

CHAPTER 22

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
22-1	PC17	R&R	Added Section E.
22-2	0	None	
22-3	PC13	R&R	Edited parts list.
22-4 thru 22-7	0	None	
22-8	PC13	R&R	Changed bulkhead 171 to 172.
22-9 thru 22-11	0	None	
22-12 & 22-13	PC13	R&R	Changed bulkhead 171 to 172.
22-14	PC14	R&R	Added instructions.
22-15	PC13	R&R	Edited Fig. 22:B:7:b
22-16	PC13	R&R	Changed bulkhead 171 to 172.
22-17 thru 22-25	0	None	
22-26	PC10	R&R	Changed bolt no. on 22:D:6
22-27 thru 22-29	0	None	
22-30 thru 22-31	PC17	Add	New Section



CHAPTER 22

(Pressurized Version)

ELEVATOR CONTROLS



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 When such revisions are made, you should immediately replace all outdated pages with the revised pages.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

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4. PHOTO PAGES



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Chapter 22

REV. PC17/7-15-98

Elevator Controls

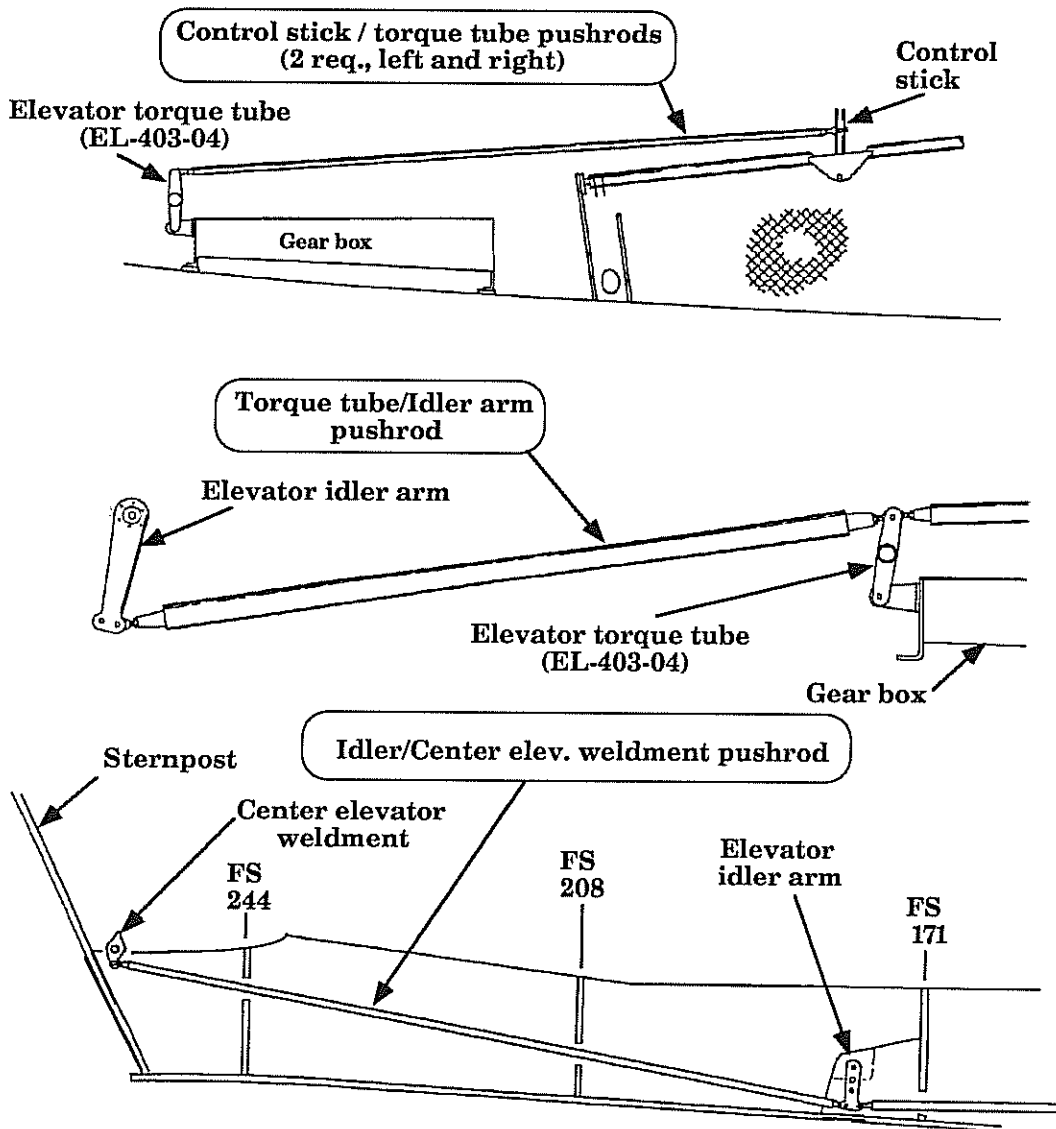


1. INTRODUCTION

Between the control stick and the center elevator weldment, there are two fixed assemblies that must be completed; the elevator torque tube, and the elevator idler arm. The elevator torque tube is mounted to the aft face of the gear box, coupling the two side stick pushrods to one pushrod that goes back to the elevator. The elevator idler is necessary to break up the long run from the torque tube to the elevator weldment.

Elevator controls

Figure 22:i:1



2. SPECIAL PARTS, TOOLS, AND SUPPLIES LISTS

A. PARTS

Fuselage assembly

1 3/8" D., .083" wall, 6061-T6 aluminum tubing

1" D., .083" wall, 6061-T6 aluminum tubing

1 BC4W10 bearing

2 EL-056-02 elevator idler arm halves

2 ply per side, 1/4" thick prepreg panel

4 OR-1.0x1.5x1.5 Orkot Block

1 EL-403-04 elevator torque tube

2 EL-053-T hinges

4 FM057-02 rod end

4 MD4616M rod end bearing

4 FM057-01 rod end

4 MD35-14M rod end bearing



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Chapter 22

REV.

PC13/8-26-96

Elevator Controls



B. TOOLS

- Drill press (not required but handy)
- Drill bits
- Rivet squeezer
- Hack saw (or band saw)
- Deburring tool
- Protractor (angle gauge)



C. SUPPLIES

- Epoxy
- Micro
- Fiberglass
- Mixing cups
- Mixing sticks
- Paper towels
- MC
- Paint brushes
- Sandpaper (40 grit)



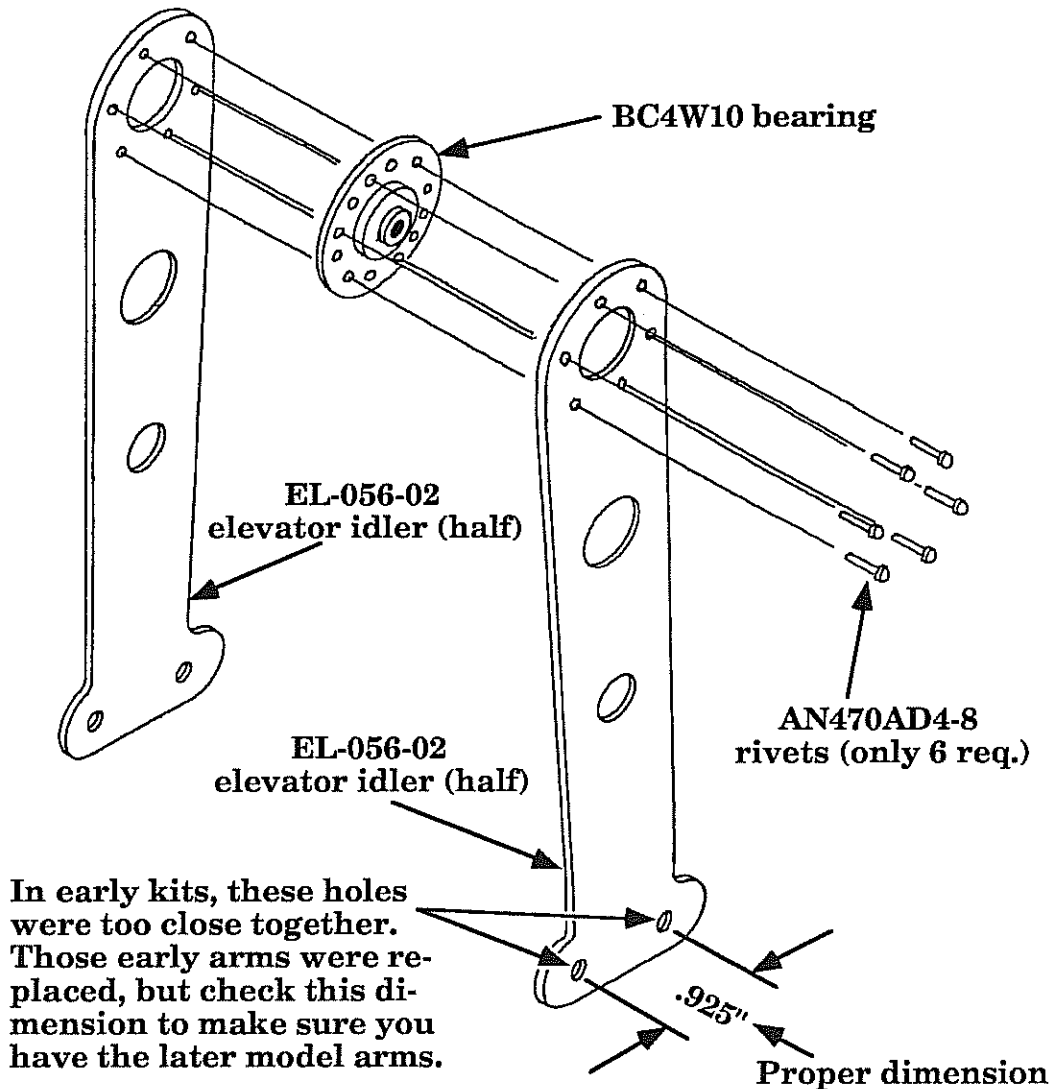
3. ASSEMBLY PROCEDURES

A. ELEVATOR IDLER ARM ASSEMBLY

The elevator idler arm is assembled much like the aileron bellcranks, with a bearing riveted between two aluminum plates. The idler is located just behind the FS171 bulkhead.

Elevator idler arm

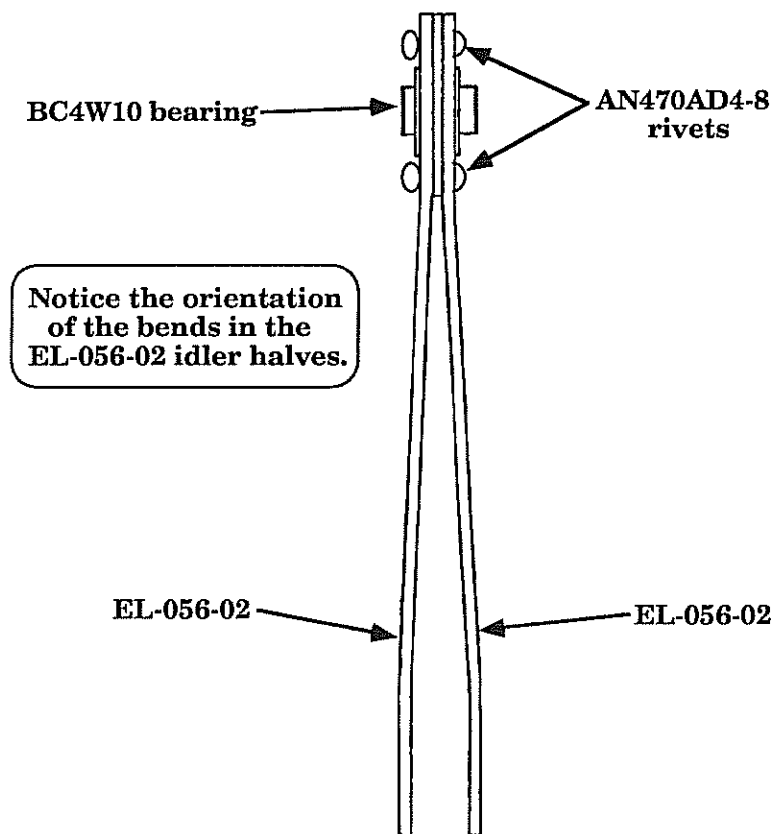
Figure 22:A:1



- A1. Place a BC4W10 bearing onto one of the EL-056-02 idler arm halves. Notice that the bearing holes in the idler arm halves are tapered to accommodate the small radius in the bearing. Be sure you have the bearing on the correct side of the idler arm halves.
- A2. Use **every other** hole in the BC4W10 bearing as guides to drill 1/8" diameter holes through the idler half. This will produce **SIX**, 1/8" D. holes through the idler half.
- A3. Remove the BC4W10 bearing from the idler half you just drilled. Place the other idler half against the drilled one and match drill the six, 1/8" diameter holes through the second idler half. Be sure the two idler halves are aligned with each other before drilling.
- A4. Deburr all the 1/8" D holes you have drilled.
- A5. Place the BC4W10 bearing between the idler halves and secure it with six, AN470AD4-8 rivets. This will also secure the two idler halves together.

Completed elevator idler

Figure 22:A:2



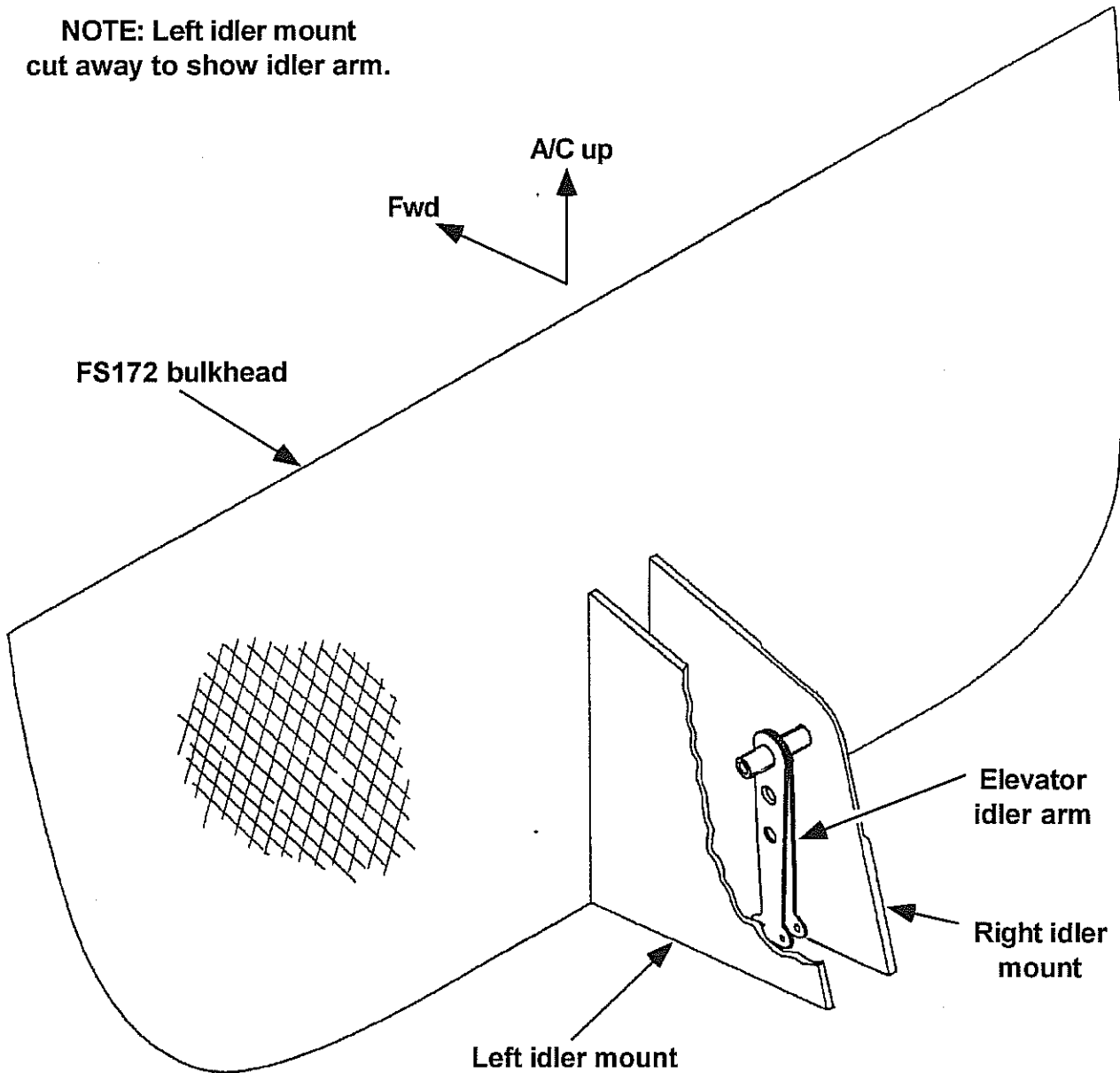
B. IDLER MOUNTS

The elevator idler is mounted between two sections of prepreg, which are secured to the FS172 bulkhead and the fuselage bottom.

Elevator idler arm mounts

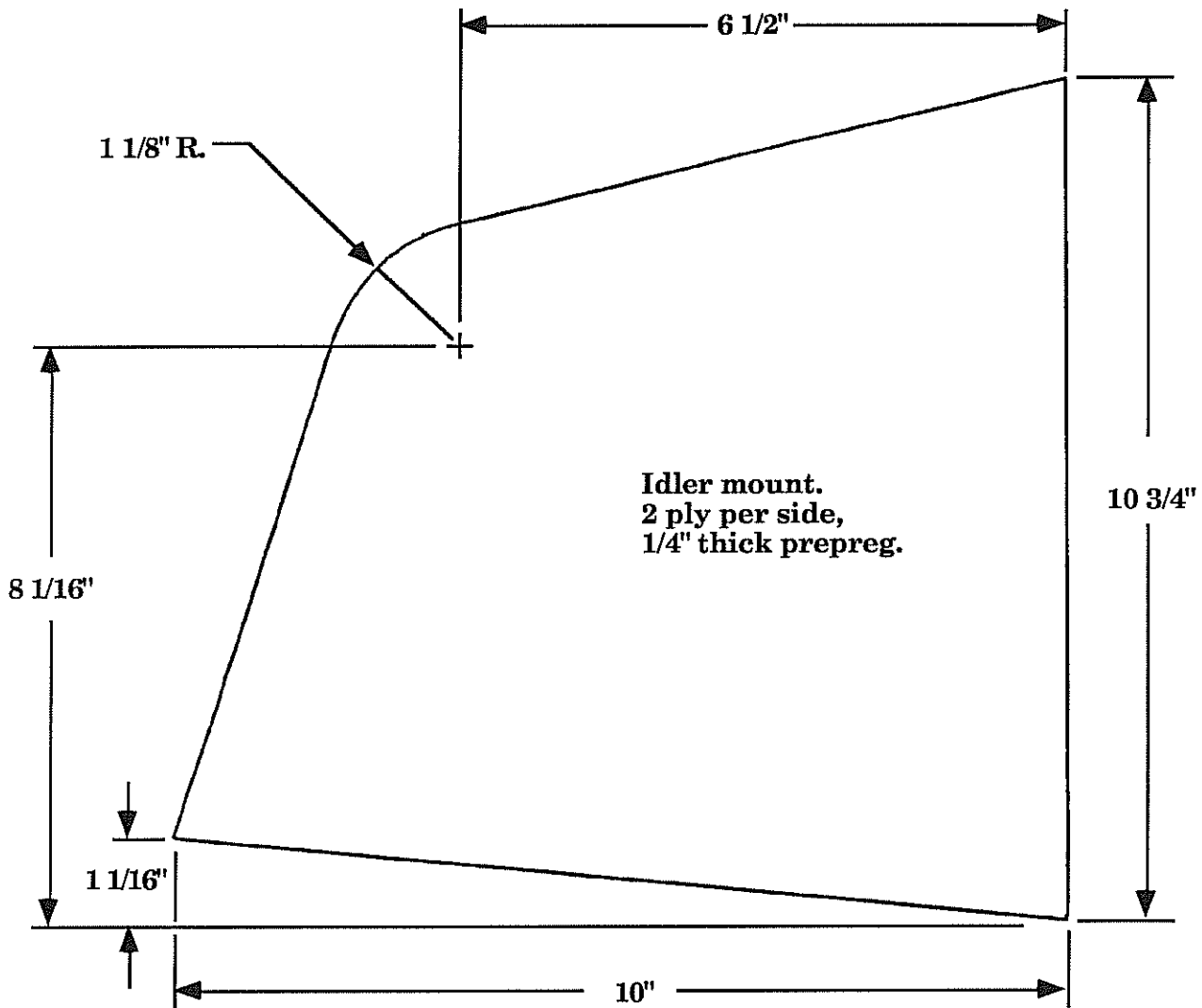
Figure 22:B:1

NOTE: Left idler mount cut away to show idler arm.



- B1. Use the dimensions in Figure 22:B:2 to cut two idler mounts from 2 ply per side prepreg panel.

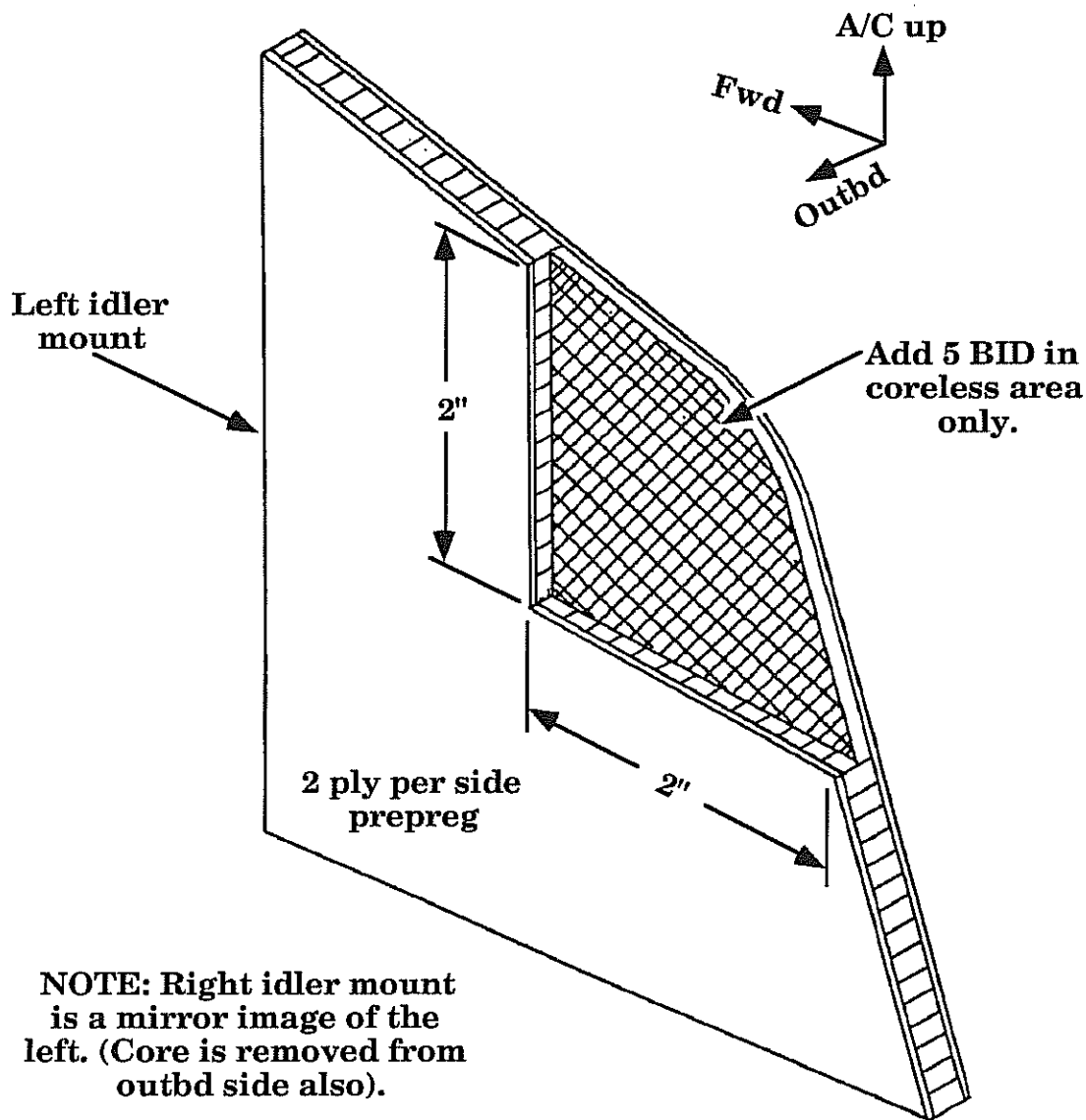
Cutting elevator idler mounts
Figure 22:B:2



- B2. Remove the outer laminate and core of the idler mounts, as shown in Figure 22:B:3. Don't remove the core from the same side of both mounts. Make a left and a right mount (mirror images).
- B3. Use 40 grit to sand the coreless areas of the idler mounts in preparation for a 5 BID laminate. Clean these areas with MC.
- B4. Apply a 5 BID laminate to both idler mounts ONLY in the coreless area.

Coreless areas of idler mounts w/ 5 BID

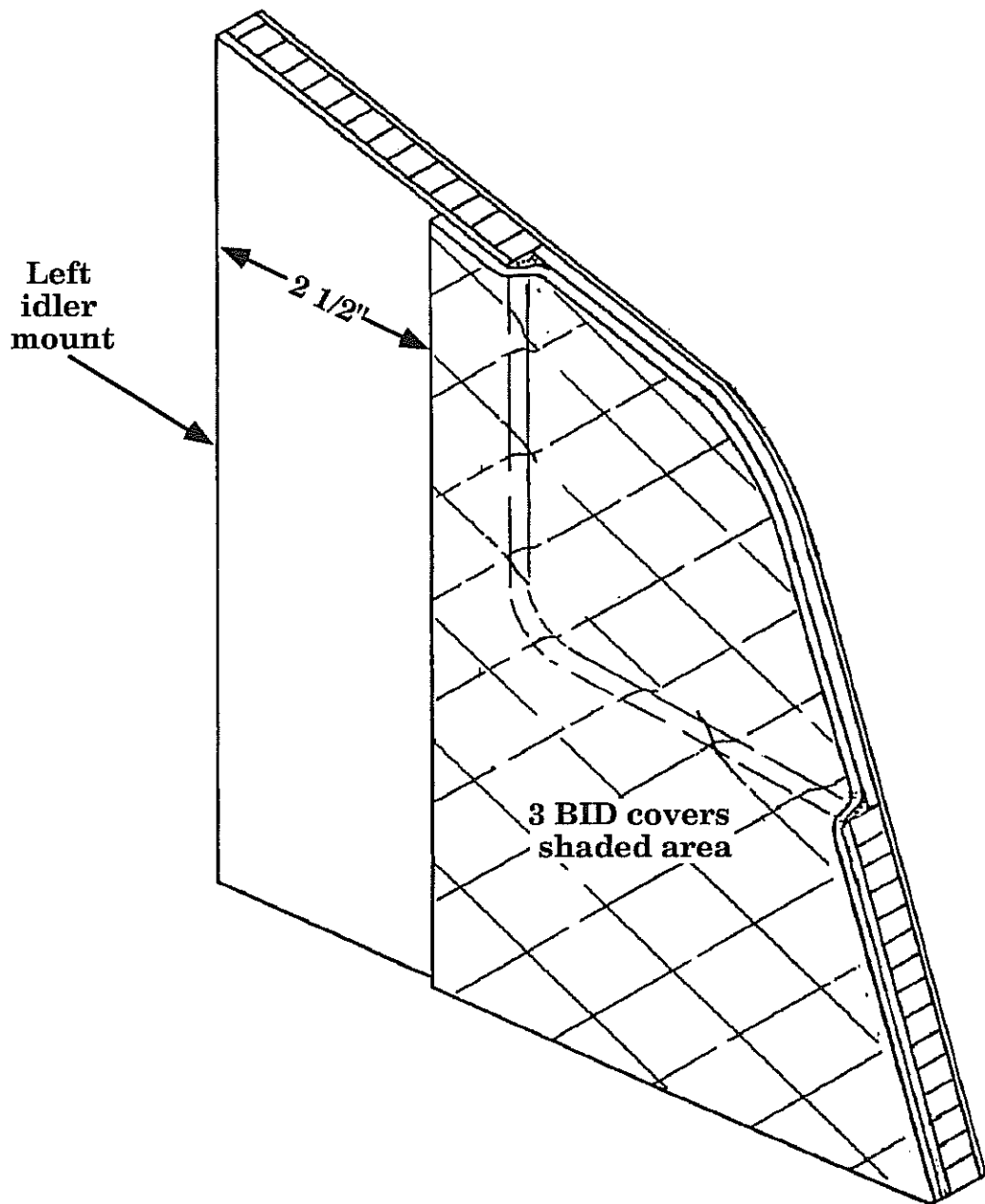
Figure 22:B:3



- B5. Use 40 grit to sand the areas (shown in Figure 22:B:4) where you will apply a 3 BID laminate to the idler mounts. Clean these areas with MC.
- B6. Apply 3 BID to the areas of the idler mounts shown in Figure 22:B:4.

3 BID laminate on idler mount

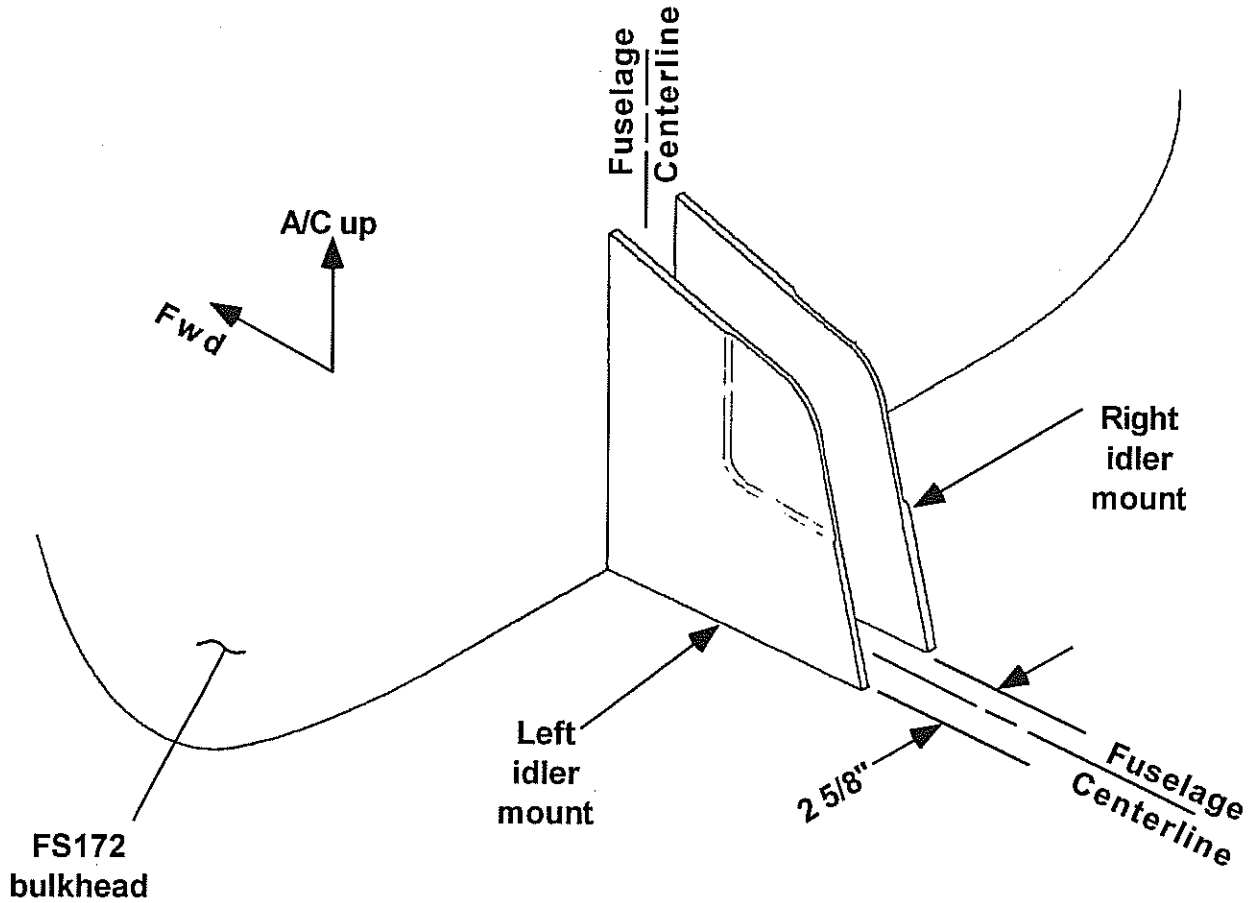
Figure 22:B:4



- B7. Use 40 grit to sand the areas of the fuselage shell and the FS172 bulkhead where the elevator idler mounts will be located. Clean this area with MC. The locations of the idler mounts are shown in Figure 22:B:5
- B8. Use a thick epoxy/micro mixture to bond the idler mounts to the FS172 bulkhead and the fuselage shell.

Elevator idler mount locations

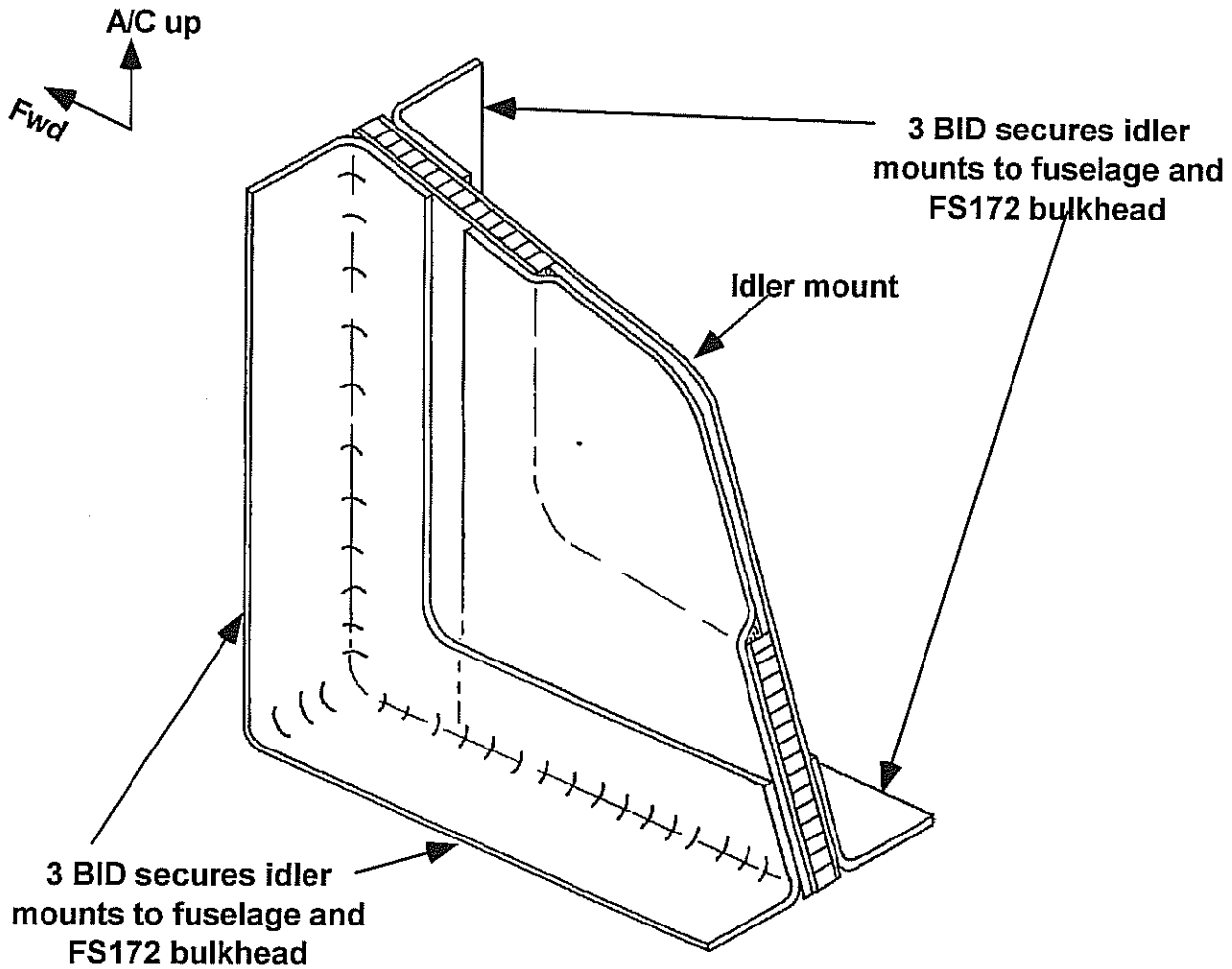
Figure 22:B:5



- B9. Secure the idler mounts to the FS172 bulkhead and fuselage shell with 3 BID, 2" wide laminates as shown in Figure 22:B:6.

Securing idler mounts

Figure 22:B:6





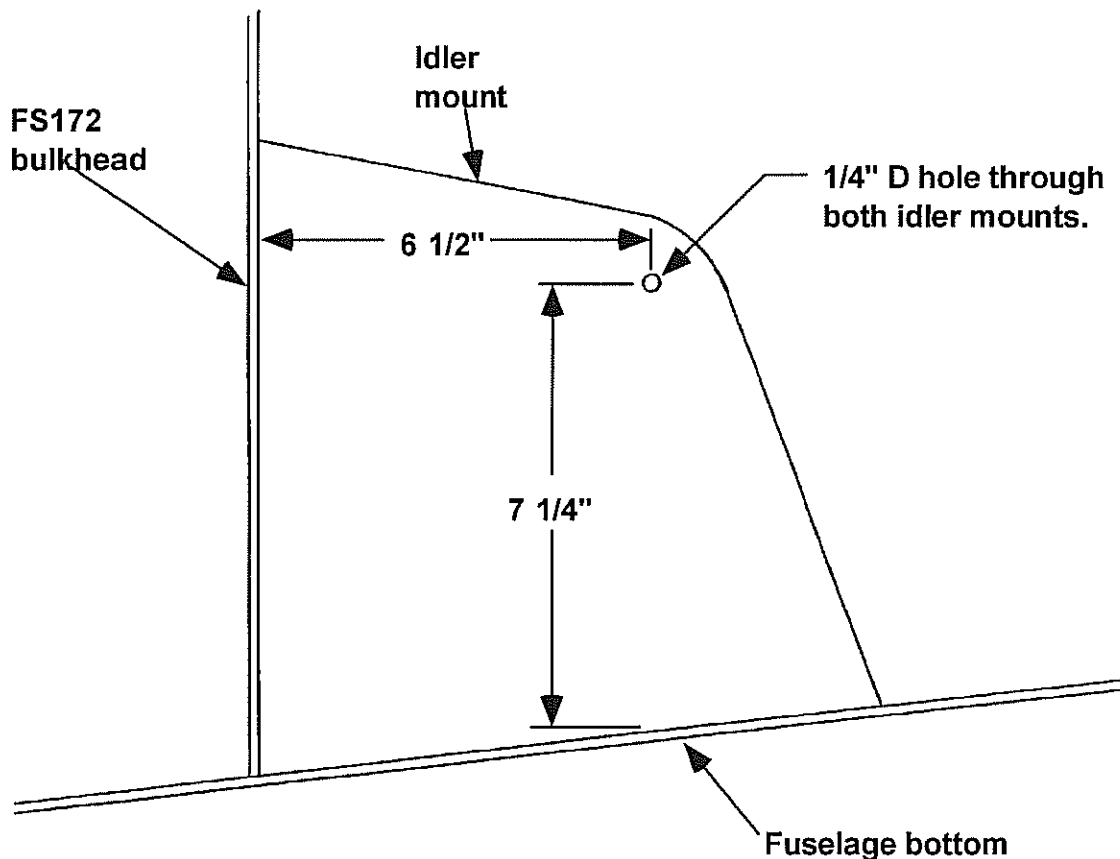
B10. Shape the phenolic blocks as shown in Figure 22:B:7:b. Locate the center of the blocks and drill a 1/4" diameter hole through the blocks and both idler mounts at the location given in Figure 22:B:7:a.

1. Prepare the phenolic block and the idler mount for the bonding of the block. Clean with MC.
2. Bond the block to the idler mount with Hysol™. Align the support block using the 1/4" holes that were drilled. If the bolt is left in the hole during cure, it must be covered with mold release (or petroleum jelly, etc.). Clamp the support block in place.
3. Reinforce the support blocks with 2 BID.

B11. Secure the elevator idler arm between the idler mounts as shown in Figure 22:B:7:b. Note that you will be using AN970-4 area washers instead of the normal diameter washers. Tighten the AN365-428A locknut until the phenolic blocks are tight against the bearing and washers. If the locknut bottoms out on the shoulder of the AN4-34A bolt before the blocks are tight, use more washers under the locknut so you can tighten it further.

Locating Idler Pivot Location

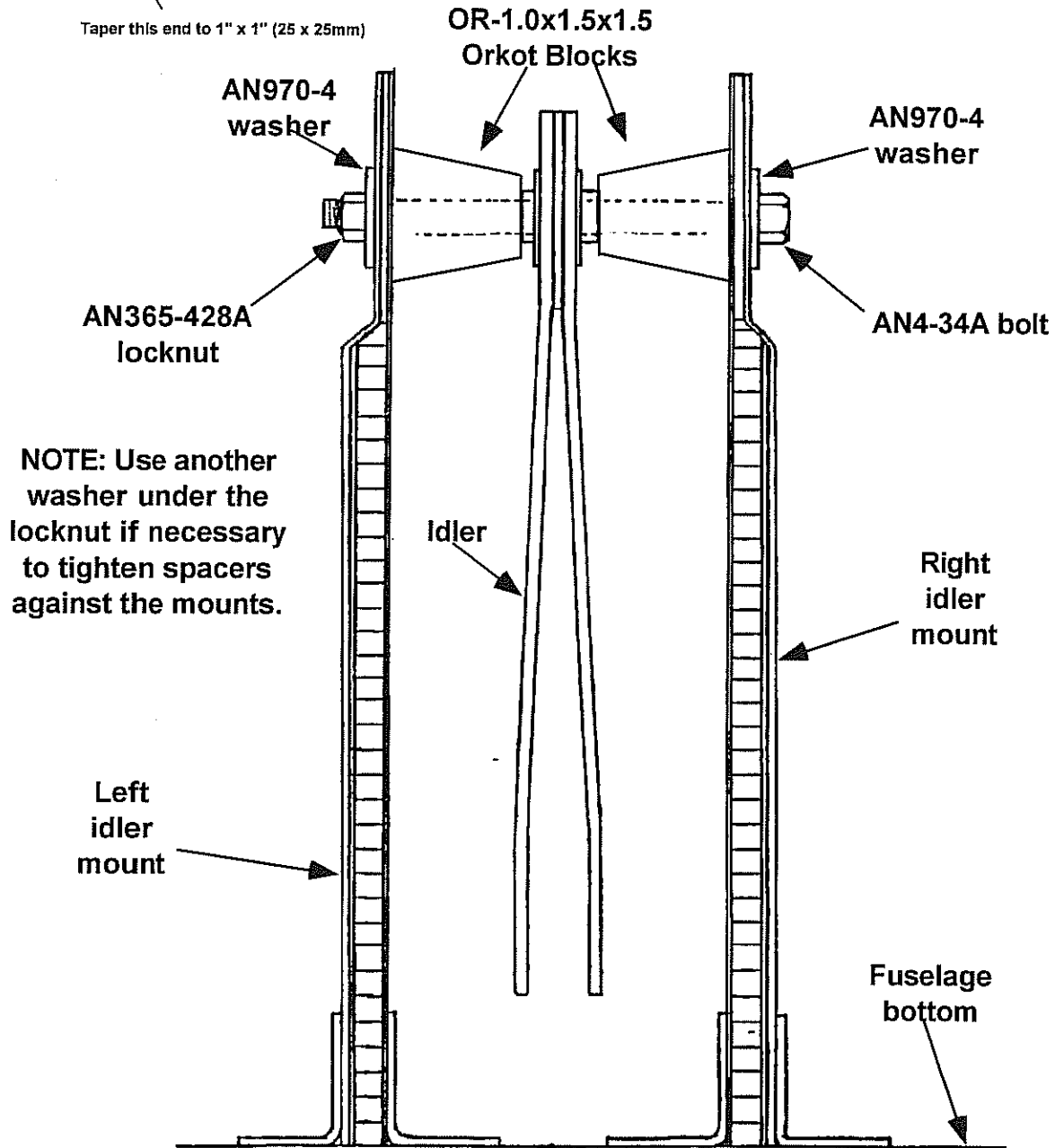
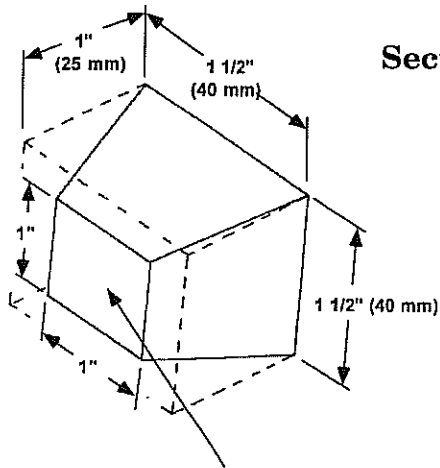
Figure 22:B:7:a





Securing idler between mounts

Figure 22:B:7:b



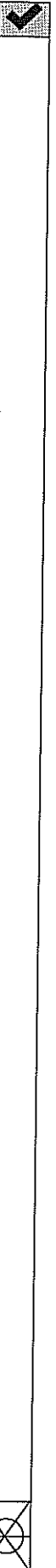
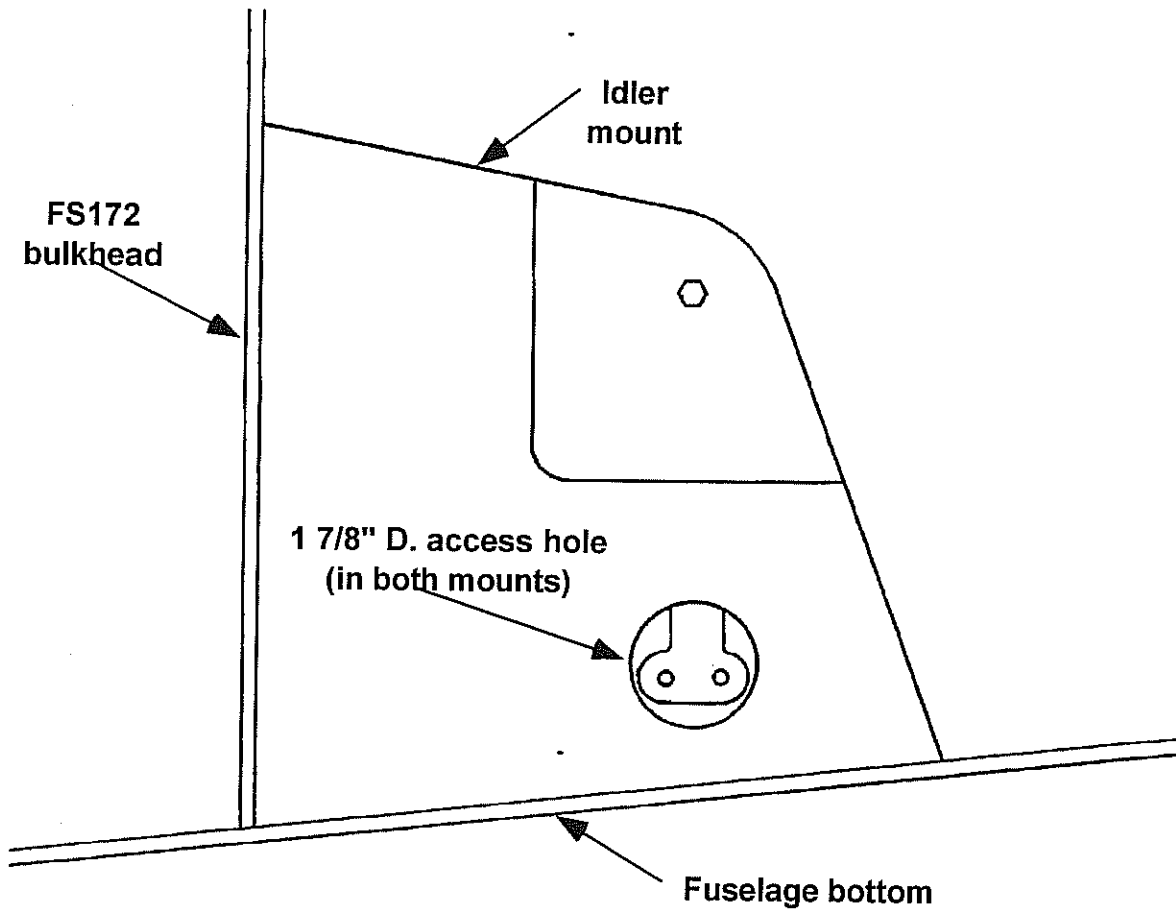
NOTE: Use another washer under the locknut if necessary to tighten spacers against the mounts.



- B12. Cut an access hole in each elevator idler mount so you can get at the two bottom bolt holes of the idler. Refer to Figure 22:B:8 for locations. The *exact* locations and sizes of the holes are not critical, just so you have enough room to tighten and remove the pushrod bolts that will be in the idler. (Read ahead for a description of these bolts).

Access holes in idler mounts

Figure 22:B:8

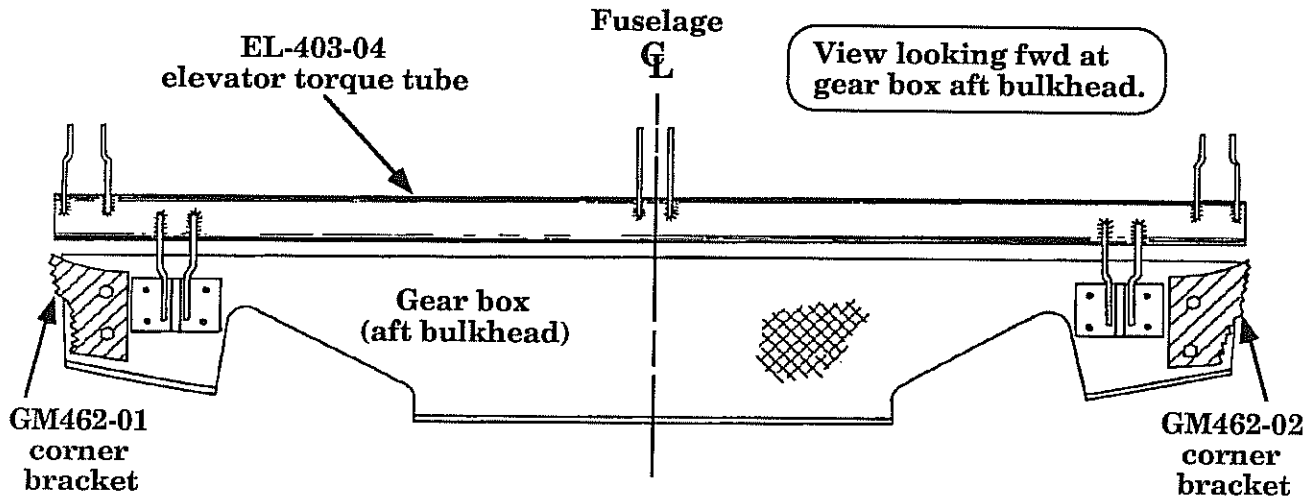


C. ELEVATOR TORQUE TUBE MOUNTING

The elevator torque tube mounts to the aft face of the landing gear box. The hinges that the torque tube rotates on are of the same design as the horizontal stabilizer hinges, with pre-installed bearings for easy operation. The torque tube translates the pitch inputs of the two control sticks into one pushrod that goes back to the elevator.

Elevator torque tube

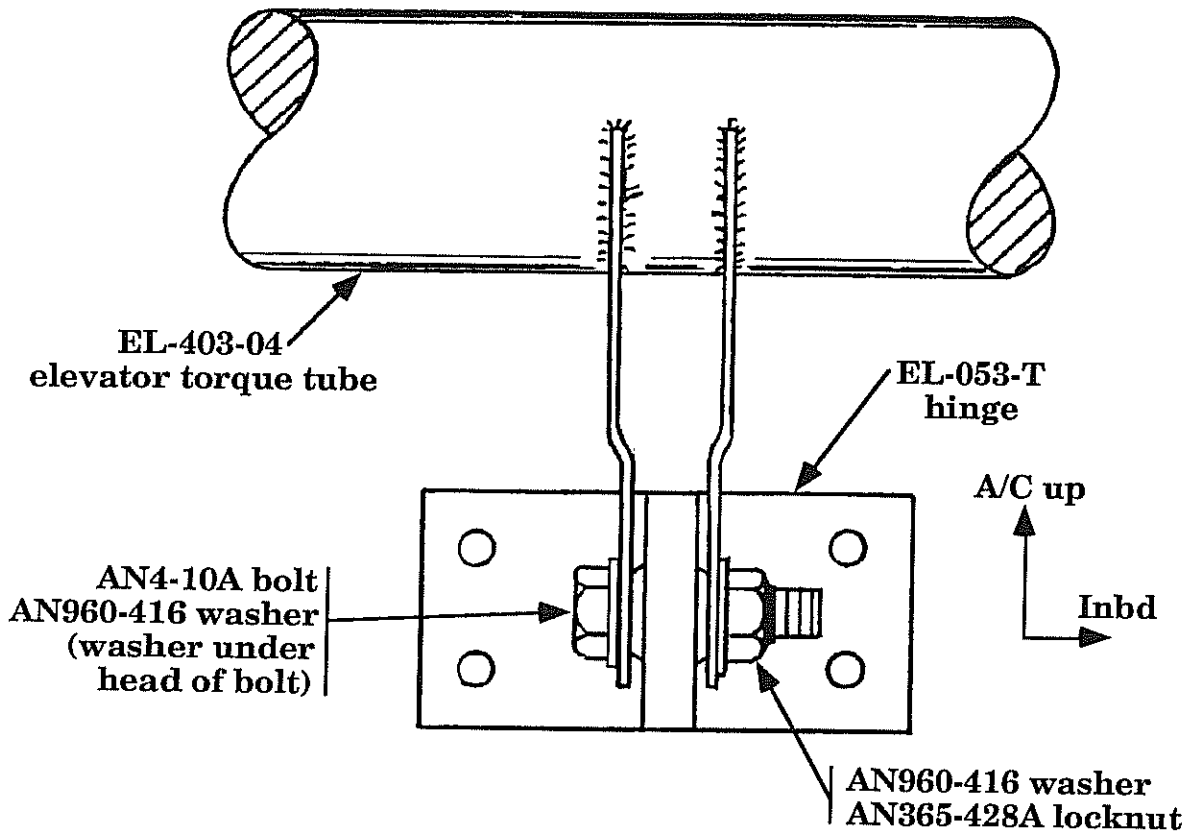
Figure 22:C:1



- C1. Secure two, EL-053-T hinges to the bottom attachment points of the EL-403-04 elevator torque tube. To differentiate between the top and bottom of the torque tube, look at the number of attachment points. The bottom has only two attachment points (four welded tabs), and the top has three attachment points, (six welded tabs).

Securing hinges to torque tube

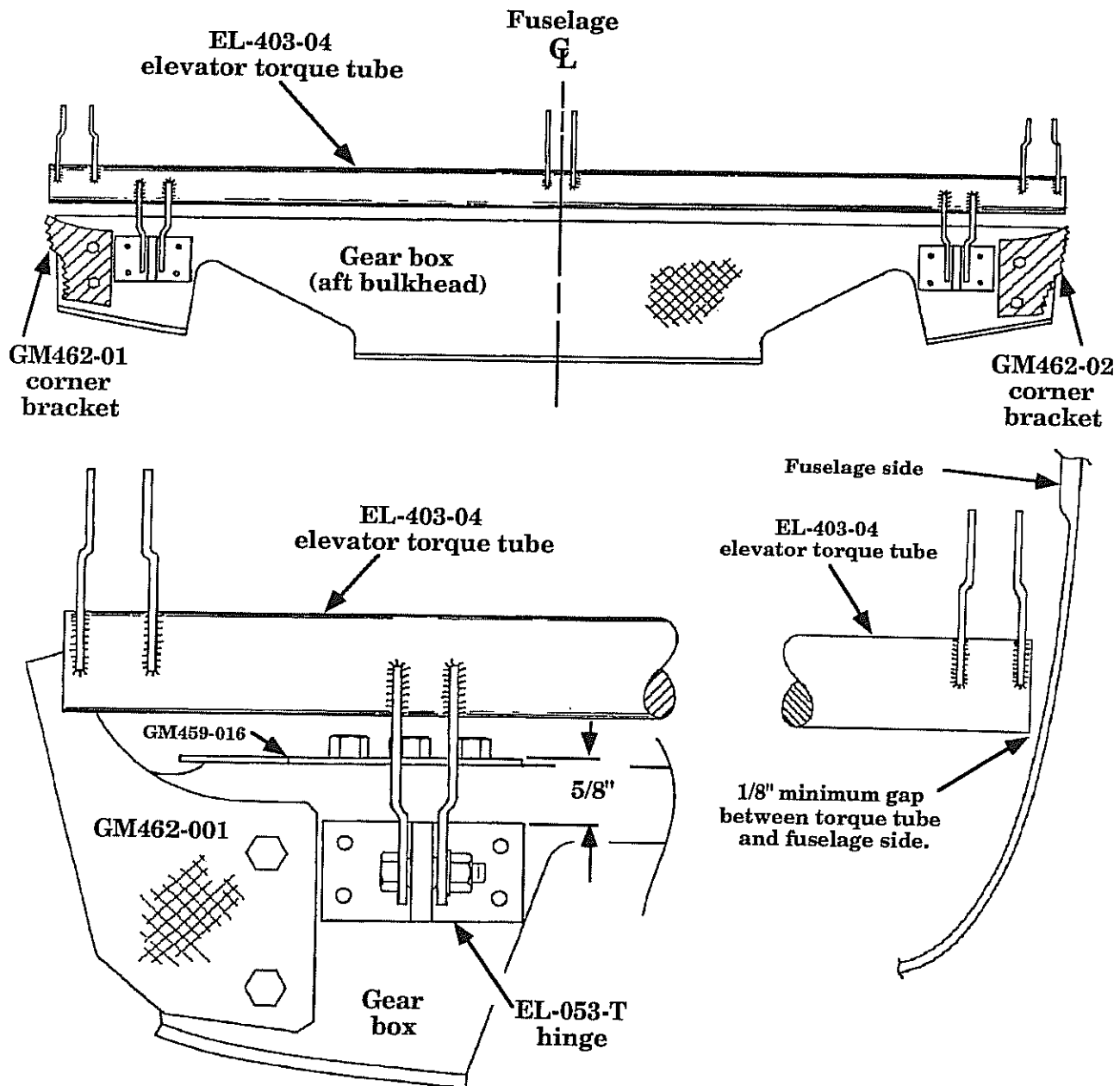
Figure 22:C:2



- C2. Position the EL-403-04 elevator torque tube so the EL-053-T hinges rest flat against the aft face of the gear box. The center attachment point (on the top side) of the torque tube should be aligned with the fuselage centerline. This will give equal spacing (or close to equal) between the ends of the torque tube and the sides of the fuselage. The top edges of the hinges should be $5/8$ " below the top edges of the GM459-016 corner braces, as shown in Figure 22:C:3.

Positioning elevator torque tube

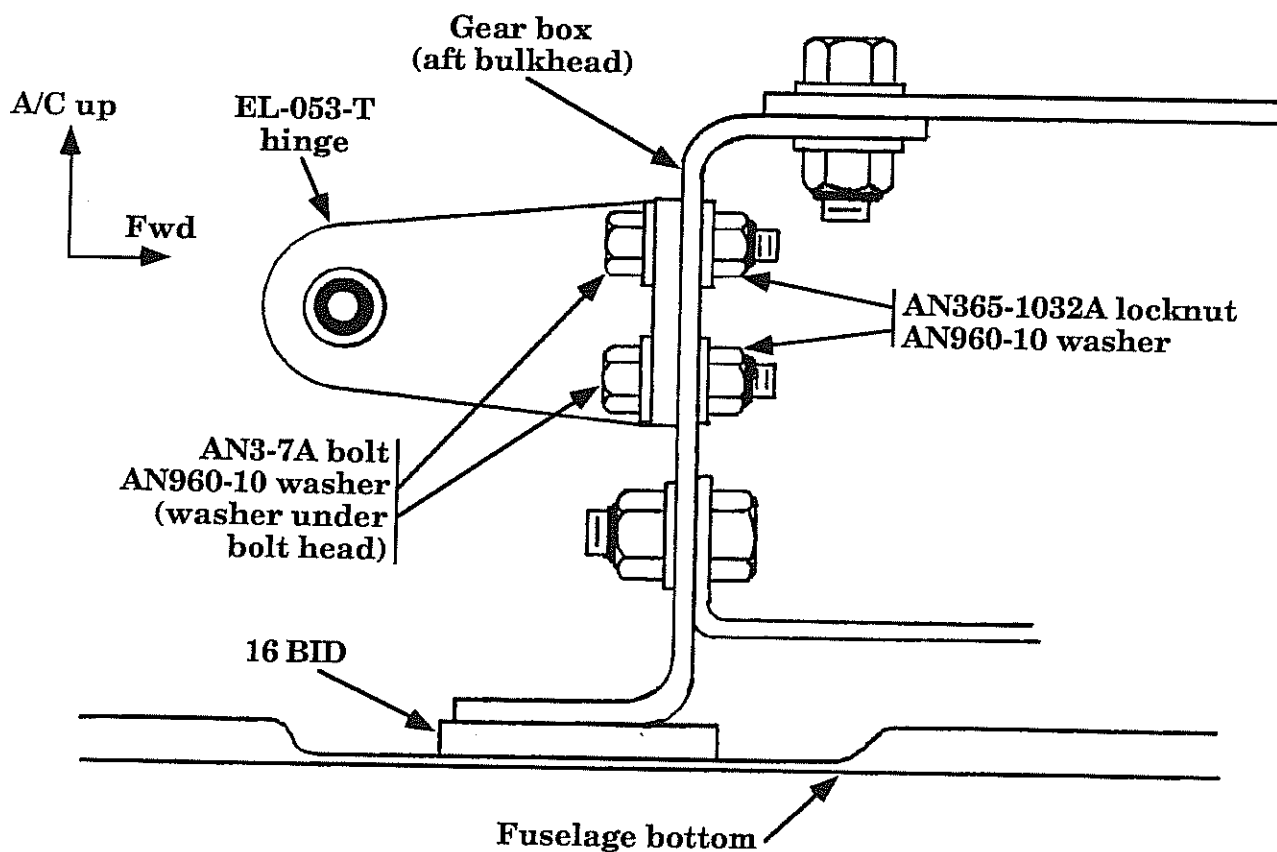
Figure 22:C:3



- C3. When you are satisfied with the location of the elevator torque tube, use instant glue to temporarily secure the hinges to the aft face of the gear box. Remove the elevator torque tube from the hinges.
- C4. Use the four pilot holes in each hinge as guides to drill 3/16" diameter holes through the hinges and aft gear box bulkhead. As usual, you should start with a small drill, then increase the drill size until you reach 3/16".
- C5. Secure the hinges to the the aft face of the gear box with AN3-7A bolts, AN960-10 washers, and AN365-1032A locknuts.

Securing hinges to gear box

Figure 22:C:4



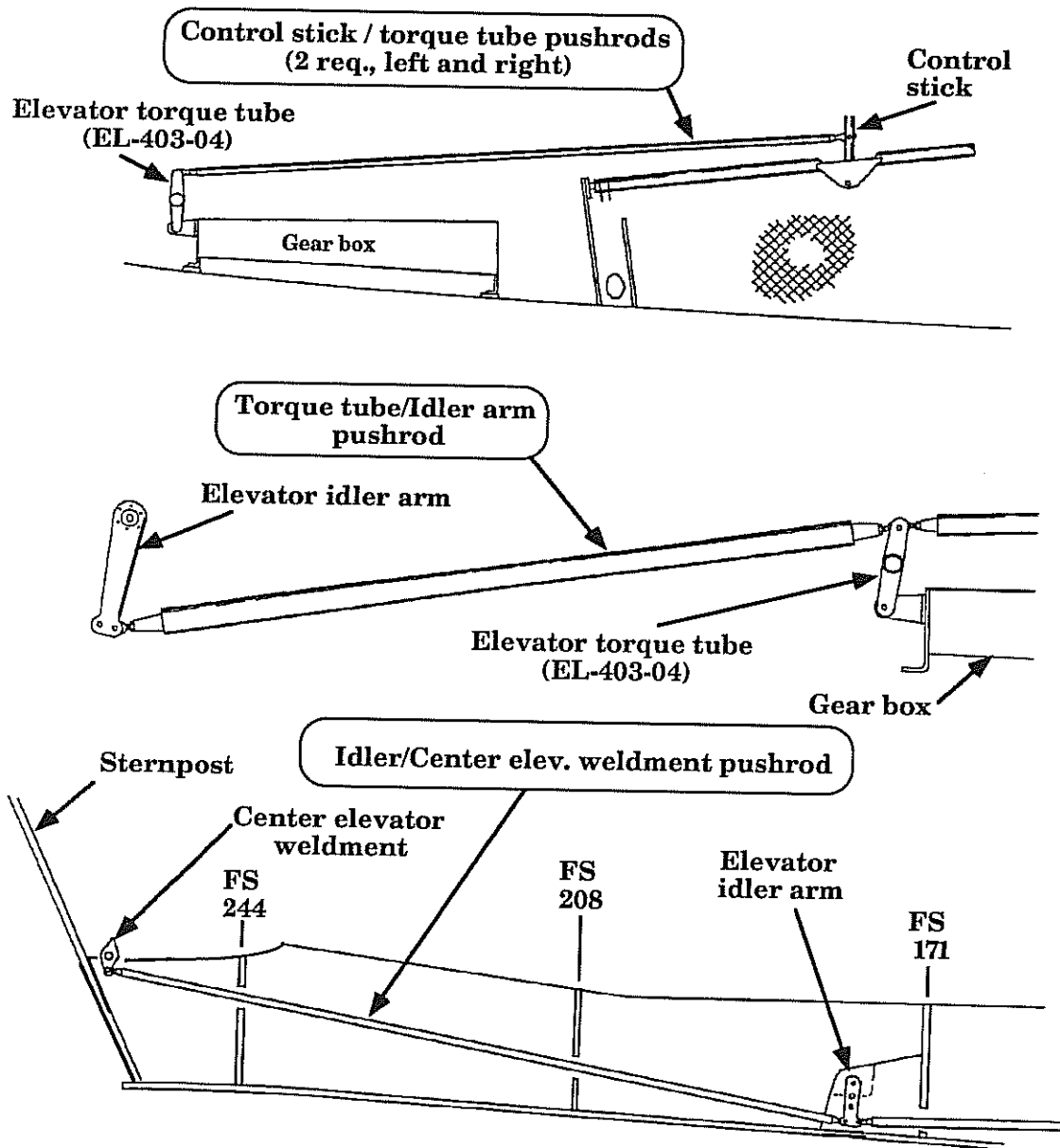
- C6. Remount the elevator torque tube to the hinges and verify that the torque tube moves freely.

D. ELEVATOR PUSHROD INSTALLATION

Four pushrods are required to connect the control sticks to the elevator. One pushrod connects each control stick to the elevator torque tube. Another pushrod connects the torque tube to the idler arm. The last pushrod connects the idler arm to the center elevator weldment.

Elevator pushrods

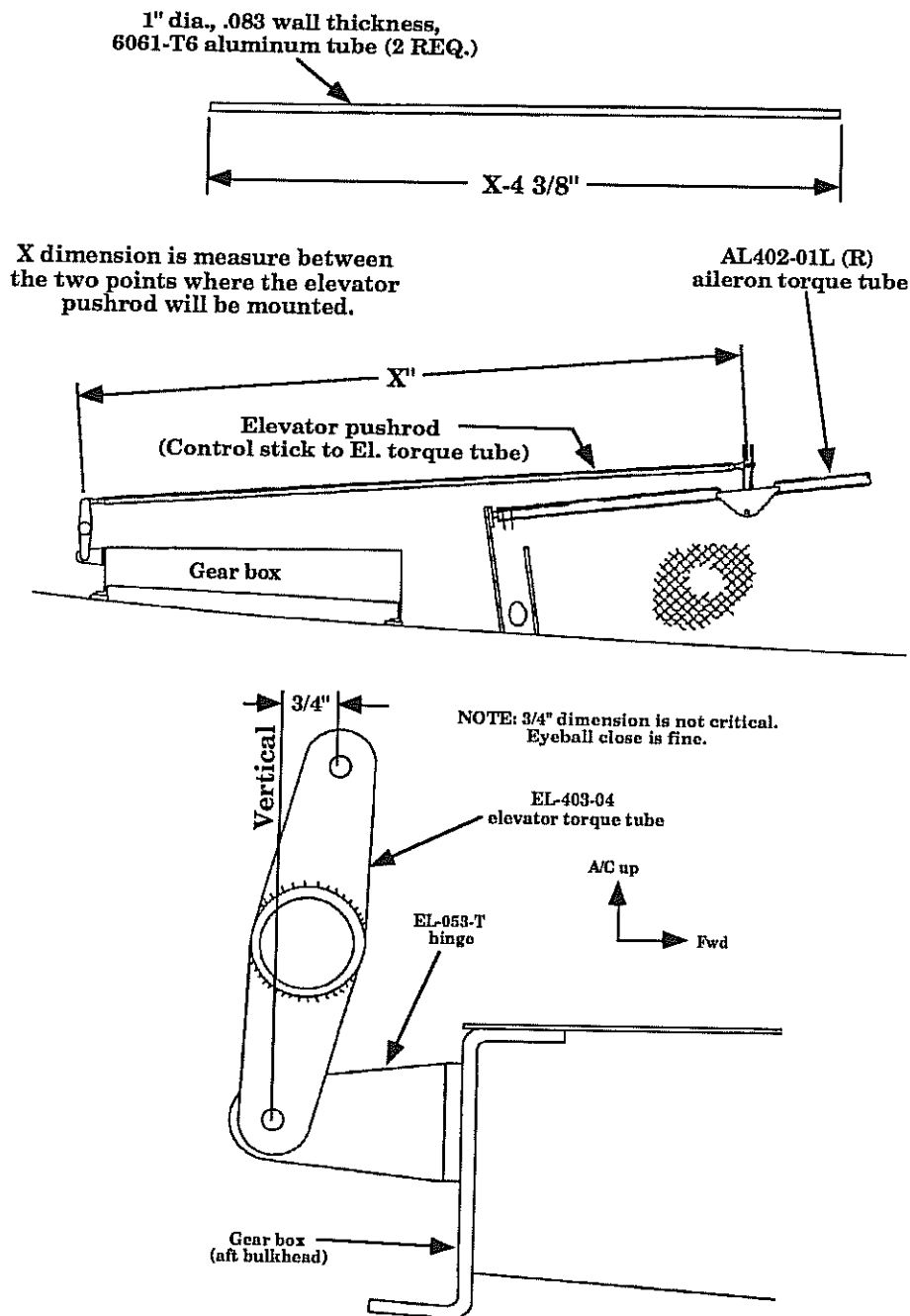
Figure 22:D:1



- D1. To find the length of the two, fwd pushrods (connecting control sticks to the torque tube), place the control sticks in a vertical position (fore/aft). Position the elevator torque tube as shown in Figure 22:D:2, angled forward of vertical $3/4"$ at the upper bolt holes.

Elevator torque tube (neutral position)

Figure 22:D:2

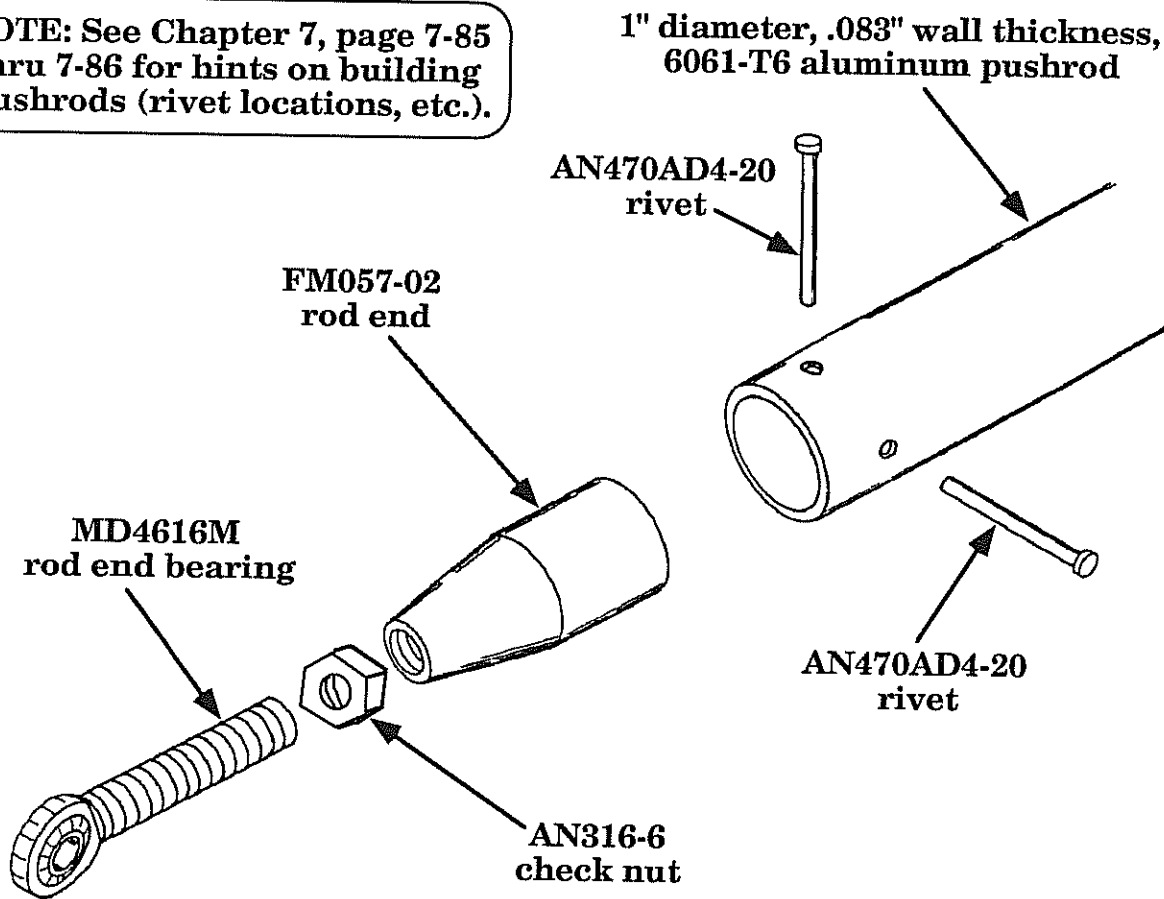


- D2. Measure the distance between the pushrod mounting points on the control sticks and the elevator torque tube. Subtract $4 \frac{3}{8}$ " from this overall dimension. The resulting length is the length you should cut your pushrods from 1.000" diameter, .083" thick, 6061-T6 aluminum tubing. Cut two pushrods to length.
- D3. Slide a FM057-02 rod end into both ends of the pushrods. Secure the rod ends to the pushrods with AN470-20 rivets (two for each rod end). As usual, the rivets are spaced .2" and .4" from the ends of the aluminum pushrod tube.

Securing rod ends and bearings

Figure 22:D:3

NOTE: See Chapter 7, page 7-85 thru 7-86 for hints on building pushrods (rivet locations, etc.).

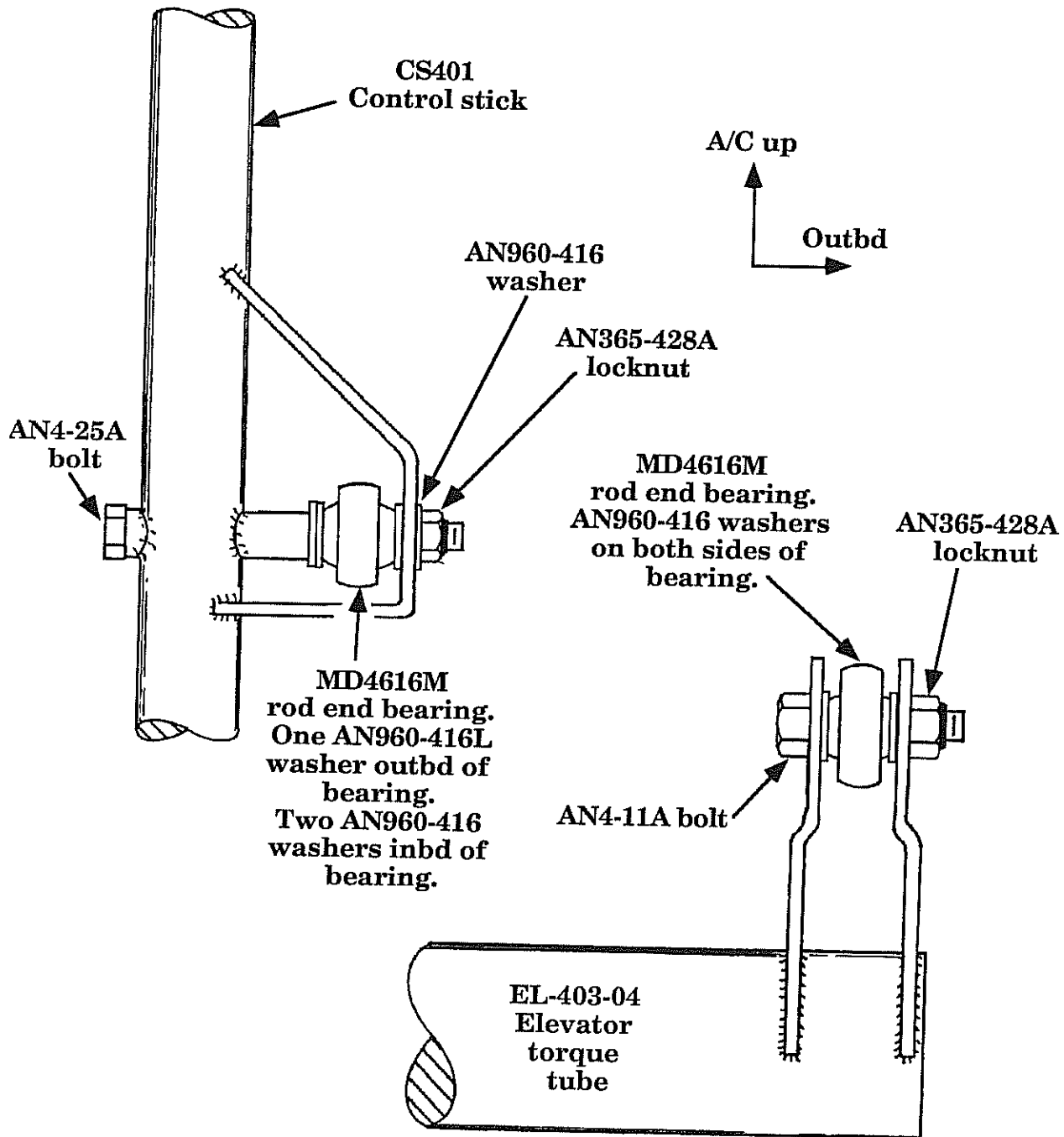


- D4. Thread an AN316-6 check nut onto each of four MD4616M rod end bearings. Then thread the rod end bearings into the 057-02 rod ends until the center of the bearing is $2 \frac{3}{16}$ " from the edge of the pushrod tube.

- D5. Secure the MD4616M rod end bearings to the elevator torque tube and the control sticks as shown in Figure 22:D:4.

Control stick/torque tube pushrod installation

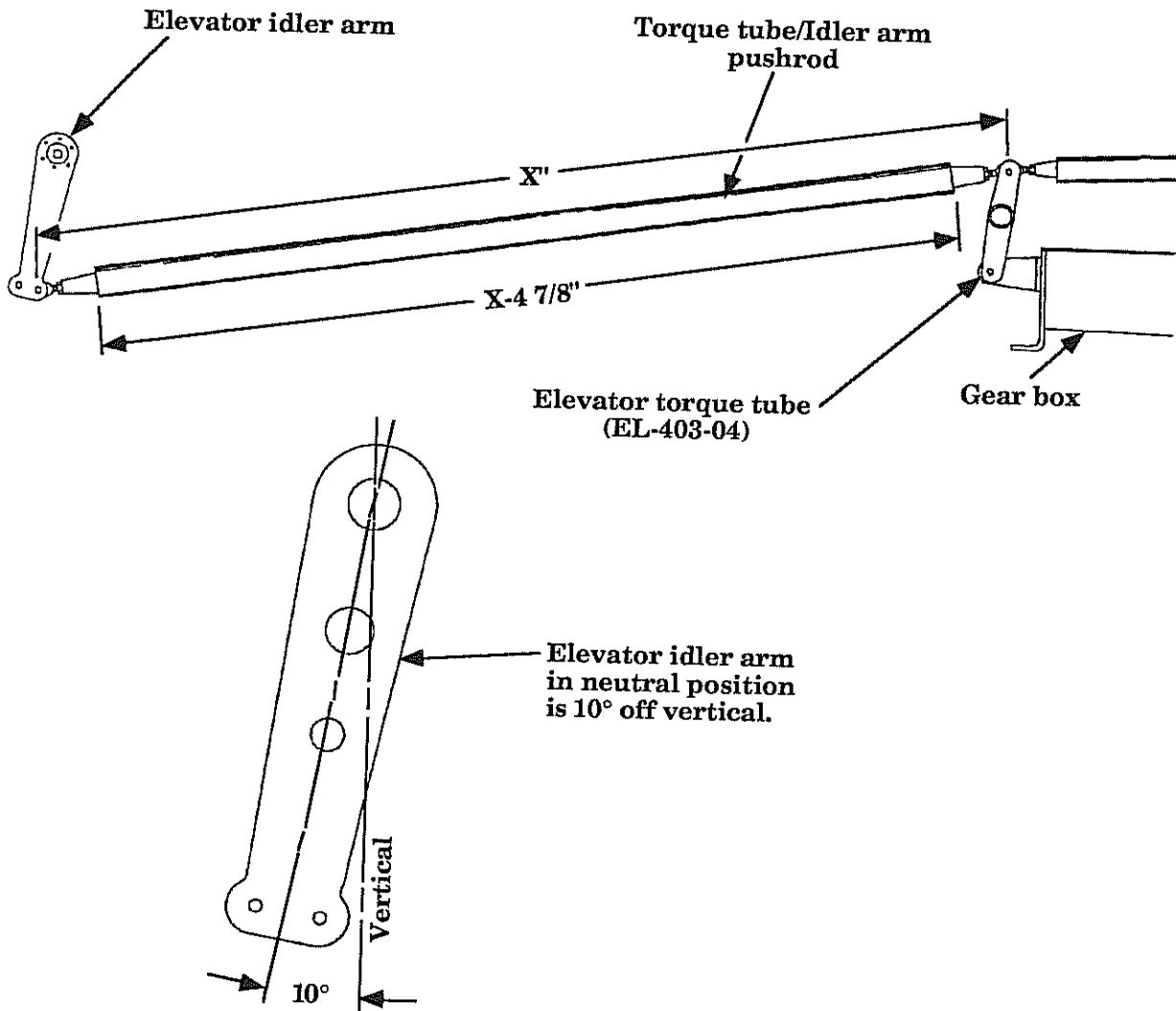
Figure 22:D:4



- D6. Position the elevator idler arm 10° aft of vertical as shown in Figure 22:D:5. To accommodate the torque tube/idler arm pushrod, a 2" diameter transit hole must be ground out of the FS171 bulkhead. To center this hole, grind a small hole first, and pull a string from the fwd pushrod mounting hole of the idler arm to the center mounting hole of the torque tube. Enlarge the hole to 2" diameter with the string centered in it.
- D7. Measure the distance from the pushrod mounting holes in the torque tube and the idler arm. Subtract 4 7/8" from this measurement and cut a section of 1 3/8" diameter, .083" thick, 6061-T6 aluminum tubing to the resulting length.

Torque tube/idler arm pushrod

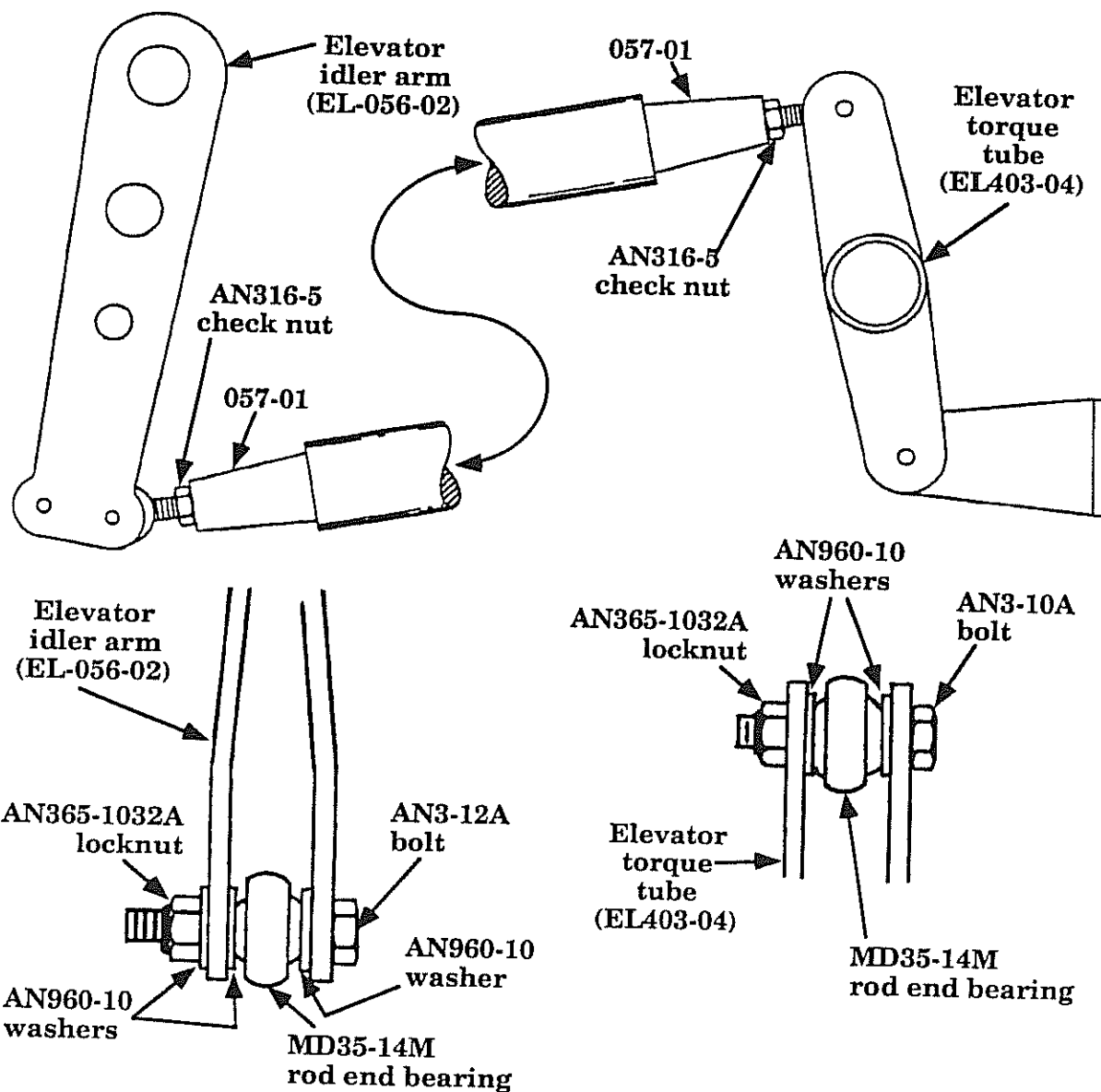
Figure 22:D:5



- D8. Slide an FM057-01 rod end into both ends of the pushrod tube you have just cut. Secure the rod ends with AN470AD4-26 rivets (two rivets per rod end). Again, the rivets are located .2" and .4" from the ends of the aluminum tubing.
- D9. Thread an AN316-5 check nut onto the ends of two MD35-14M rod end bearings. Thread the MD35-14M rod end bearings into the FM057-01 rod ends until the bearing holes are 2 7/16" from the ends of the aluminum pushrod.
- D10. Connect the pushrod you have just made to the torque tube and idler arm as shown in Figure 22:D:6. Be sure to secure the pushrod to the *FWD* mounting hole in the idler arm.

Securing torque tube/idler arm pushrod

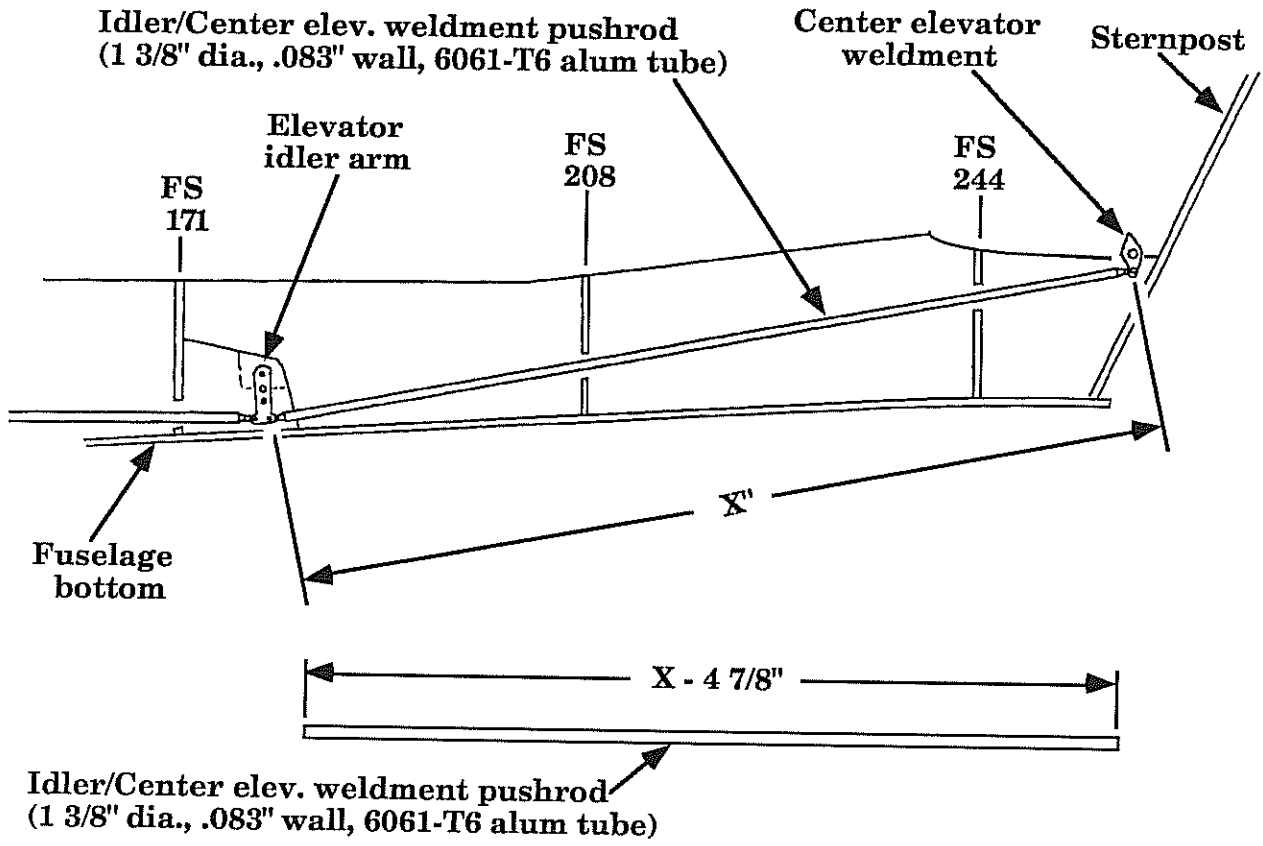
Figure 22:D:6



- D11. The last pushrod you must build to complete the elevator system connects the elevator idler arm to the center elevator weldment. Clamp the elevators in the neutral position. Also put the control sticks, torque tube and idler arm all in the neutral positions.
- D12. Measure the distance from the aft pushrod mounting point on the idler arm to the pushrod mounting point on the center elevator weldment. Subtract $4 \frac{7}{8}$ " from this measurement. The resulting length is the length you should cut your pushrod from $1 \frac{3}{8}$ " diameter, .083" thick, 6061-T6 aluminum tubing.

Measuring idler arm/elevator weldment pushrod
Figure 22:D:7

NOTE: Grind transit hole in FS208 bulkhead for pushrod. 3" dia. hole should be sufficient.

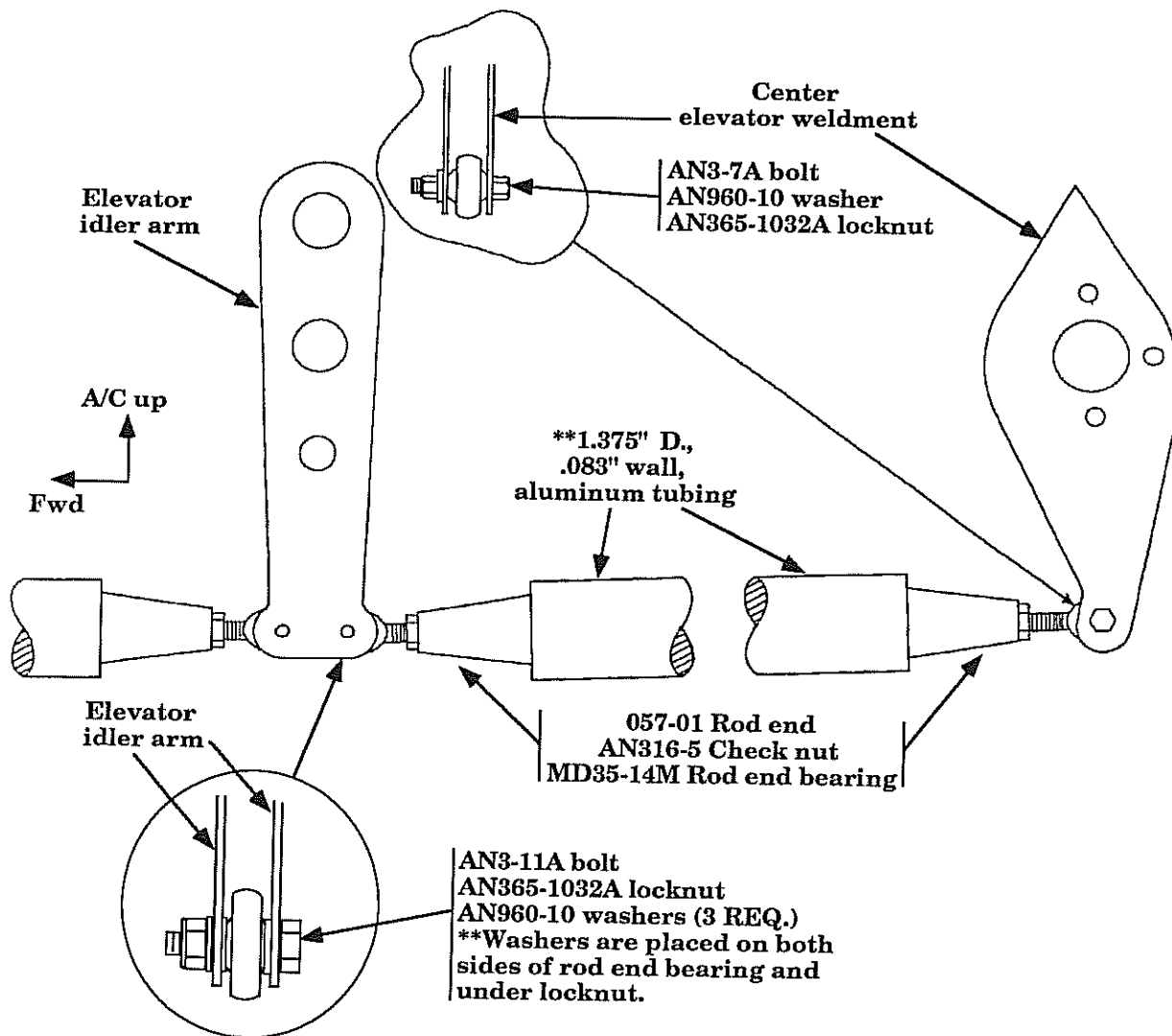


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- D13. Slide an FM057-01 rod end into both ends of the pushrod tube you have just cut. Secure the rod ends with AN470AD4-26 rivets (two rivets per rod end).
- D14. Thread an AN316-5 check nut onto the ends of two MD35-14M rod end bearings. Thread the MD35-14M rod end bearings into the FM057-01 rod ends until the bearing holes are 2 7/16" from the ends of the aluminum pushrod.

Securing idler arm/elevator weldment pushrod

Figure 22:D:8



D15. Secure the pushrod you just made to the elevator idler arm and the center elevator weldment as shown in Figure 22:D:8.

Your elevator control system is now complete. You should be able to freely move the elevator to its stops with both control sticks.

D16. The fwd elevator pushrods, that run along the side of the fuselage, may require rod end bearing adjustment to accomodate the left/right movement of the control sticks. If the MD4616M rod end bearings twist to their limits before reaching full left or right aileron travel, loosen the AN316-6 checknuts, twist the pushrods slightly, then retighten the checknuts. Check the bearing twist again and adjust if necessary. When the control stick is full left and full right, you should be able to rotate the fwd elevator pushrods slightly, indicating that they are not bound up.

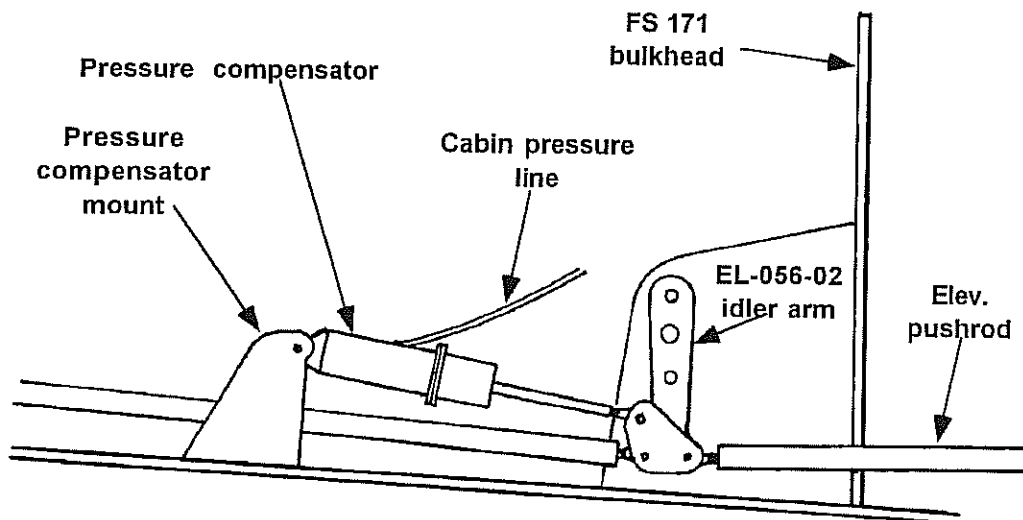


E. ELEVATOR PRESSURE COMPENSATOR

When the inside of the cabin pressurizes, the elevator pushrod bellows both have 5 psi pushing them (and the pushrods) aft. If left unchecked, this condition would cause the aircraft to climb when it is pressurized. To eliminate any pitch trim change with pressurization, a compensator is added to balance the pressure forces on the elevator pushrod. This compensator is energized with cabin pressure and has two bellows of the same size you have already installed on the elevator pushrods. When these bellows inflate, they want to push the elevator pushrod forward, directly balancing the aft force of the other two bellows. Hence, the system is balanced.

Elevator pressure compensator

Figure 29:E:1



- E1. Blueprint FM-419-1 is a very complete drawing of the pressure compensator assembly. In this section, we will concentrate on some important assembly steps instead of a lot of part numbers, which are shown on the blueprint.
- E2. Assemble the pressure compensator as shown on Blueprint FM-419-1. The rubber boots should be installed with a thin coat of silicon on the mounting flange. The screws that secure the boots should be snugged, then fully tightened after the silicon has dried. When you go to tighten the outer nut (AN365-428A) on the end of each 419-08 rod, hold the rod between two aluminum pieces in a vise to prevent it from turning. You will have to build the TMS60-154 bridge from the piece of 3/4" x 3/4", 6061-T6 aluminum "L" stock provided. When the bridge is mounted to the 419-01 housings, you should be able to move the bridge in and out smoothly, especially when the rubber boots have air pressure (5 psi cabin pressure) behind them.

- E3. Bolt the EL056-02-02 tab to the elevator idler. Secure the F34-14 rod end bearing to the EL056-02-02 tab.
- E4. Make two compensator supports from 1/4" thick, 3 ply per side prepreg. Remove the core material and install phenolic hardpoints where the pressure compensator will mount, as shown on Blueprint FM-419-1. If you are installing an autopilot, the right compensator support is a good location for the elevator servo. Form a coreless area in this support as shown on Blueprint FM-419-1.
- E5. With the pressure compensator and all elevator controls in the neutral positions, bond the compensator supports to the fuselage with epoxy/flox, then secure with 3 BID, 2" wide laminates.
- E6. A plastic hose (Part #5268K13) is required to route cabin air to the pressure compensator. This hose runs from the AN838-4D fitting on the compensator, through the left side of the FS171 bulkhead (just above the wheel cover), fwd to the brake lines, then follows the brake lines over the gear legs and into the gear box. The hose connects to an AN838-4D bulkhead hose fitting on the bottom of the outflow valve bucket (1043). The AN838-4D fitting can be mounted anywhere on the bottom of the fiberglass bucket except directly underneath the outflow valve. Secure the hose to the fittings with hose clamps (Part #'s 5321K16).

Cabin pressure hose to compensator

Figure 29:E:2

