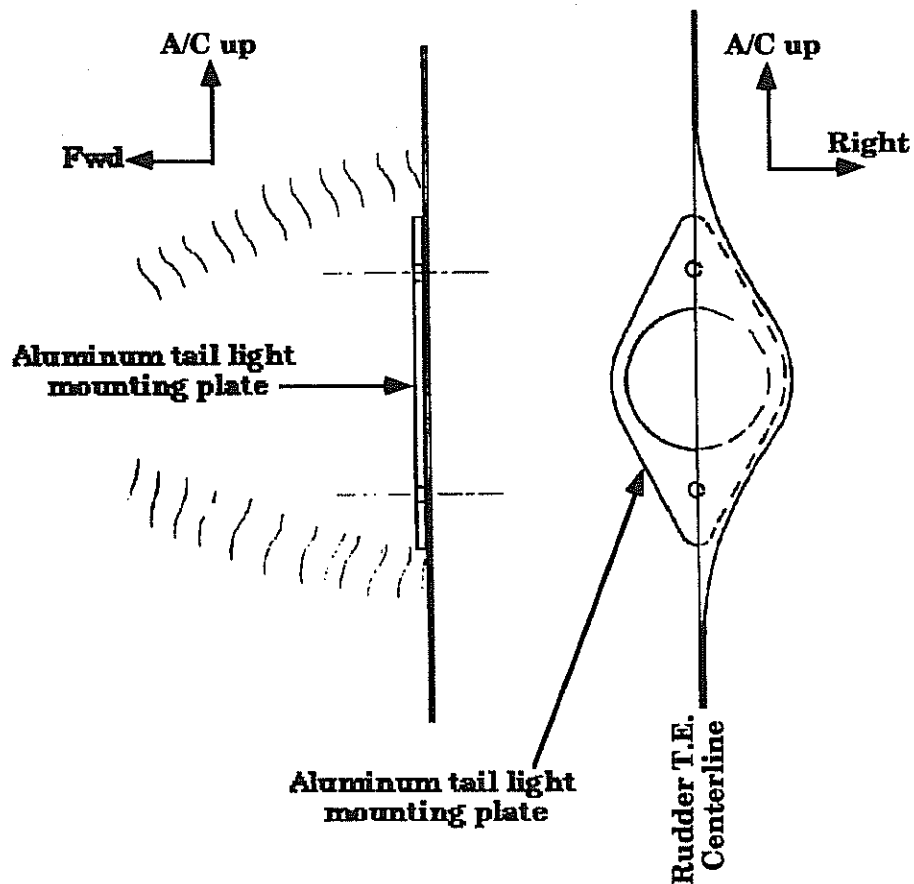


- F1. Scuff the surface of the precut, .090" aluminum mounting plate with 40 grit. Clean the plate with MC.

- F2. Position the mounting plate against the inner face of the premolded light blister in the rudder as shown in Figure 15:F:2. Use the predrilled mounting holes as guides to drill #28 holes through the rudder flange.

Positioning tail light mount

Figure 15:F:2

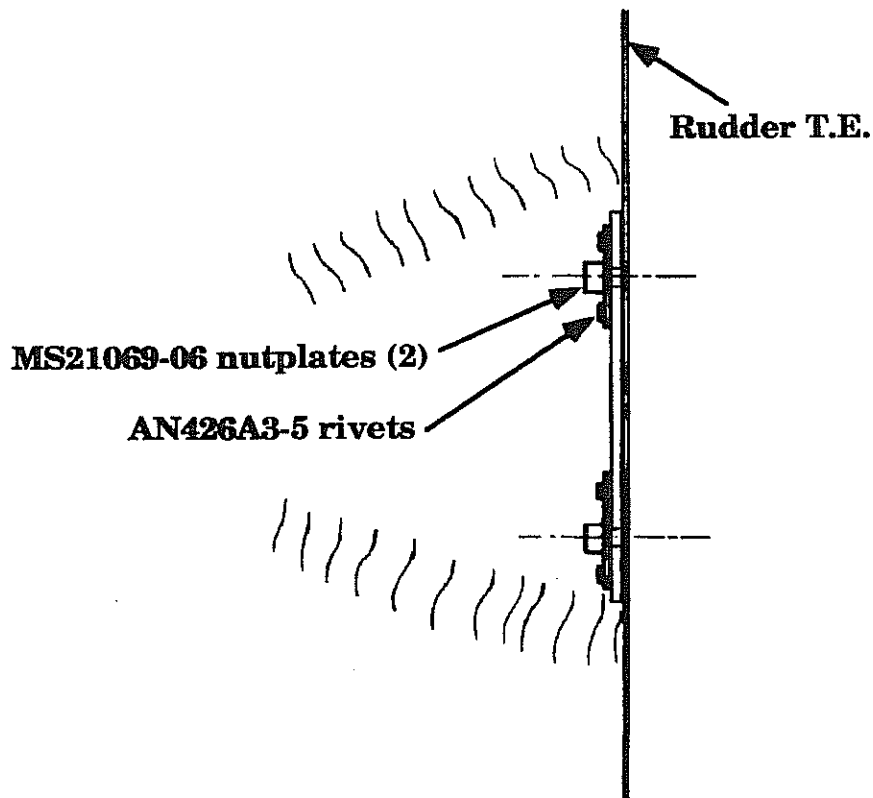


- F3. Remove the mounting plate and use AN426A3-5 rivets to secure an MS21069-06 nutplate to the forward face of the plate at each mounting screw location as shown in Figure 15:F:3.

- F4. The mounting holes in the Whelen A500 strobe are designed for 4-40 screws so it is necessary to drill them out to a #28 size to accommodate the 6-32 screws you will use. Be careful not to damage the unit when drilling.

Securing nutplates to mounting plate

Figure 15:F:3

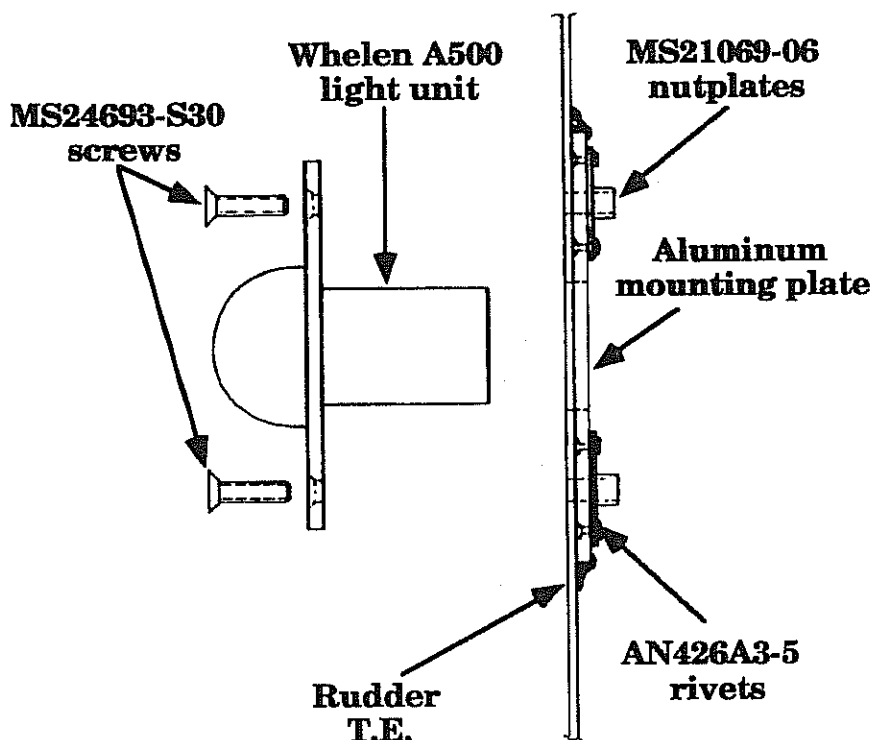


- F5. Place the tail light against the aft face of the rudder flange and check that all mounting screw holes line up properly. You will have to do some trimming on the flange so the tail light can rest on a flat surface.

- F6. Use a thick epoxy/flox mixture to bond the aluminum tail light mounting plate into the rudder. Form a fillet behind the aluminum plate for added support. Be sure not to get any flox in your nutplates.

Securing tail light mounting plate into rudder

Figure 15:F:4



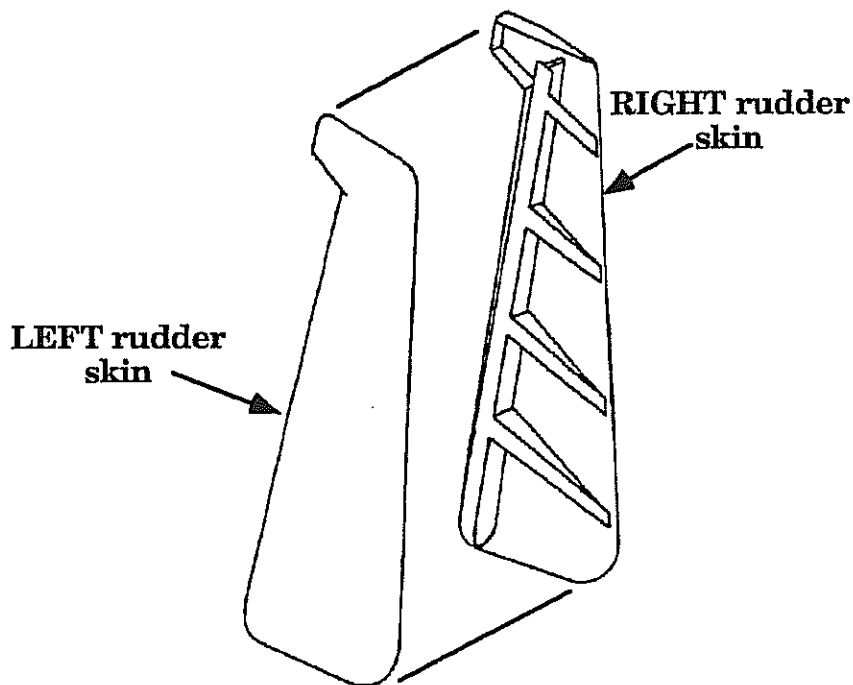
- F7. The aft face of the tail light mounting area can be finished to a flat, even surface after the rudder is closed.
- F8. The tail light wires can be run forward through the rudder spar (drill a *small* hole only large enough for the wires), through the rudder L.E., and finally through the sternpost. A quick disconnect plug between the rudder and sternpost is handy for rudder removal and installation.

G. RUDDER CLOSEOUT

The main thing to watch out for in closing the rudder is keeping the rudder T.E. vertical. The T.E. brace you have supported to the horizontal stabilizer should be enough to hold the rudder straight but if you feel you need more support, improvise as necessary.

Rudder closeout

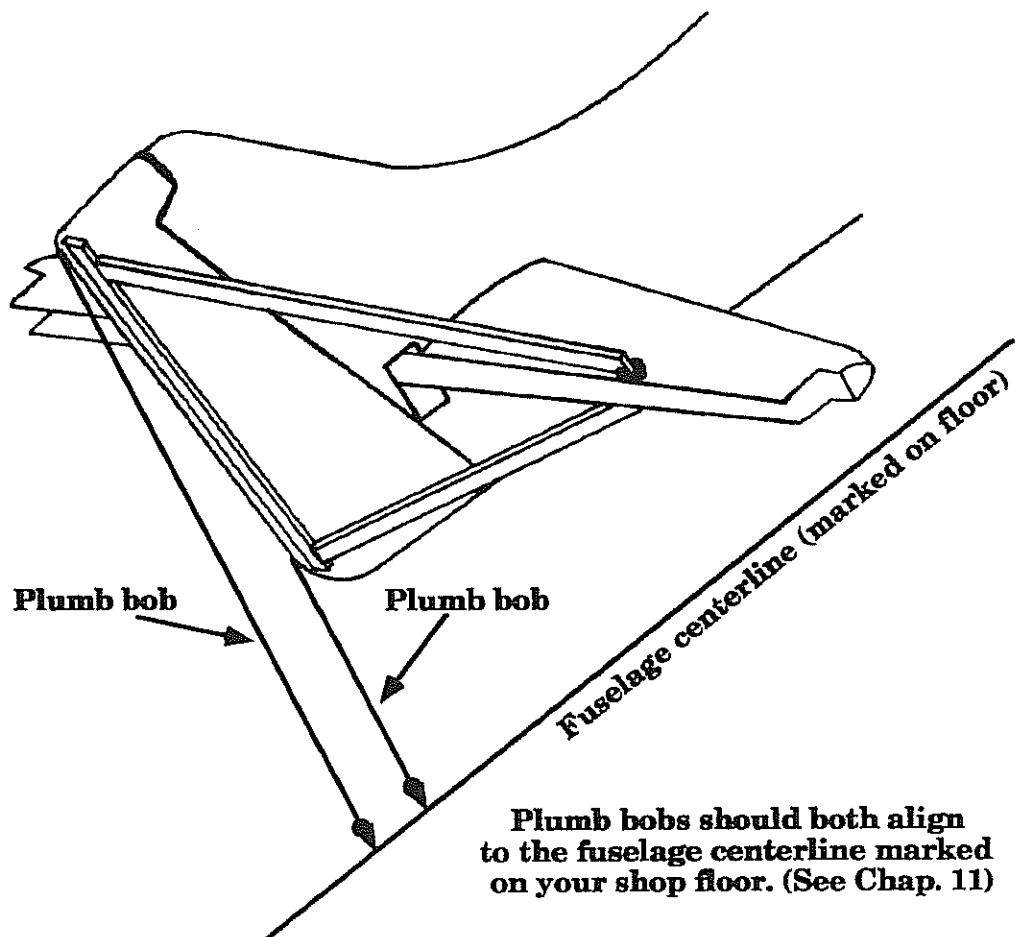
Figure 15:G:1



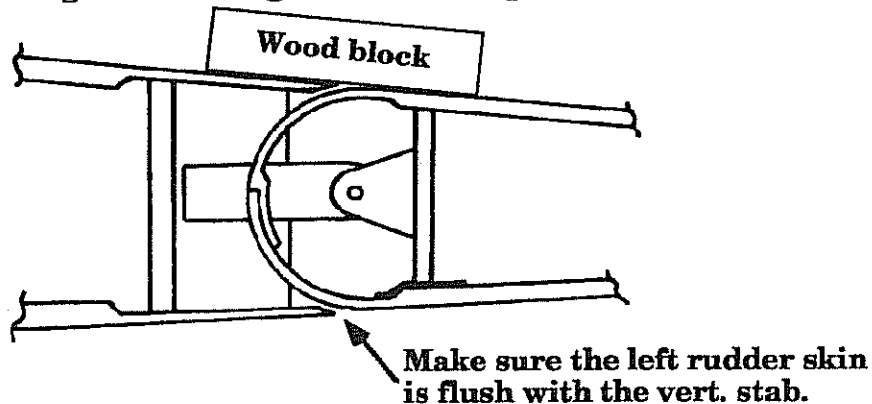
- G1. With 40 grit, sand the surfaces where adhesive will be applied to bond the left rudder skin in place. These surfaces include, the L.E. joggle, the capstrips, the T.E. joggle, and the inner surface of the left rudder skin where it touches any joggle or capstrip. Clean these surfaces with MC.
- G2. Do a trial run of positioning the left rudder skin complete with clamps and clecoes. Is the left rudder skin flush with the vertical stabilizer T.E.? Are the joggles around the counterweight area fitting together properly? Is the rudder T.E. straight and vertical? If the answer is yes to all of the above, it's time to bond.

Trial fit of left rudder skin

Figure 15:G:2



Wood block glued to vert. stab. and rudder in Section B will keep these two surfaces flush to each other while rudder is being closed. (Hinges will also help)



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- G3. Spread a thin coat of Hysol on all bonding surfaces. Mix a little floc into the Hysol to give it some body and apply a thicker coat to the bonding surfaces of the right rudder skin and capstrips. Mound up the Hysol toward the center of all bonding surfaces to avoid trapping air in the adhesive.
- G4. Carefully place the left rudder skin in place and secure with clamps and clecoes. Be sure all tools and knick knacks are removed from the rudder.
- G5. When the Hysol has cured, remove the clamps and clecoes. Use 40 grit to sand the joggles around the perimeter of the rudder. Clean all joggles with MC.
- G6. Use a thick epoxy/micro mixture to fill the T.E. joggle of the rudder. Since the rudder is closed, you can remove it from the vertical stabilizer. This will ease the application of the micro. You can also remove the wood T.E. supports.



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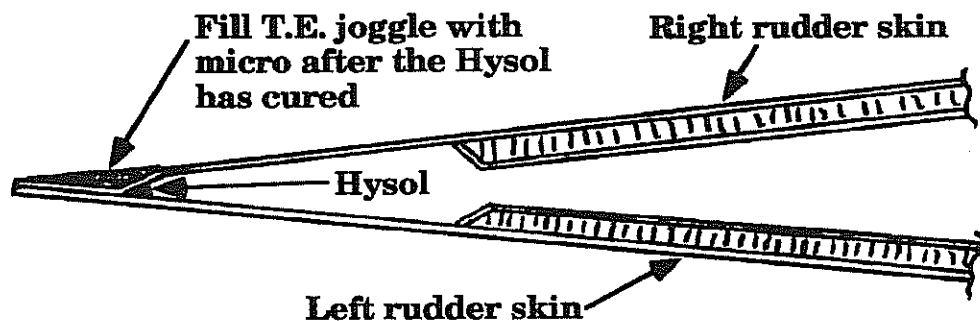
RUDDER



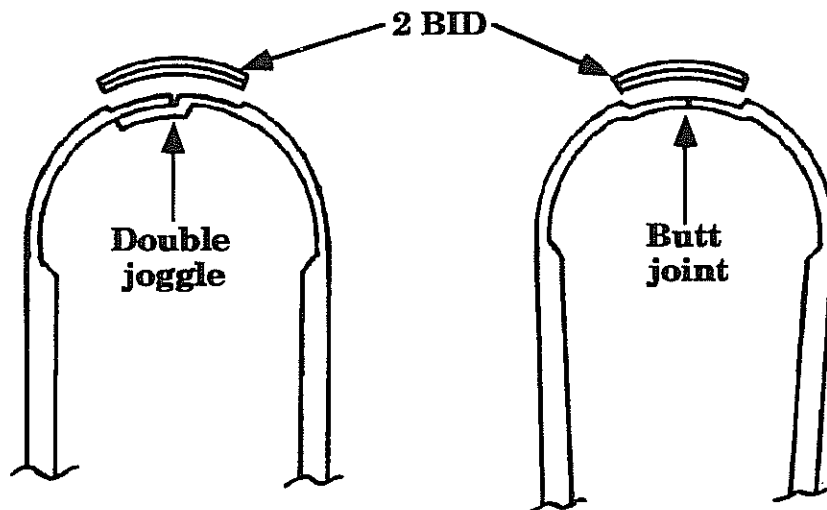
- G7. Apply 2 BID in the joggles at the bottom of the rudder, top of the the rudder, and around the counterweight area.
- G8. When the 2 BID has cured, apply a thick epoxy/micro mixture to the joggled areas. When the micro cures, sand the micro to fair in the edges around the joggled areas.

Finishing joggled areas

Figure 15:G:3



Some edges of the rudder have double joggles and some are simply butt joints. A recess is provided on each type for a 2 BID closeout.

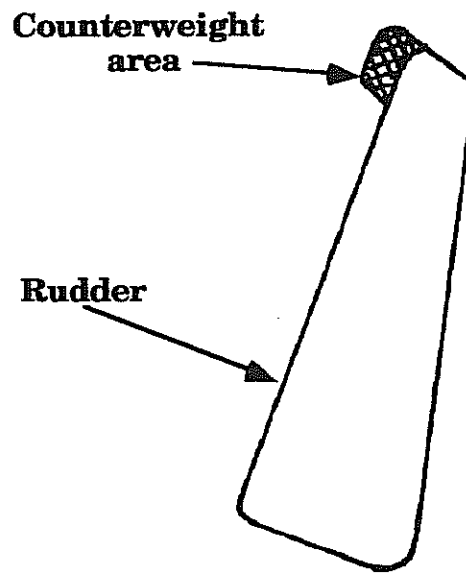


H. BALANCING RUDDER

The Lancair IV rudder is 100% counterbalanced with a premolded lead weight. When balancing this and any other control surface, be sure you have installed all the hardware into the rudder such as the trim servo, tail light, wires, etc.

Rudder counterweight

Figure 15:H:1

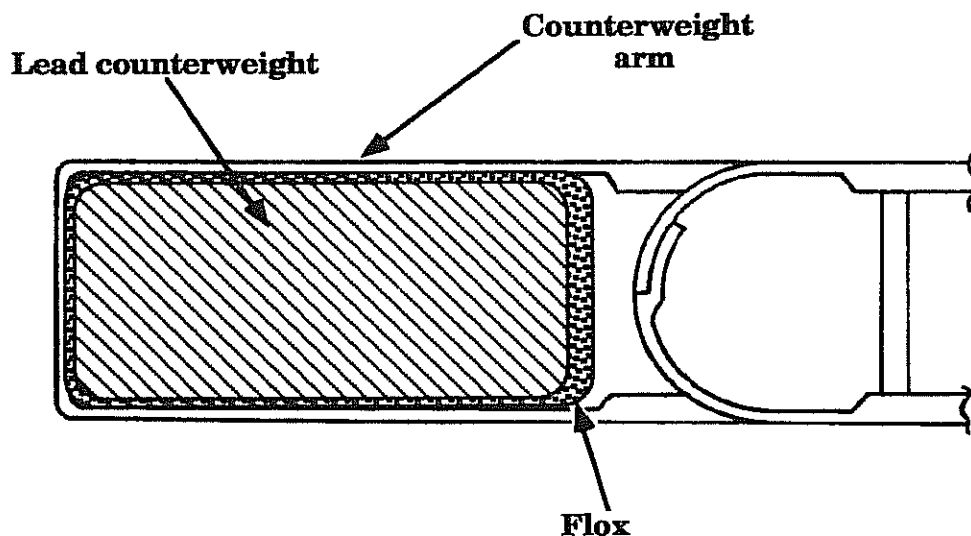


- H1. Remove just enough of the bottom surface of the rudder counterweight arm so you can slip the lead weight into position.
- H2. With 40 grit, sand the inner surface of the rudder counterweight arm where the lead will be bonded. Yes, it is hard to thoroughly sand this area because of its size, but do the best you can. Clean the sanded area with MC.

- H3. Use epoxy/flox to pot the lead weight into the counterweight arm. Be sure there is flox built up behind the counterweight to prevent it from sliding aft.

Floxing counterweight into arm

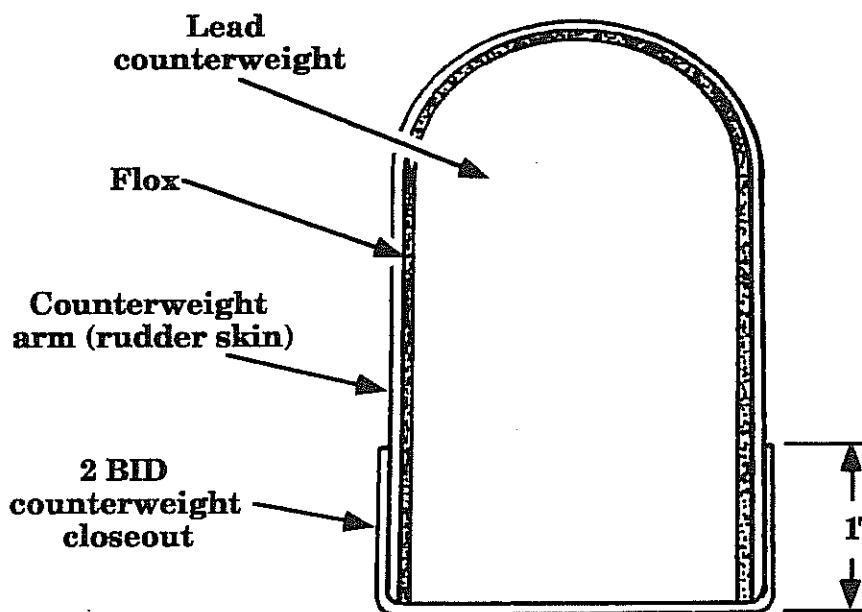
Figure 15:H:2



- H4. Secure the lead counterweight in position with 2 BID as shown in Figure 15:H:3. Fair the BID into the surface of the counterweight arm with epoxy/micro.

Securing counterweight in position

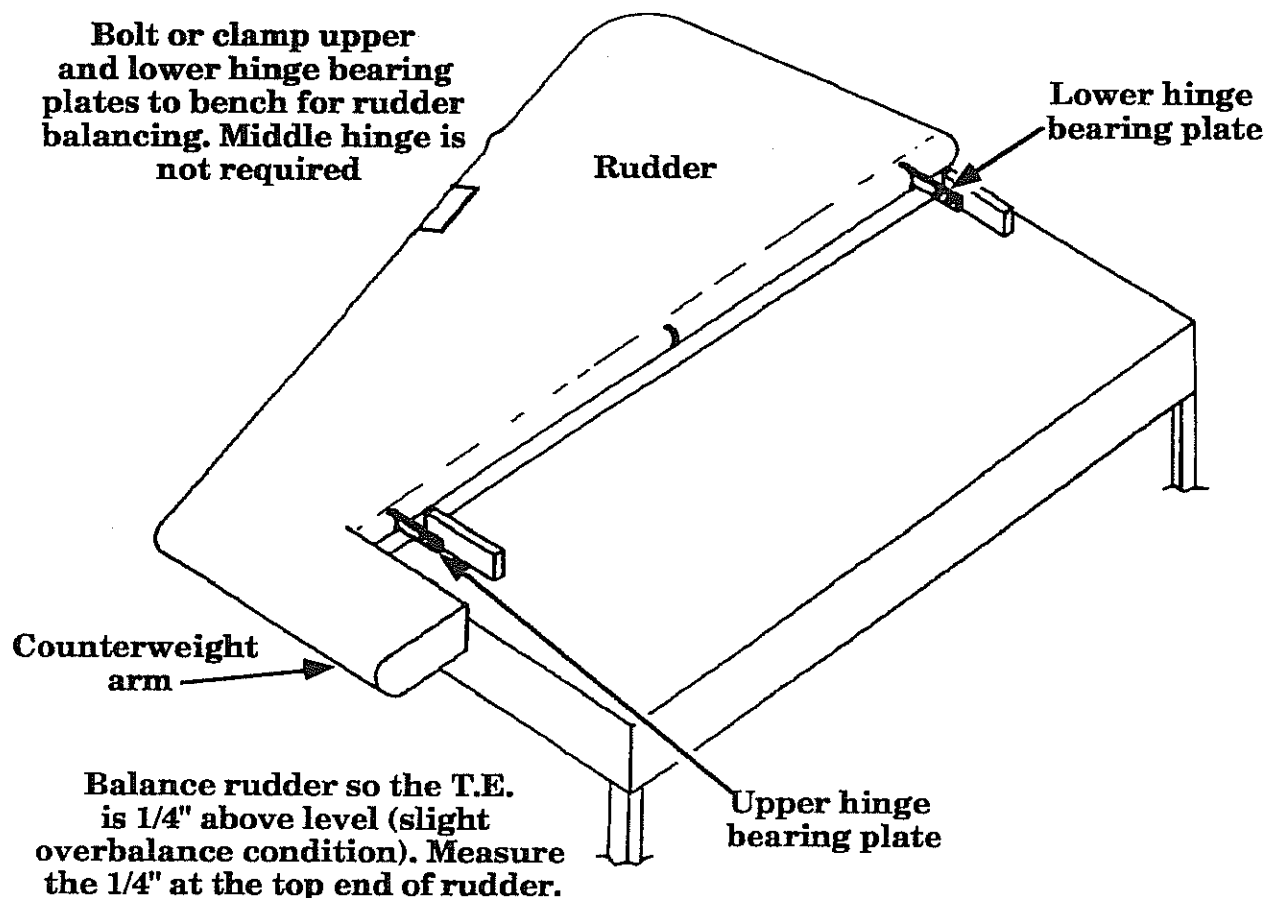
Figure 15:H:3



- H5. For balancing, rig up a test stand on the edge of a bench so the rudder is suspended by its hinge points. Figure 15:H:4 can be used as a reference for making the test stand.

Rudder balancing stand

Figure 15:H:4



NOTE: Before you balance the rudder, it's a good idea to apply the first coat of primer to the rudder. Primer will add weight to the rudder to more closely simulate the final counterweight requirements.

- H6. The lead counterweight provided in the kit should overbalance the rudder, so you'll have to drill out some of the lead. Do this now, drilling out enough lead so the rudder T.E. (at the top end) is 1/4" above the level condition. This will slightly overbalance the rudder to accommodate future paint. Fill your drill holes in the counterweight arm with epoxy/micro and sand flush.

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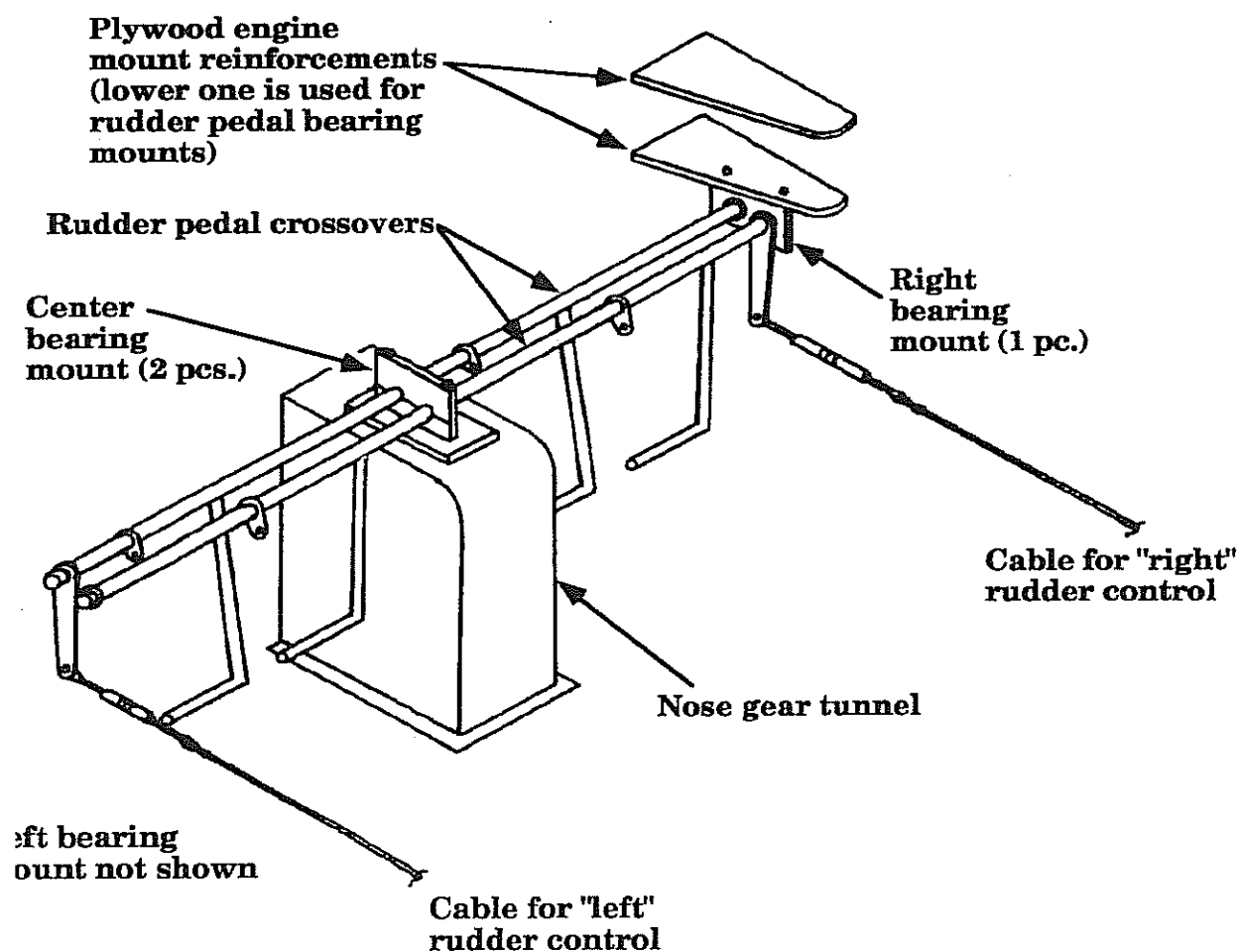
I. RUDDER PEDAL INSTALLATION

The Lancair IV has dual rudder pedals so either pilot or co-pilot can actuate the rudder. The rudder pedal assembly is mounted using the nose gear tunnel and engine mount reinforcements as supports.

Familiarize yourself with the rudder pedal assembly before you begin installation. There are two rudder pedal crossover tubes, one forward and one aft. The forward crossover tube is used for left rudder control and the aft crossover is used for right rudder control. The crossovers are supported in three Delrin plastic bearing mounts. The center bearing mount is sliced in two pieces and the left and right mounts are single pieces.

Rudder pedal assembly

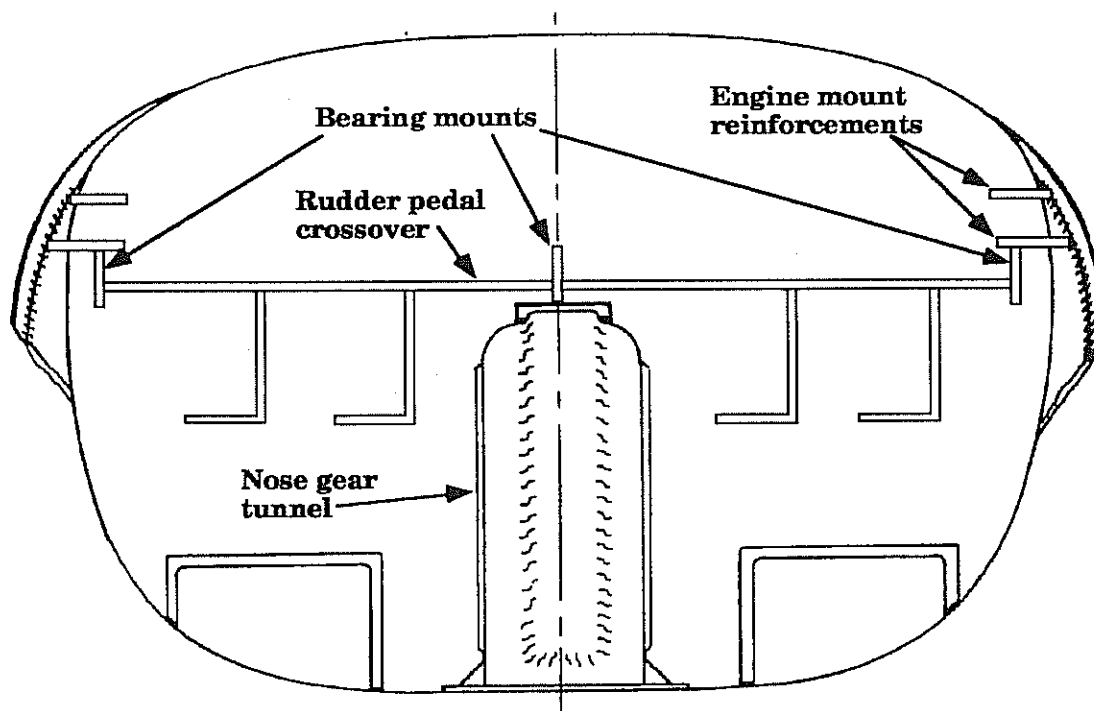
Figure 15:I:1



- I1. Insert the rudder pedal crossovers into the bearing mounts. The holes that the crossovers slip into are off-centered. The wider part of the bearing mounts should be up. Slide the assembly onto the nose gear tunnel. When the center bearing mount is resting on the plywood hardpoint that you glassed onto the nose gear tunnel, the left and right mounts should rest against the bottom of the engine mount reinforcements. If it doesn't fit perfectly, and it probably won't, don't worry, you'll be doing a release against the nose gear tunnel mounting area to take up any slop. If the assembly doesn't want to slide into position because the height between engine mount reinforcements and the nose gear tunnel is too small, carefully sand the center bearing mount until the assembly fits.

Fitting crossover tubes

Figure 15:I:2

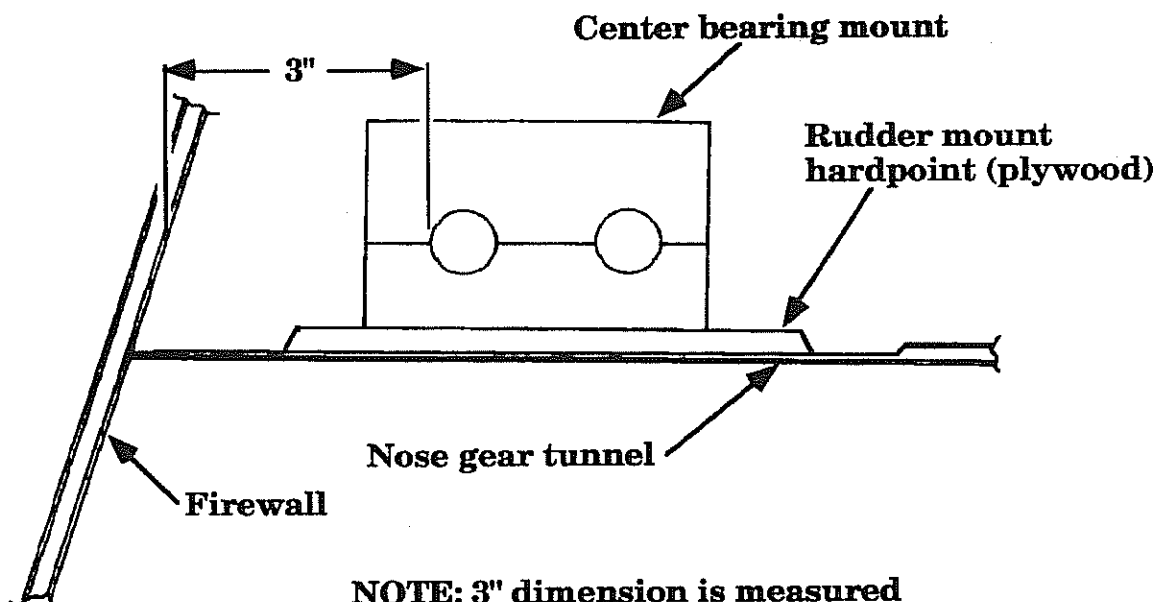


Notice how the holes in the bearing mounts are offset. Install the rudder pedal crossovers so they are on the lower side of the mounts.

- I2. Adjust the rudder pedal assembly so the forward holes of the bearing mounts are centered 3" aft of the firewall.

Locating center bearing mount

Figure 15:I:3



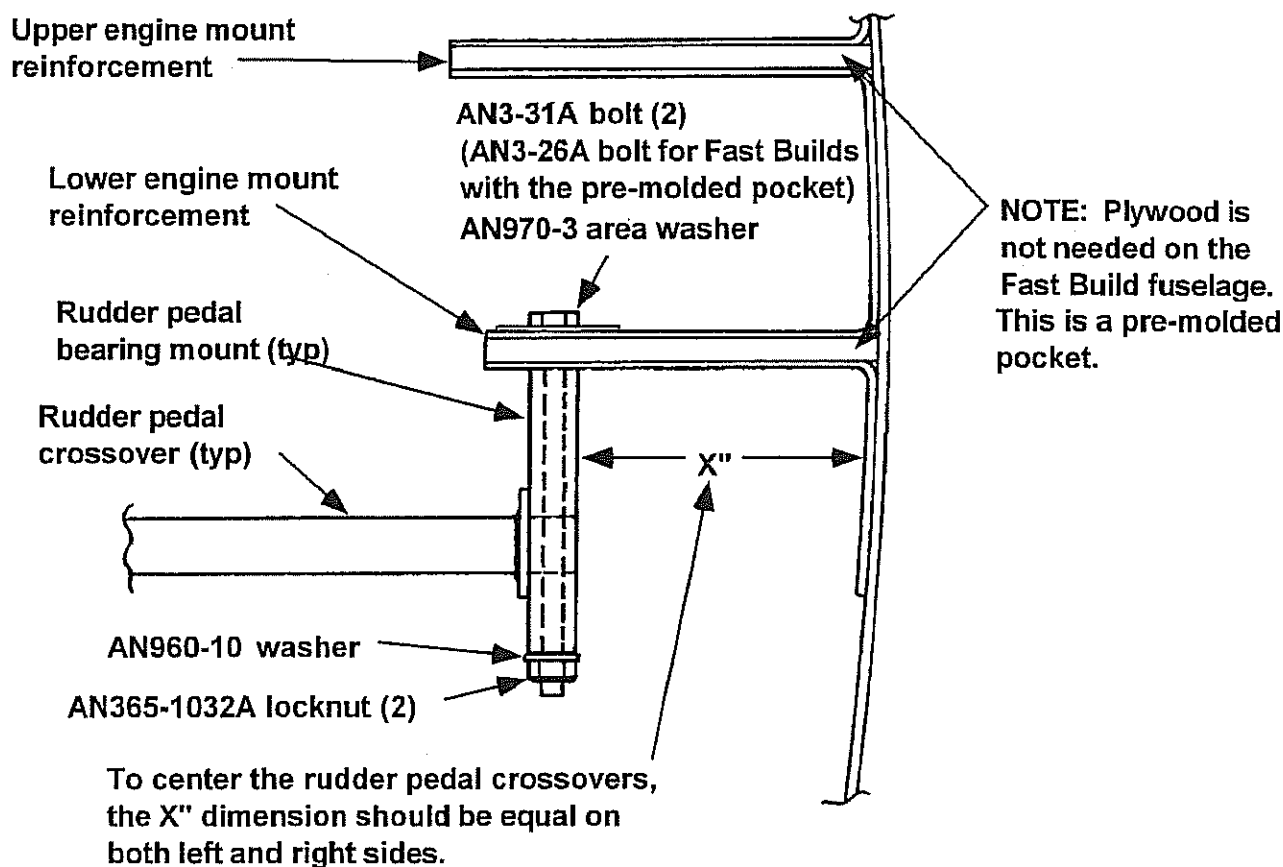
NOTE: 3" dimension is measured from aft face of the firewall.

- I3. Center the rudder pedal assembly by attaining an equal distance between left and right bearing mounts and the fuselage sides. Clamp the bearing mounts to the engine mount reinforcements.

- I4. An angle drill is required to drill the #12 mounting holes up through the engine mount reinforcements. Use the predrilled holes in the bearing mounts as guides. The best way of drilling is to use an angle drill with a long #12 (or 3/16" dia.) bit. Run the bit up through the bearing mounts and spot drill at the four hole locations in the engine mount reinforcements. Remove the pedal assembly and bearing mounts, then drill all the way through the engine mount reinforcements. Don't drill the two holes through the nose gear tunnel yet.

Mounting left and right bearing mounts

Figure 15:I:4

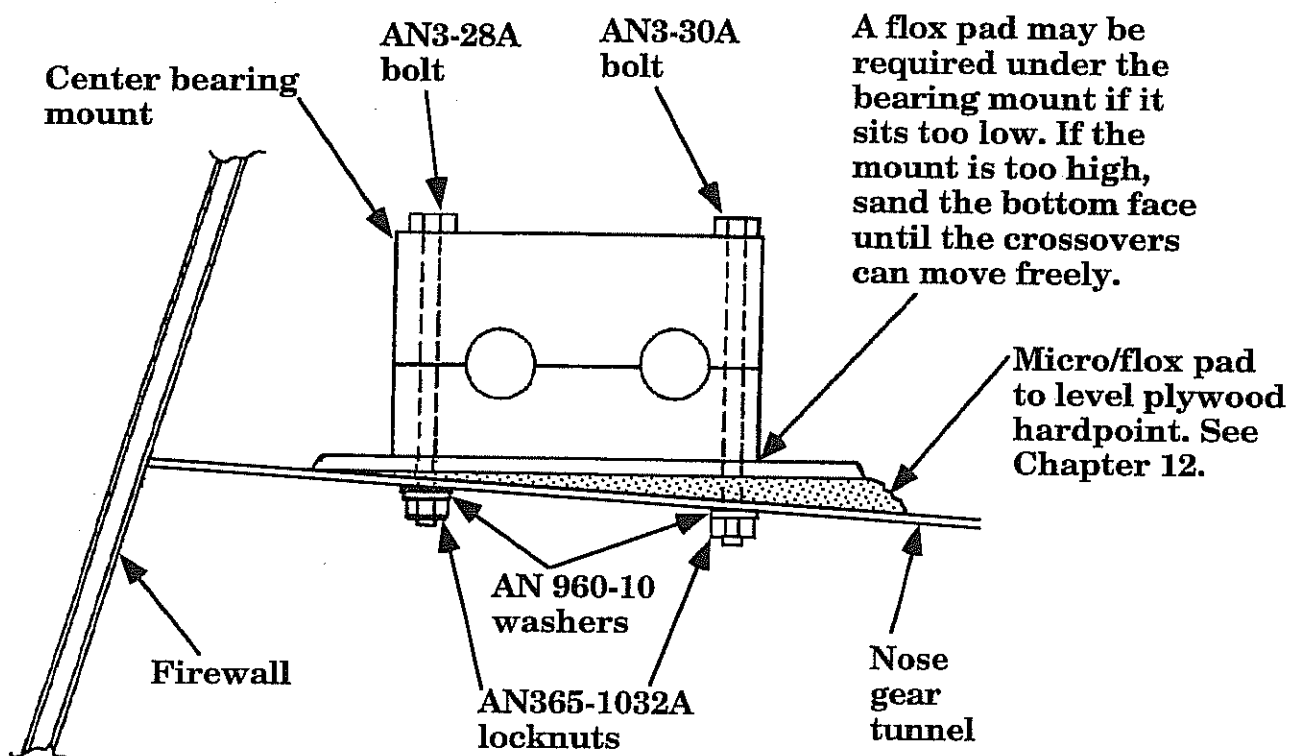


- I5. Reposition the rudder pedal assembly and secure the left and right bearing mounts to the engine mount reinforcements with AN3-28A bolts, AN365-1032A locknuts, and AN960-10 washers.

16. Is there any gap between the center bearing mount and the nose gear tunnel hardpoint? If there is, apply one layer of release tape to the bottom face of the center bearing mount and do a flox release between it and the nose gear tunnel. Remember to sand and clean the surface of the nose gear tunnel where you apply epoxy/flox.

Mounting center bearing mount

Figure 15:I:5



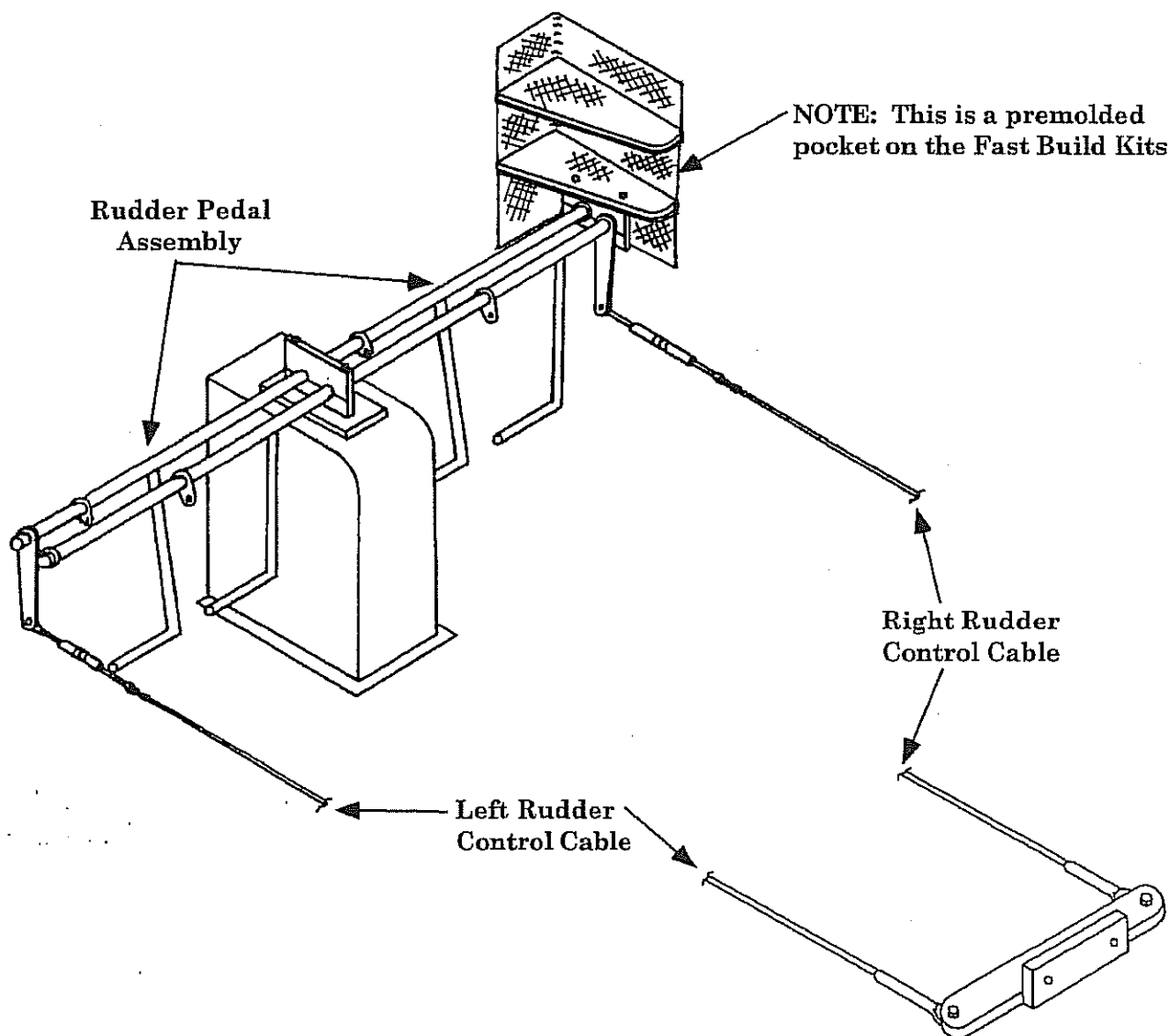
17. Use the center bearing mount as a guide to drill two #12 holes through the nose gear tunnel hardpoint.
18. Secure the center bearing mount to the nose gear tunnel with AN3-28A and AN3-30A bolts, AN365-1032A locknuts, and AN960-10 washers. Due to a combination of builder variances, these bolt lengths can vary. Use more washers or a longer bolt if required for your installation.
19. Your rudder pedal crossover tubes should both move freely when they are bolted into the bearing mounts. There can be friction in the system, but if the crossovers bind excessively, one of the bearing mounts may be torqued off-center. In this case you would have to do another flox release on the off-centered bearing mount.

J. RUDDER CABLE INSTALLATION

There are two, 1/8" diameter cables connecting the rudder pedals to the rudder control horn. The cables should slide freely through Nyloseal tubing that is bonded to the fuselage sides. The Nylo Seal tubes are labeled "Nylo Seal Tubing 44-NSR."

Rudder cables

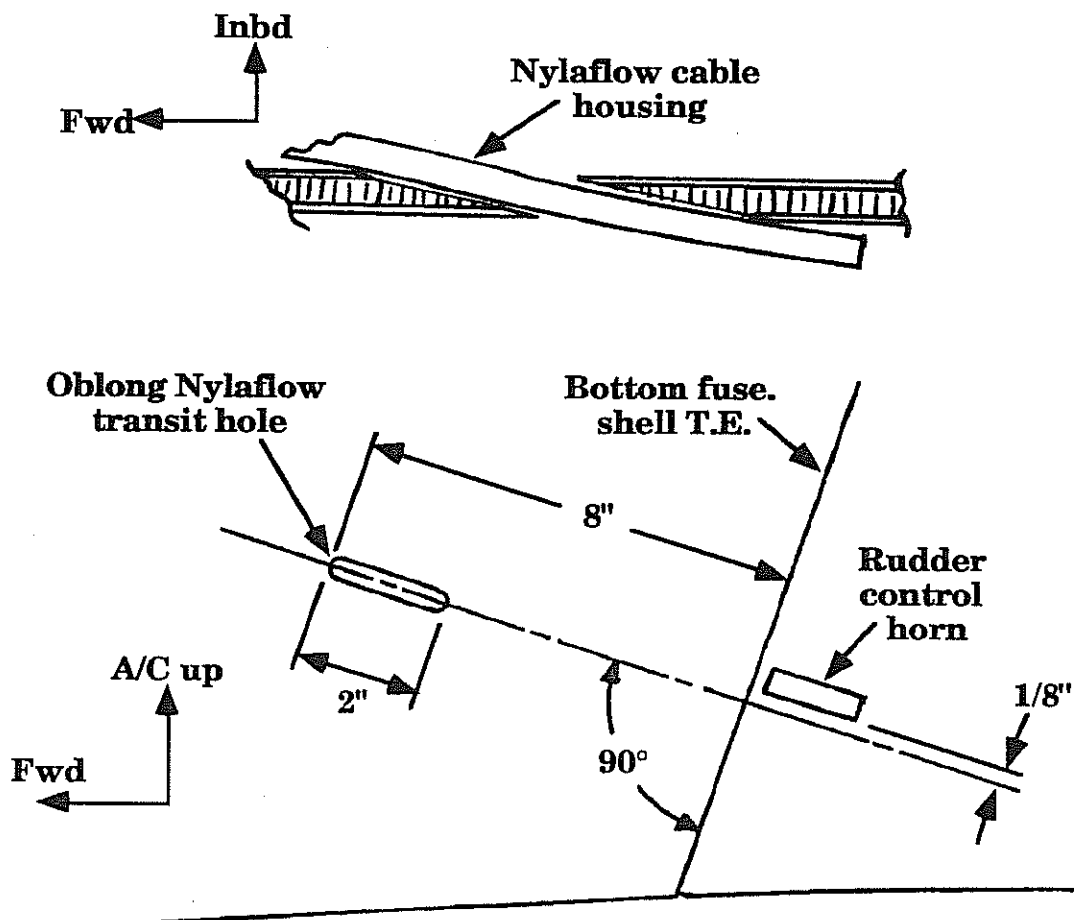
Figure 15:J:1



- J1. Grind an oblong hole in both sides of the fuselage 8" forward of the rudder actuator arm as shown in Figure 15:J:2. Grind the holes at angles so the nylaflow cable housing can smoothly transition through the fuselage sides.

Grinding holes in fuselage sides

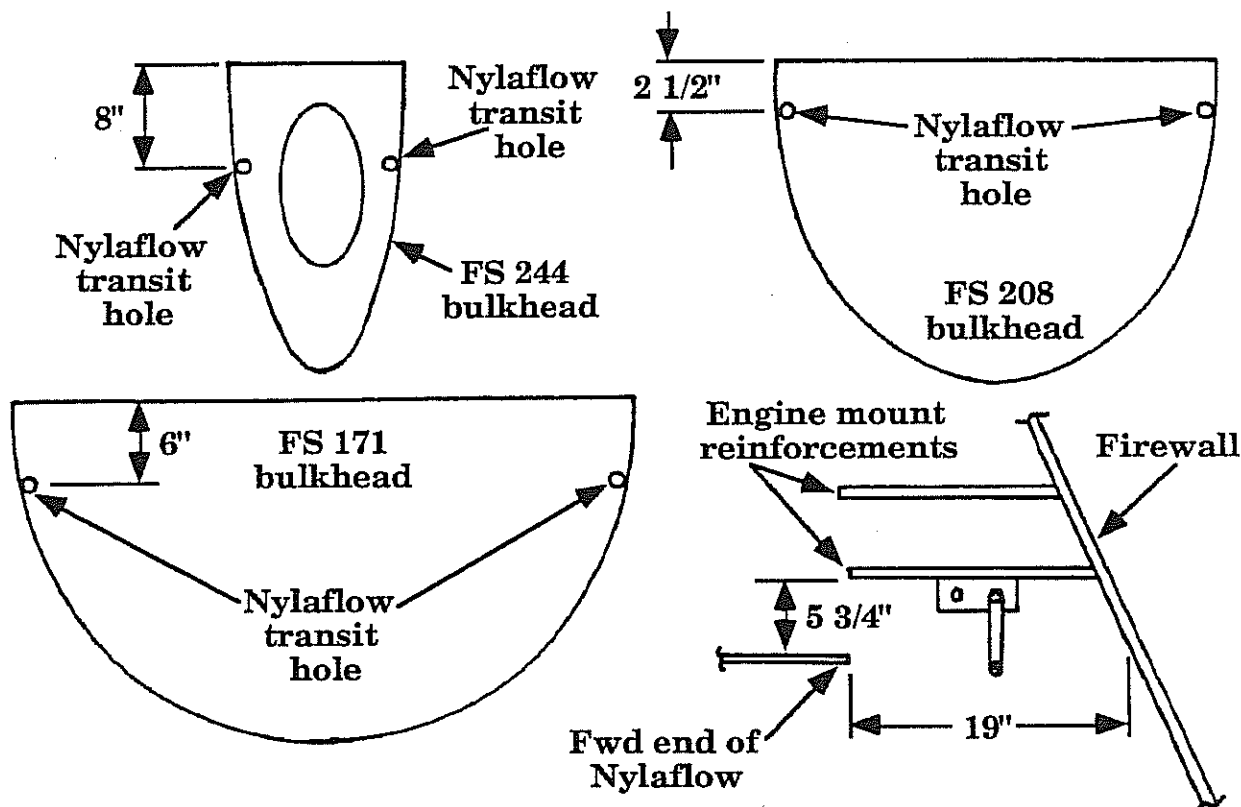
Figure 15:J:2



- J2. Grind transit holes through the FS 244, 208, and 171 bulkheads on both sides of the fuselage as shown in Figure 15:J:3.

Nylaflow transit holes in bulkheads

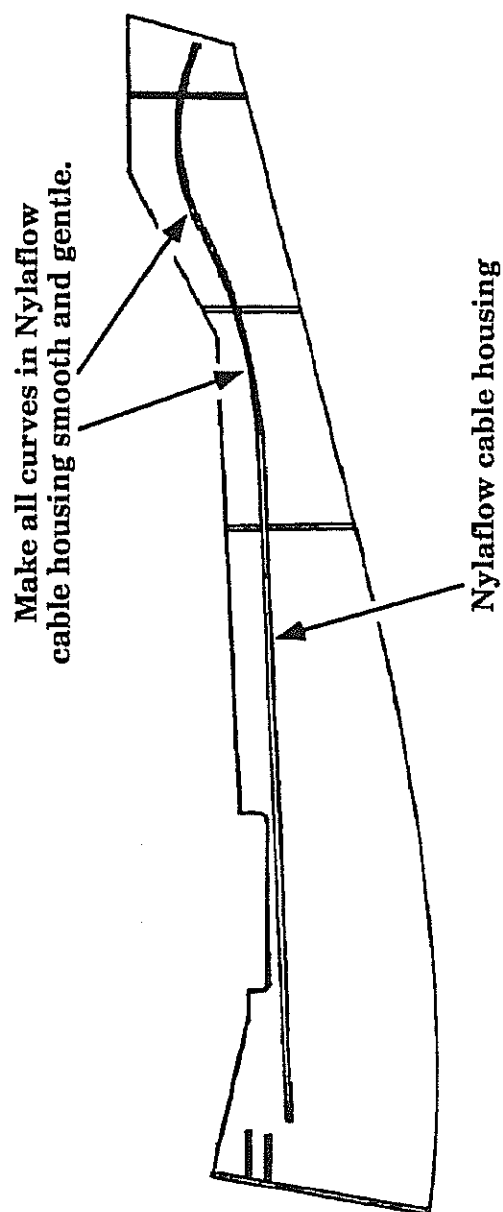
Figure 15:J:3



- J3. Test fit the nylaflow cable housings into the fuselage as shown in Figure 15:J:4. Keep the curves smooth and larger to avoid cable binding. The nylaflow runs in a straight line between FS 171 and the rudder pedal crossovers. The forward end of the nylaflow should be level with the attachment hole in the crossover tube arms. You can use a few drops of instant glue to temporarily secure the nylaflow to the fuselage sides.
- J4. Slip a rudder cable into each nylaflow housing and check that it slides freely. The most common place for binding would be where the nylaflow exits the fuselage sides in the tail area. If this bend is too severe, grind a little more of the fuselage to lessen the angle.

Routing nylaflow and rudder cable

Figure 15:J:4



- J5. When satisfied that the rudder cable is routed properly and will not bind, mark the position of the nylaflow then remove it from the fuselage.

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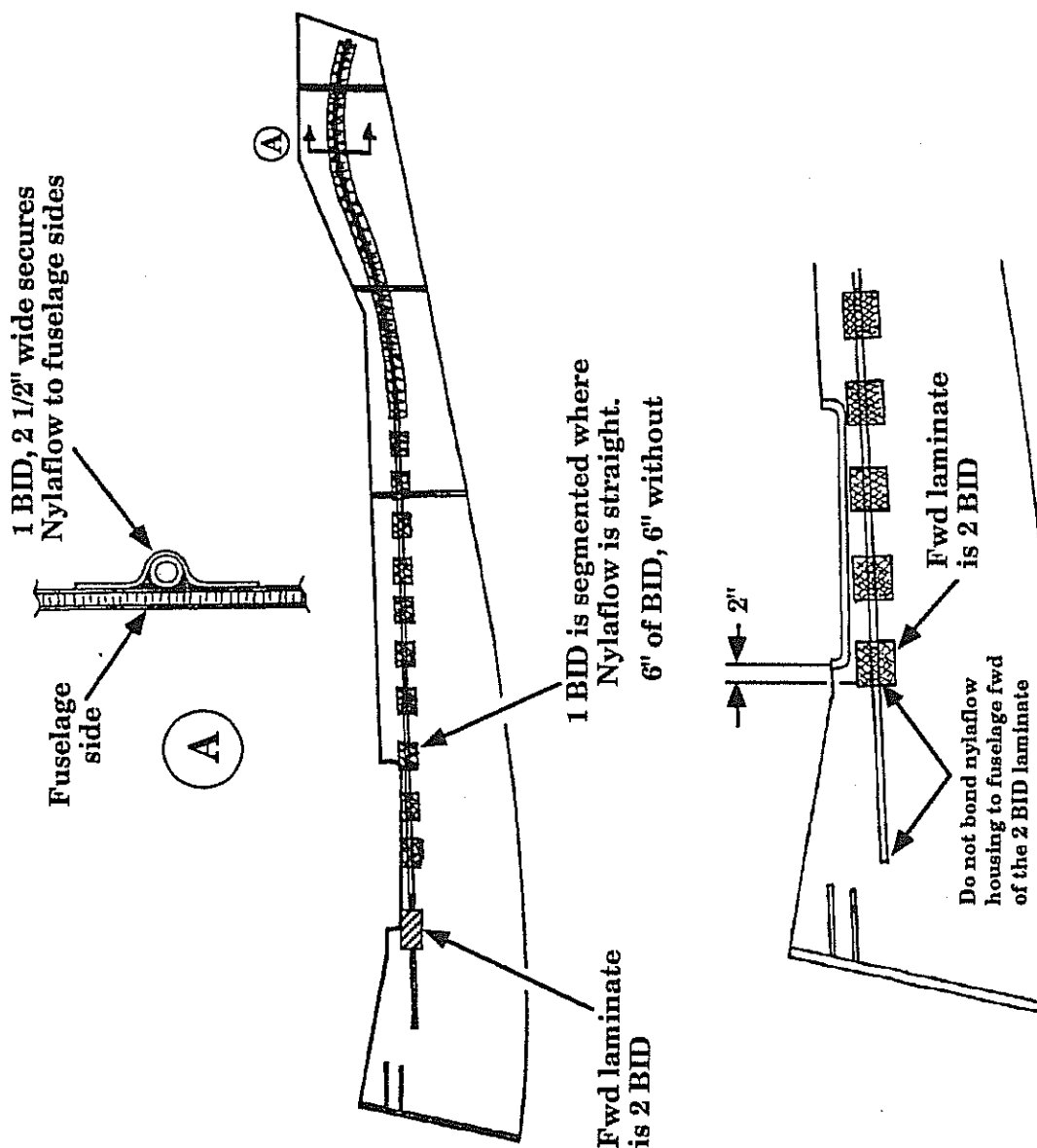
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- J6. Scuff up the surface of the nylaflow with 40 grit where it will be bonded to the fuselage sides. Also scuff the fuselage where the nylaflow will be bonded. Clean all bonding areas with MC.
- J7. Slip the two nylaflow cable housings back into position and bond them to the fuselage with a thick epoxy/micro mixture. Notice in Figure 15:J:5 that the housing is not bonded to the fuselage side ahead of the forward securing laminate.

Securing nylaflow to fuselage

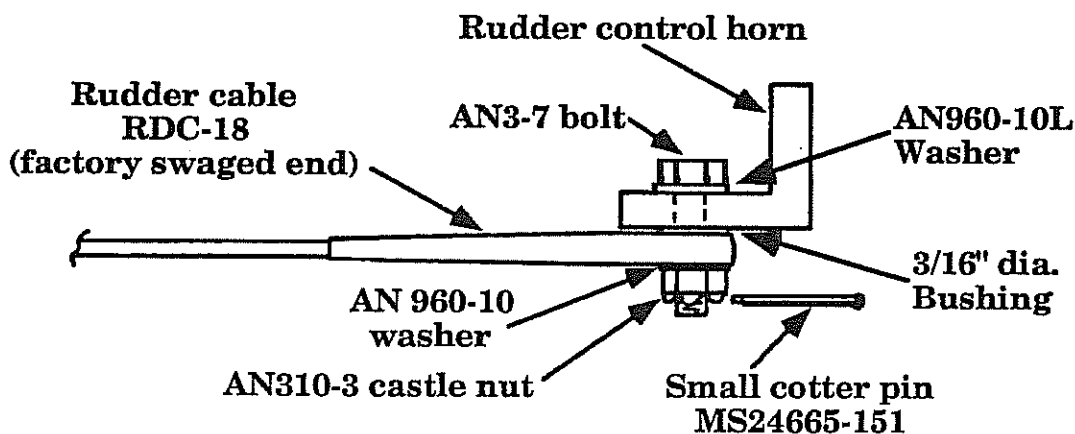
Figure 15:J:5



- J8. Secure the nylaflow cable housings to the fuselage sides with 1 BID as shown in Figure 15:J:5. Notice that the 1 BID covers the whole cable housing in the area of sharp curves, but is segmented in the straight areas to save weight. The forwardmost securing laminate is a 2 BID piece that ends 2" forward of the door joggle. The cable is free floating from this point forward.
- J9. Insert the rudder cables into the nylaflow housings. The factory swaged eye end terminals are the aft ends of the cables.
- J10. Secure the eye end terminals of the rudder cables to the rudder actuator arm with AN3-7 bolts, AN960-10 washers, AN310-3 castle nuts, and small cotter pins. Don't tighten the castle nut so much that the eye end cable terminal will not rotate. Snug up the castle nut just enough so there is no slop in the eye end, then use the cotter pin to secure the nut.

Securing rudder cable to rudder actuator arm

Figure 15:J:6

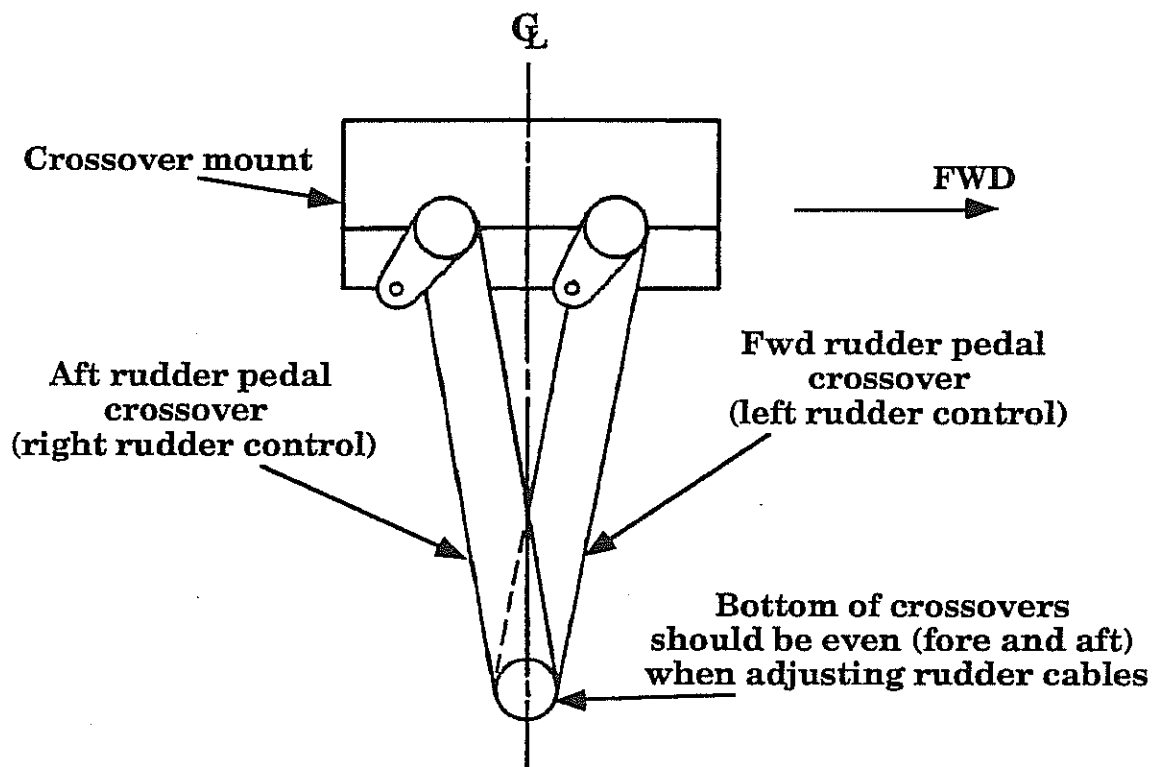


- J11. Clamp the rudder in the neutral position. Use a "C" clamp and a couple pieces of wood on both sides of the counterweight to avoid crushing the rudder skin.

- J12. The rudder cables are connected to the crossover tubes using turnbuckles so you can later adjust the rudder pedal position. Make two wood spacers that will brace the left and right rudder pedals in the neutral position shown in Figure 15:J:7. Use a few drops of instant glue to hold the spacers in place.

Neutral position of crossovers

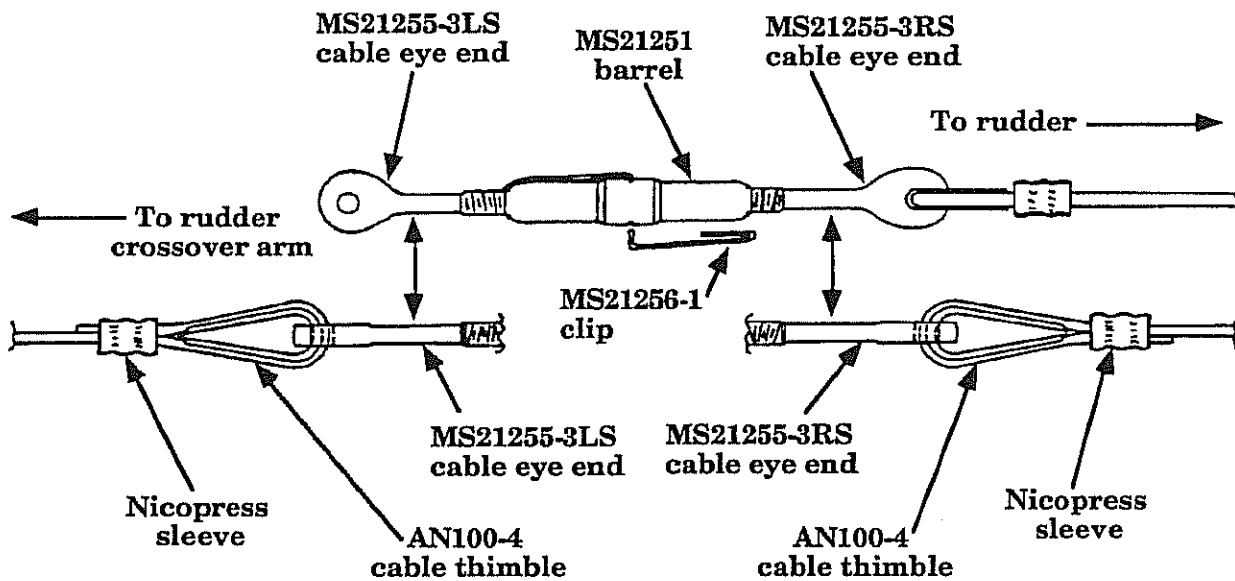
Figure 15:J:7



- J13. Assemble the turnbuckle as shown in Figure 15:J:8. Don't insert the locking clips yet as they are hard to remove without damaging them. Thread the rudder cables through the Nicopress sleeves and around the cable thimbles. Do not crimp the Nicopress sleeves yet!

Assembling turnbuckles

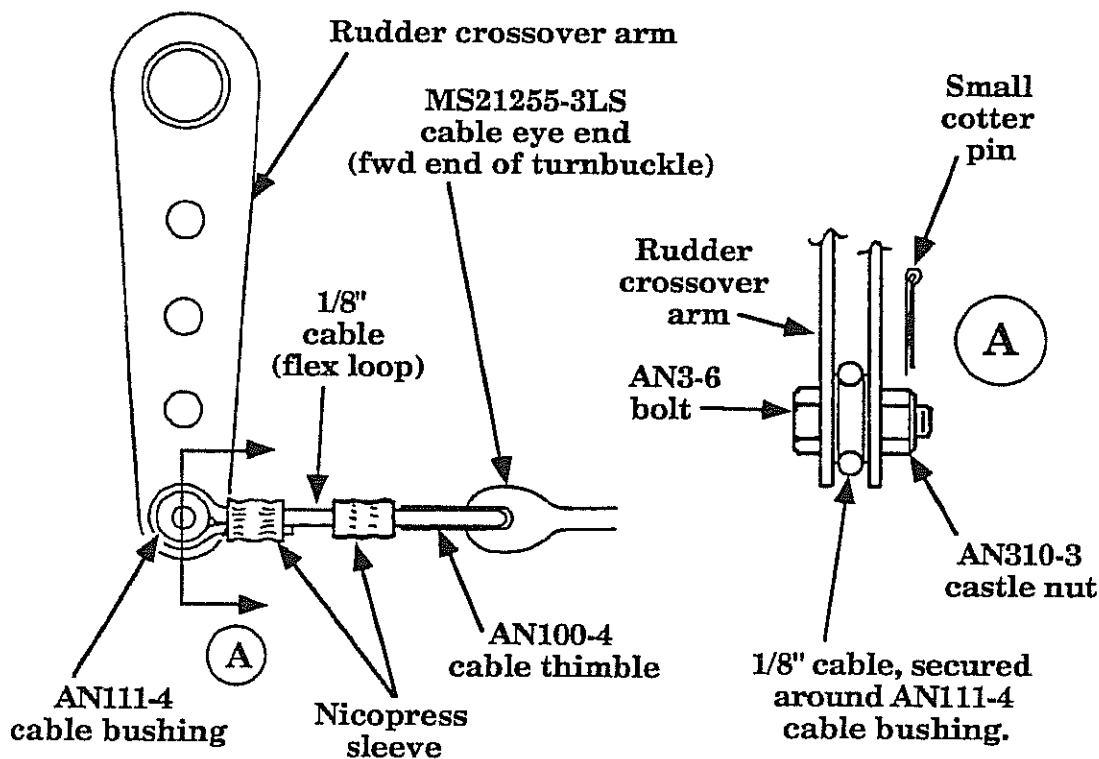
Figure 15:J:8



- J14. Assemble the short flex loop as shown in Figure 15:J:9. This small length of cable will relieve the twisting loads from the turnbuckle. You can go ahead and crimp the two nicopress sleeves on the flex loop. Remember to insert the AN100-4 cable thimbles onto the MS21255-3LS cable eye ends BEFORE crimping the nicopress sleeves. Many a builder has crimped these sleeves only to forget installing the turnbuckle ends.

The flex loop

Figure 15:J:9



NOTE: Flex loop should be about 5" in length.

- J15. Secure the AN111-4 cable bushings to the crossover arms with AN3-6 bolts, AN310-3 castle nuts, and small cotter pins. Do not tighten the castle nuts so much that you bind up the cable bushing. The bushing should be able to rotate.
- J16. Connect the turnbuckle and pull the slack out of the rudder cables without pulling the rudder pedal bars away from the wood spacer. Crimp the last two nicopress sleeves (those at the aft end of the turnbuckle). Any additional cable adjustment must be done with the turnbuckles. For now, do not insert the clips into the turnbuckle barrels. The clips are hard to remove without bending.

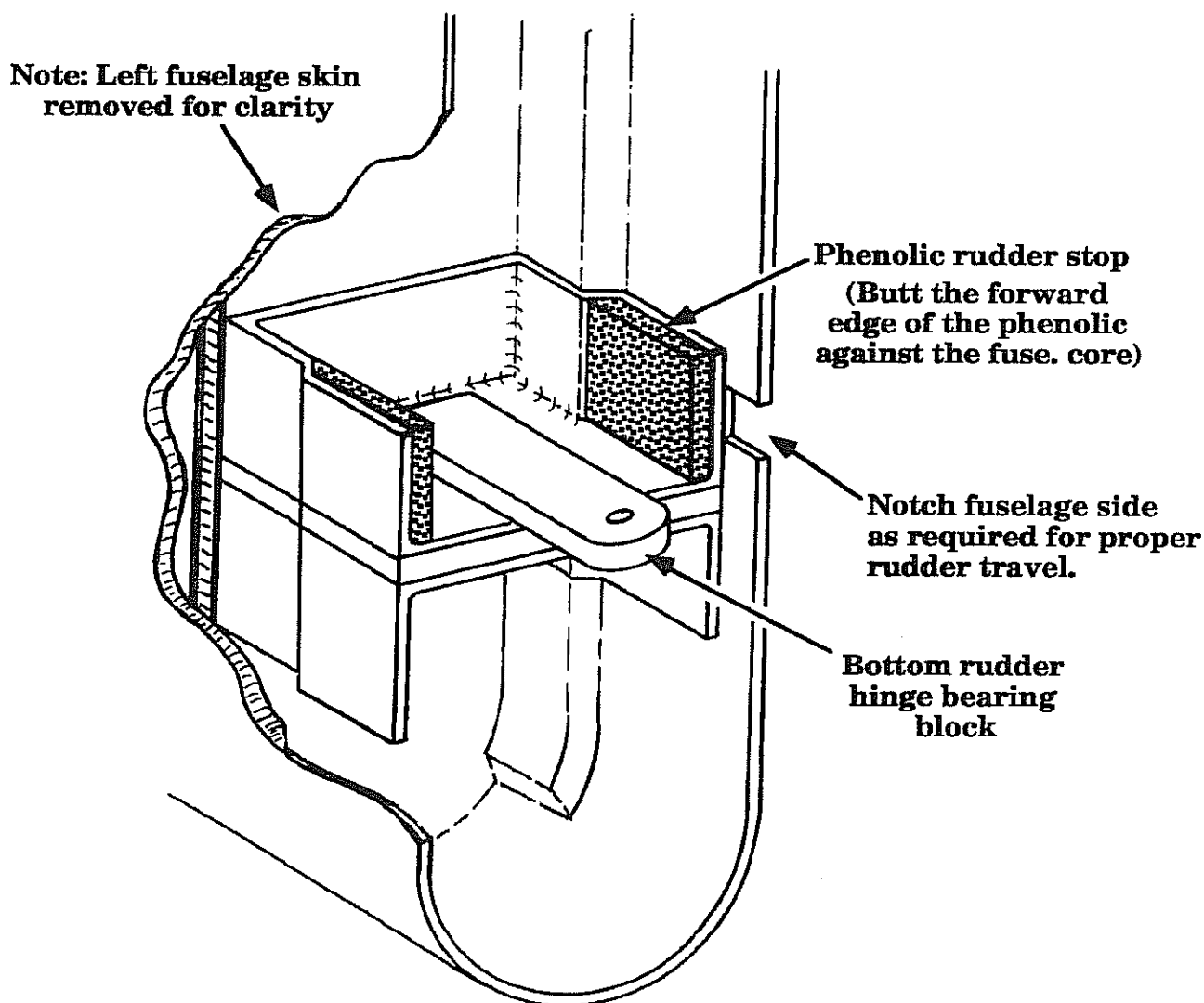
K. RUDDER STOPS

As the rudder reaches it's maximum travel, the control horn will strike a phenolic stop. Two stops must be secured to the fuselage and adjusted for the proper rudder travel.

- K1. Cut two pieces of 1/4" thick phenolic to fit against the inside of the fuselage skin as shown in Figure 15:K:1. The phenolic pieces should be cut 1 1/2" tall (the length will vary depending on the core position). The edges of the phenolic pieces will have to be rounded because of the previous layups in this area.

Phenolic rudder stops

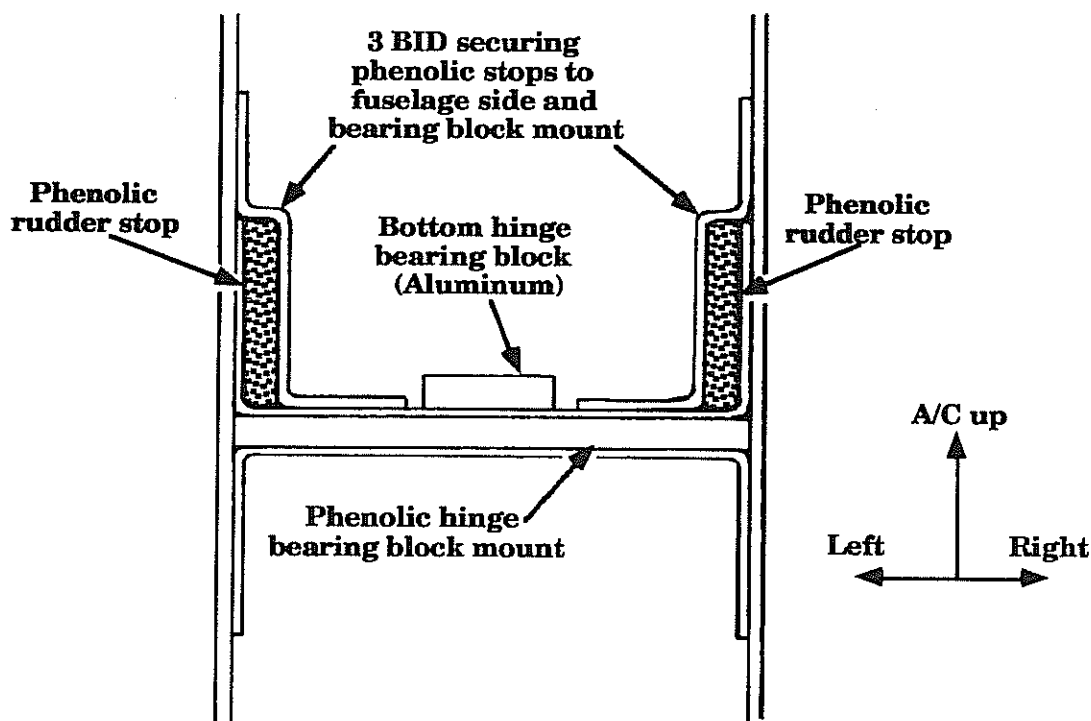
Figure 15:K:1



- K2. Sand the phenolic rudder stops on all sides with 40 grit. Also sand the areas of the fuselage skin and bearing block mount where the stops will be bonded. Clean all bonding areas with MC.
- K3. Use Hysol to bond the rudder stops to the fuselage side and the bearing block mount.
- K4. To reinforce the rudder stop bonds, apply 3 BID over the phenolic stops, overlapping onto the fuselage sides and the bearing mount by 1". Do not apply BID under where the aluminum hinge bearing block is located. This would interfere with proper hinge alignment.

Reinforcing phenolic rudder stops

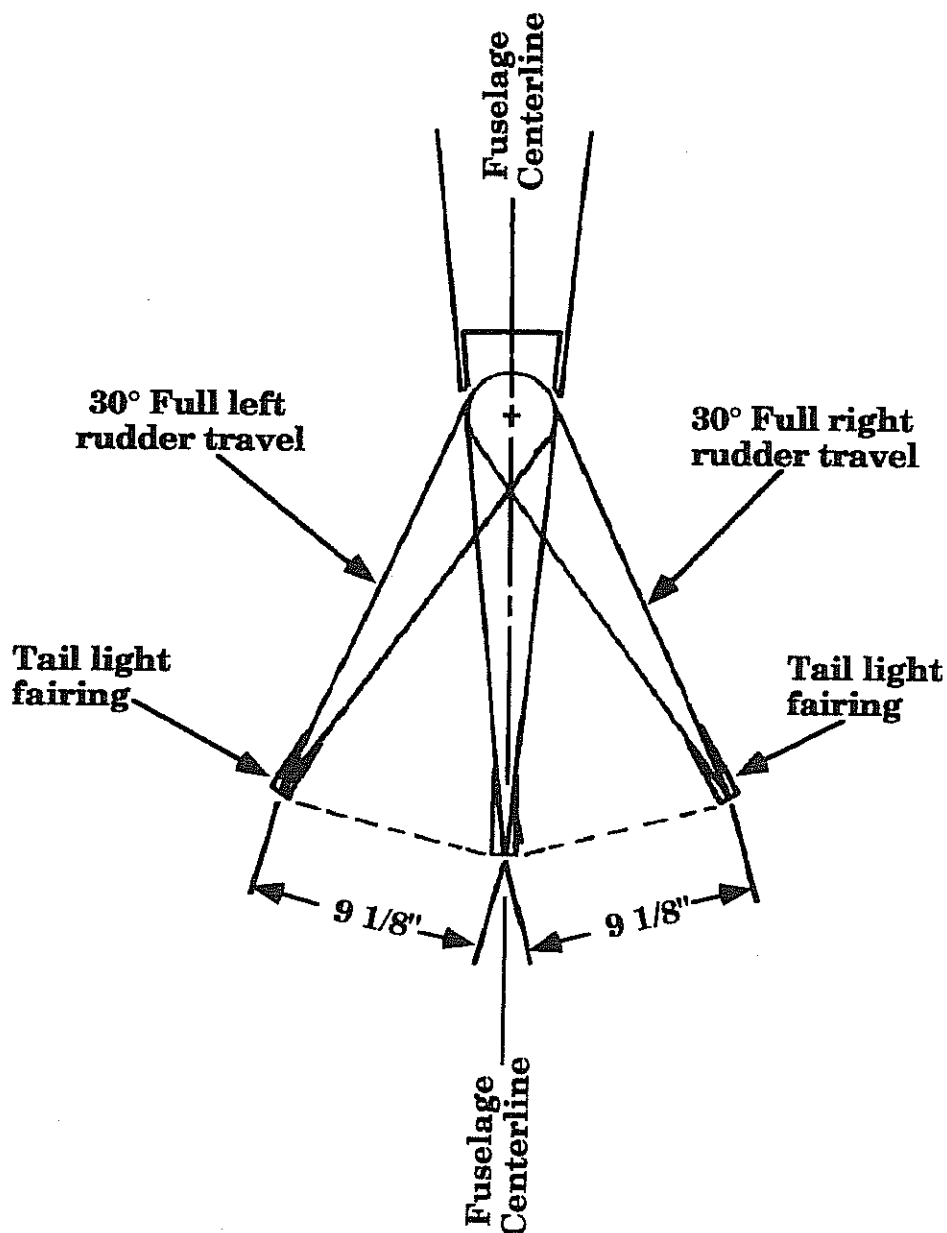
Figure 15:K:2



- K5. Grind or file the phenolic rudder stops until you can swing the rudder 30° each way before the control horn hits the stops. Grind the phenolic stops at an angle so the horn does not hit on a sharp point. An easy way to check travel is measuring the throw at the tail light fairing on the rudder trailing edge. At this location, the T.E. should move about 9 1/8" left and right. A plumb bob held at the T.E. centerline is an easy way to measure this distance if you still have a fuselage centerline marked on your shop floor.

Measuring rudder travel

Figure 15:K:3



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Chapter 15

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RUDDER