

# CHAPTER 23

## 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
23-1 thru 23-6	0	None	
23-7 & 23-8	PC10	R&R	Edited Fig. 23:A:3 & text.
23-9 thru 23-12	0	None	
23-13	PC6	R&R	Revised Figure 23:C:1
23-14 & 23-15	0	None	
23-16	PC14	R&R	Mirrored drawing again.
23-17	PC10	R&R	Added part no. to 23:C:5.
23-18 thru 23-23	0	None	
23-24 thru 23-27	PC4	R&R	Revised Steps E6, 7, 9, & 10 Revised Figure 23:E:3:a & 23:E:4
23-28	0	None	
23-29	PC4	R&R	Revised Step E12 & 13
23-30	PC15	R&R	Revised Figure 23:E:6:b
23-31 thru 23-34	0	None	



# CHAPTER 23

## BRAKE SYSTEM / RUDDER 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 When such revisions are made, you should immediately replace all outdated pages with the revised pages.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.

### CONTENTS

1. INTRODUCTION
2. SPECIAL PARTS, TOOLS, AND SUPPLIES LIST
  - A. PARTS
  - B. TOOLS
  - C. SUPPLIES
3. CONSTRUCTION PROCEDURE
  - A. RUDDER PEDAL INSTALLATION
  - B. INSTALLING BRAKE MASTER CYLINDERS
  - C. BRAKE RESERVOIR
  - D. INSTALLING BRAKE ASSEMBLIES
  - E. BRAKE LINES
4. PHOTO PAGES



23-1

Chapter 23

REV. 0 / 12-9-93

Brake System / Rudder Controls

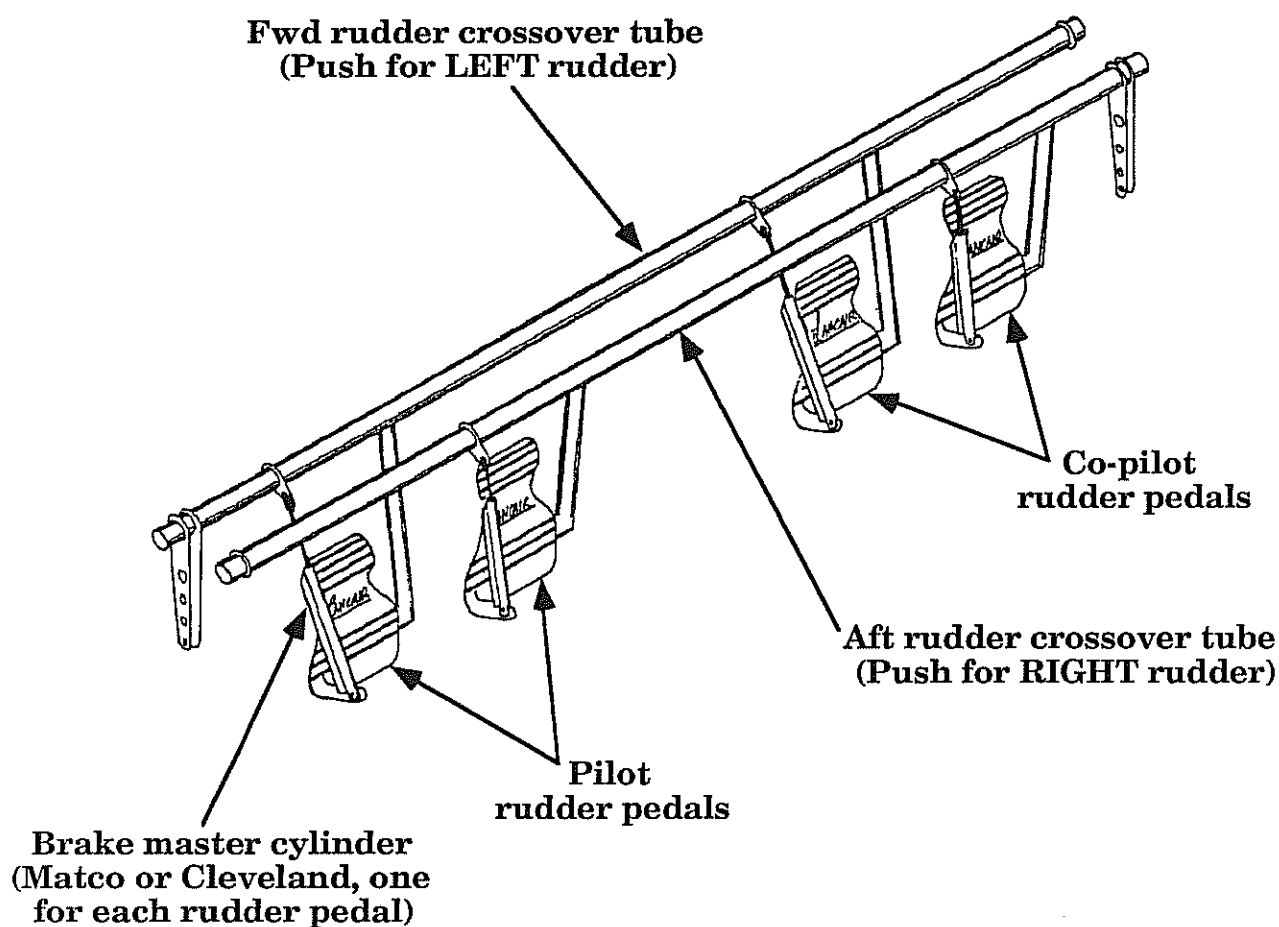
## 1. INTRODUCTION

In this chapter, you will finish up your rudder control system by installing the rudder pedals. The brake master cylinders attach to the rudder pedals and the crossover bars.

Directional control on the ground is achieved by differential braking. The entire braking system will be detailed in this chapter, from the firewall mounted reservoir to the brake assemblies on each wheel.

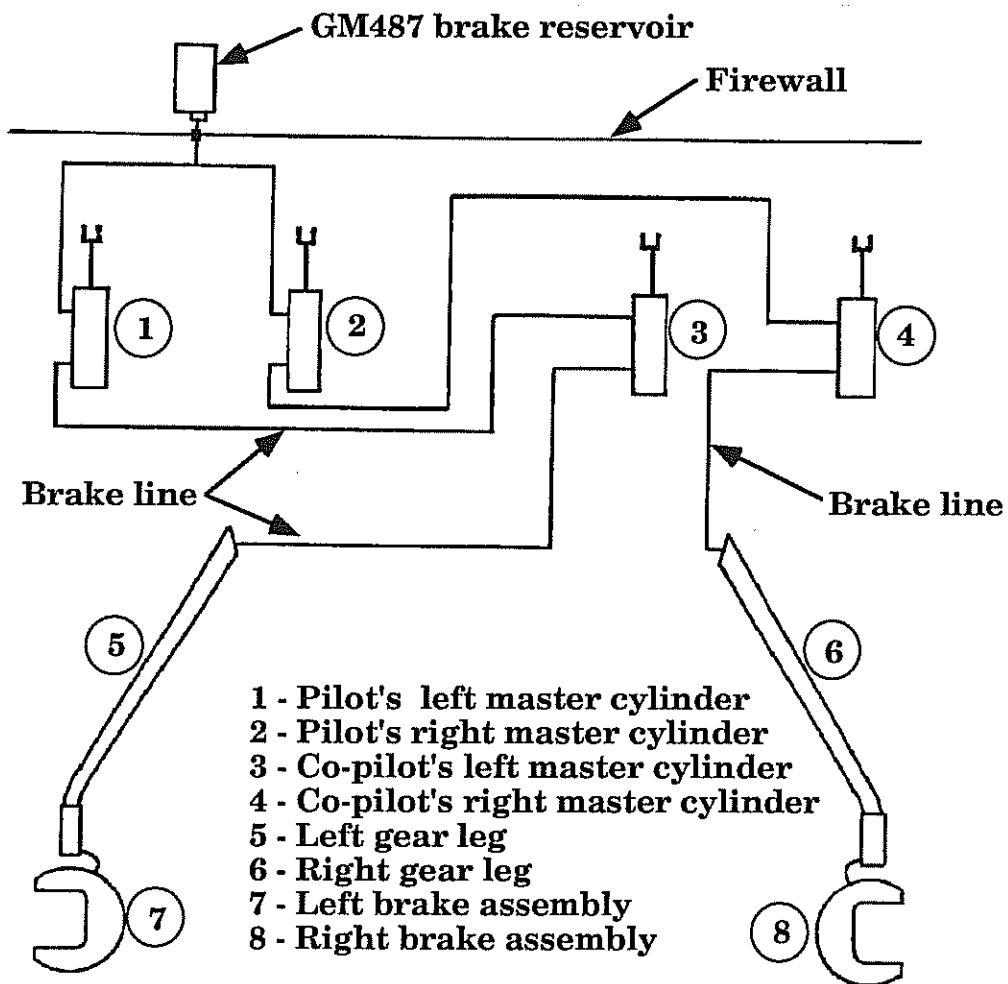
### Lancair IV rudder pedals/brakes

Figure 23:i:1



## Lancair IV brake system schematic

Figure 23:i:2



**NOTE:** This drawing is only a schematic, it doesn't show the exact brake line routing.

## 2. SPECIAL PARTS, TOOLS, AND SUPPLIES LIST

### A. PARTS

- 1 Fuselage assembly
- 4 Rudder pedals
- 4 Master cylinders
- 1 GM487 brake reservoir
- 1 Brake assembly (left, Matco or Cleveland)
- 1 Brake assembly (right, Matco or Cleveland)
- Nylaflow tubing, 3/16" D.  
1/4" D. x .035" wall, alum. tubing

### B. TOOLS

Flaring tool  
Deburring tool  
Safety wire pliers (not required but handy)  
Dremel tool  
Drill motor  
Drills  
8-32 tap

### C. SUPPLIES

Epoxy  
Flox  
Fiberglass  
Paper towels  
MC  
Mixing cups  
Mixing sticks



23-4

Chapter 23

REV. 0 / 12-9-93

Brake System / Rudder Controls

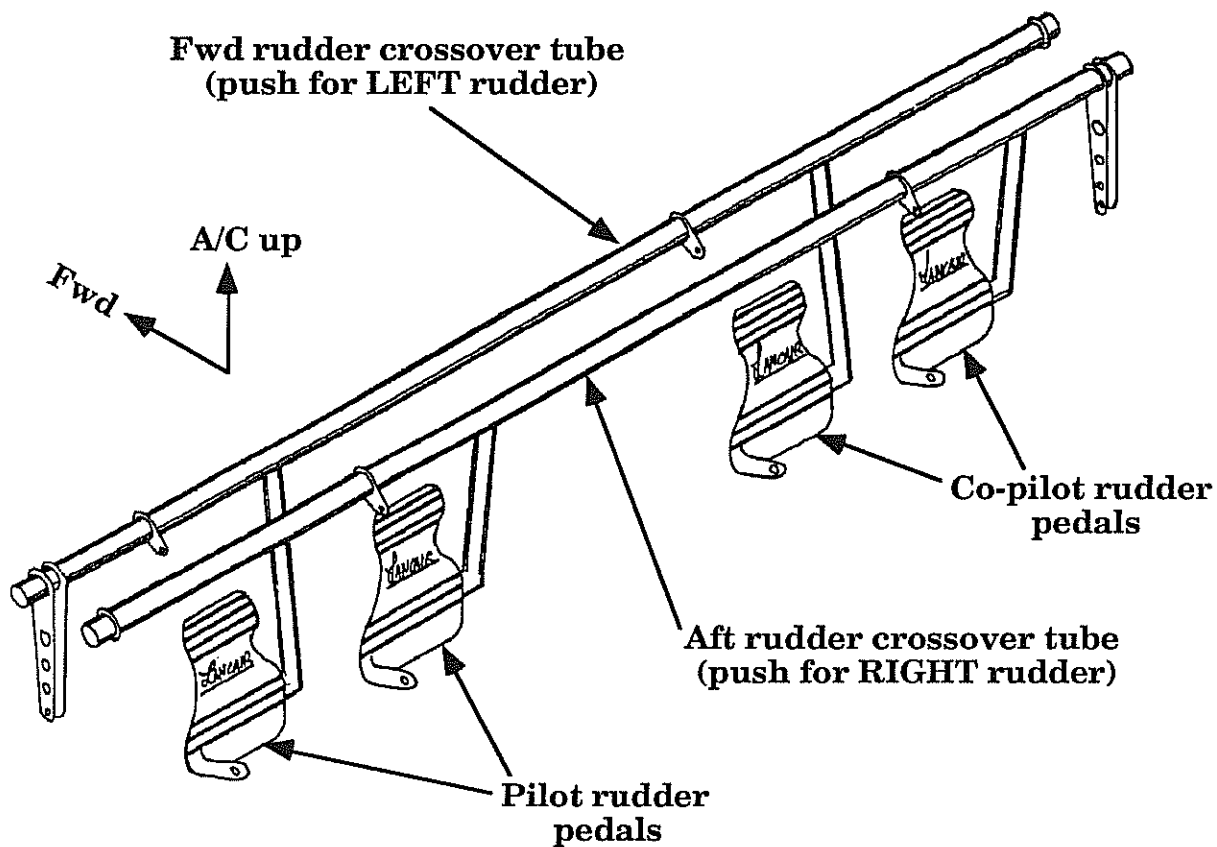
### 3. CONSTRUCTION PROCEDURE

#### A. RUDDER PEDAL INSTALLATION

The four rudder pedals provided in your kit are all identical, no lefts and rights.

#### Rudder pedals

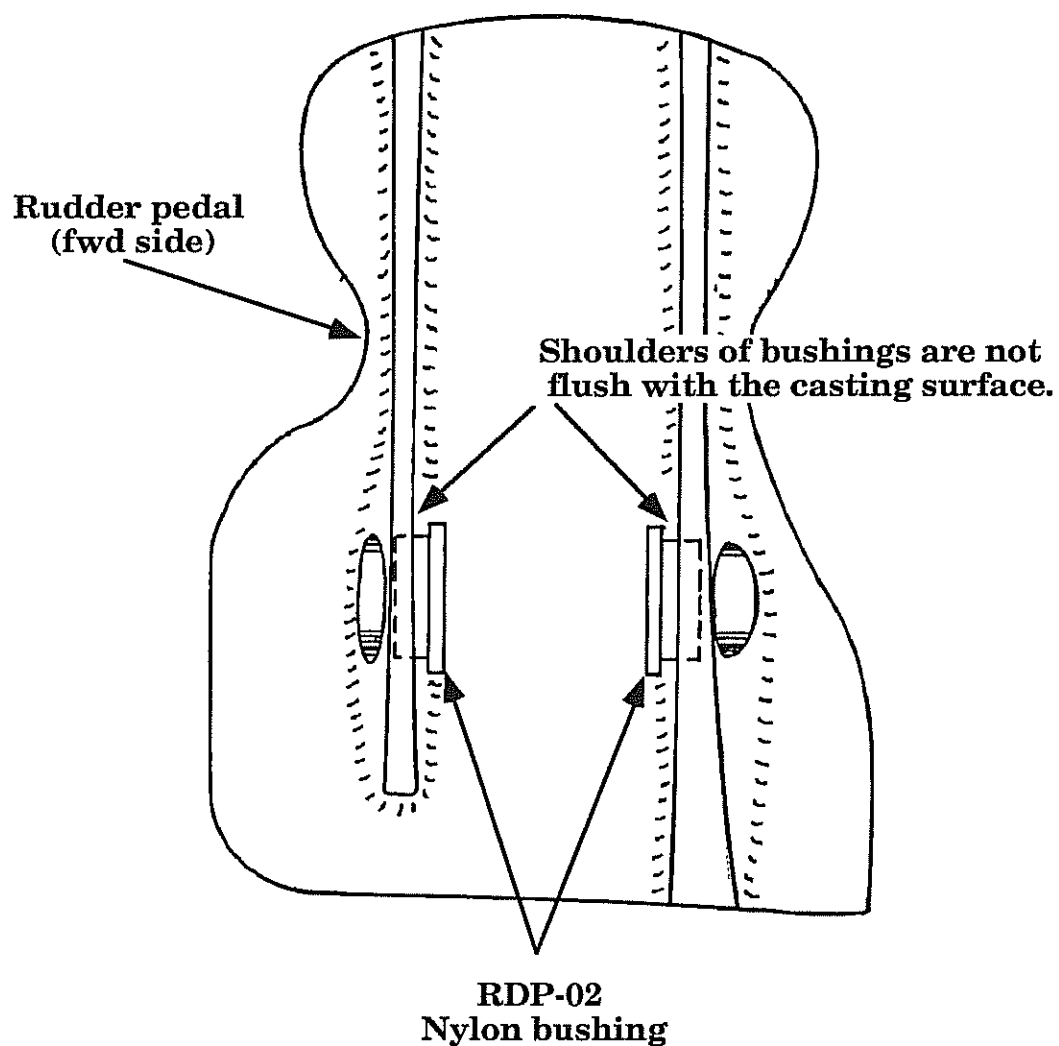
Figure 23:A:1



- A1. Push two RDP-02 nylon bushings into each rudder pedal as shown in Figure 23:A:2. Notice that the shoulders of these bushings do not rest flush against the castings because of the angled surfaces.

### RDP-02 bushings

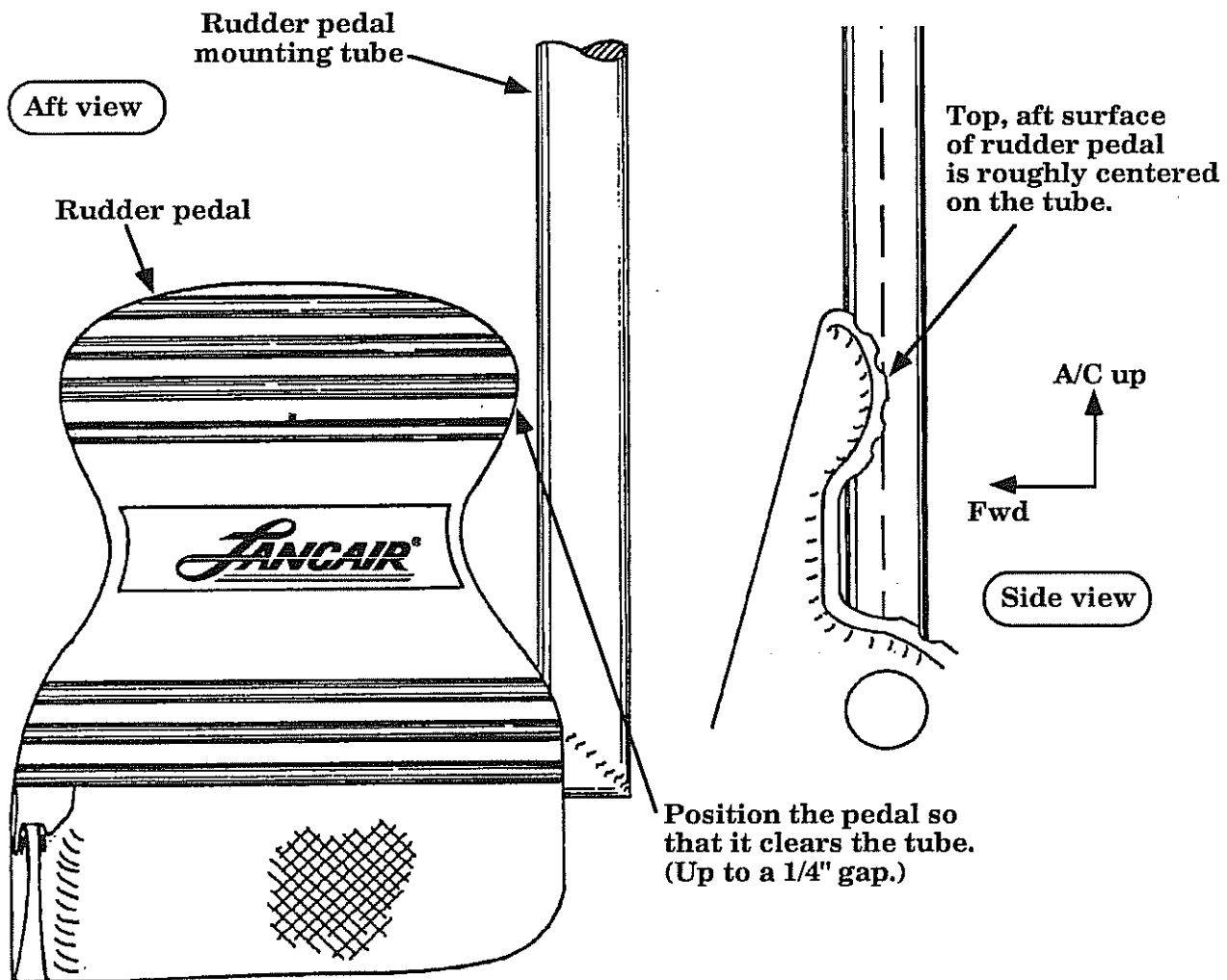
Figure 23:A:2



- A2. Cut four, 1 5/16" long pieces of .875" diameter x .058" wall, 6061-T6 aluminum tubing. These pieces should fit between the RDP-02 bushings with a little slop side to side.
- A3. Onto each rudder pedal mounting tube, slide one rudder pedal and one section of the tubing you cut in the last step. The aluminum tubing should be between the RDP-02 bushings.

### Locating rudder pedals

Figure 23:A:3

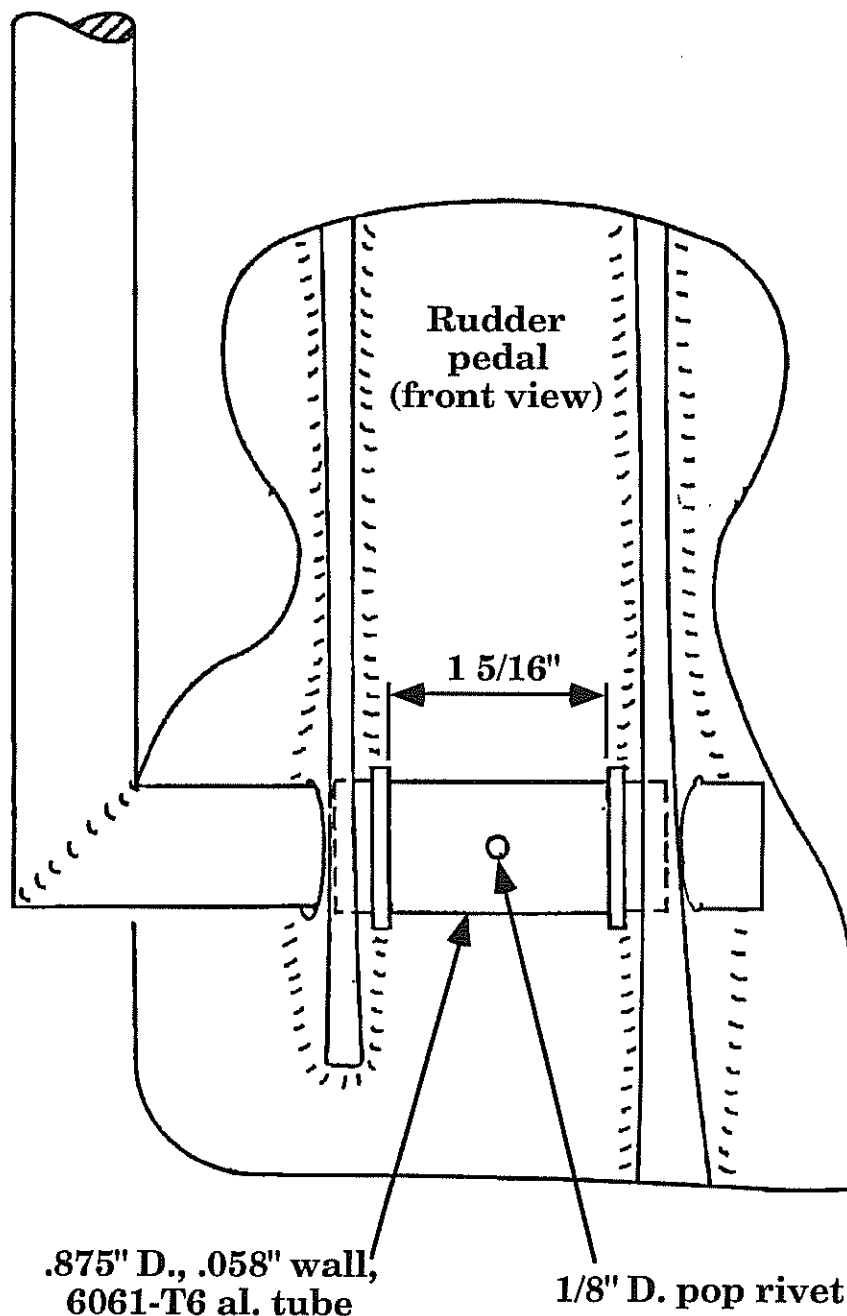




- A4. To find the proper position for the rudder pedals on the tube, align each pedal so the top bulge clears the vertical steel tube as shown in Figure 23:A:3.
- A5. Secure the  $1 \frac{5}{16}$ " long aluminum tubes to the rudder pedal mounts with a single  $\frac{1}{8}$ " diameter pop rivet. This will secure the rudder pedals to the crossovers. Unless you drill out this rivet (easy to do), the rudder pedals are now permanently secured to the crossover tubes.

### Locating and securing rudder pedals

Figure 23:A:4



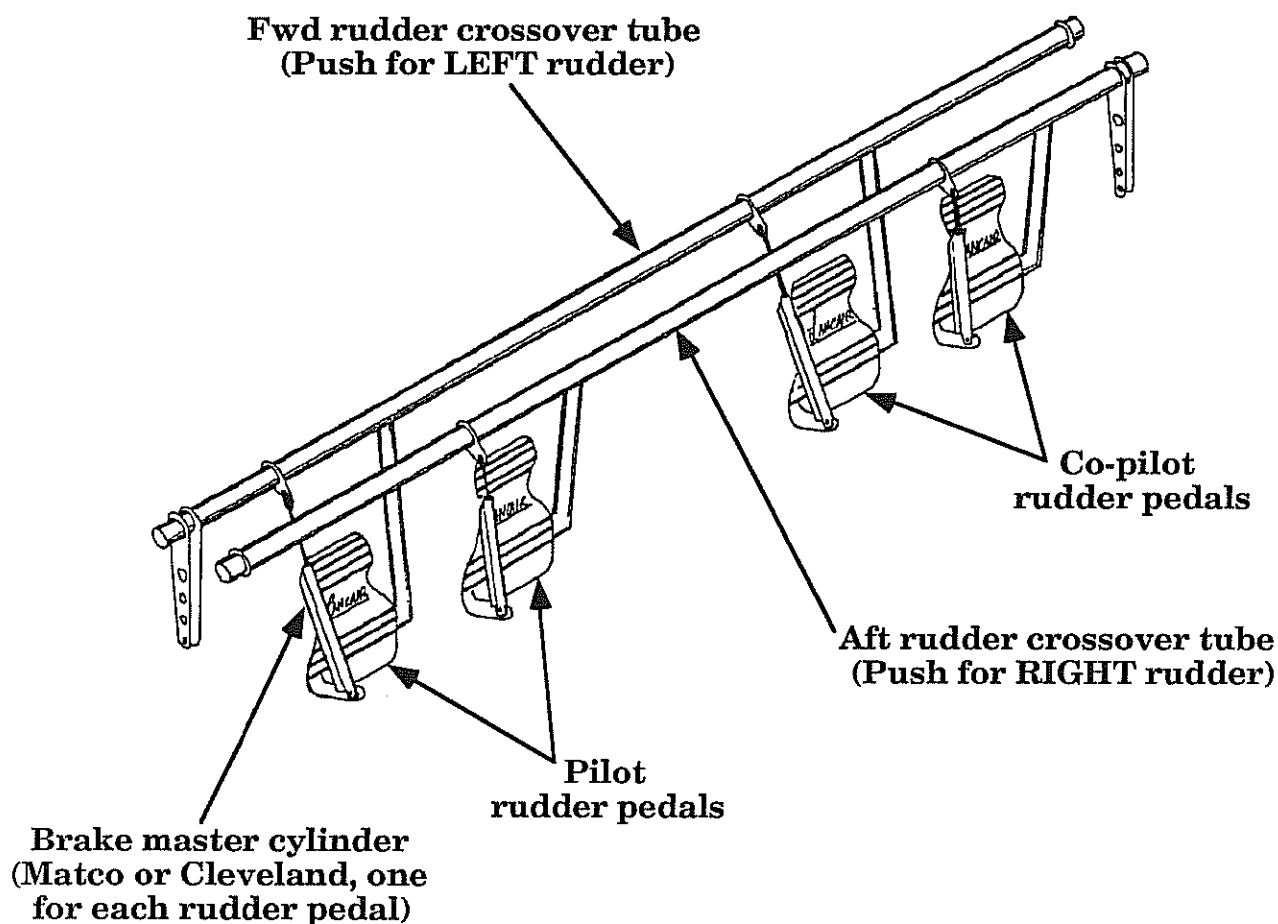
## B. INSTALLING BRAKE MASTER CYLINDERS

The brake master cylinders are mounted to the rudder pedals and the crossover tubes. When the tops of the rudder pedals are pushed forward for braking, the master cylinders compress hydraulic fluid through the brakes lines and into the wheel mounted brake assemblies. The pistons in the brake assemblies squeeze the brake pads against the disks and, voila, you have brakes.

Both Cleveland and Matco master cylinders install similarly, except for a few different bolt sizes.

### Brake master cylinders

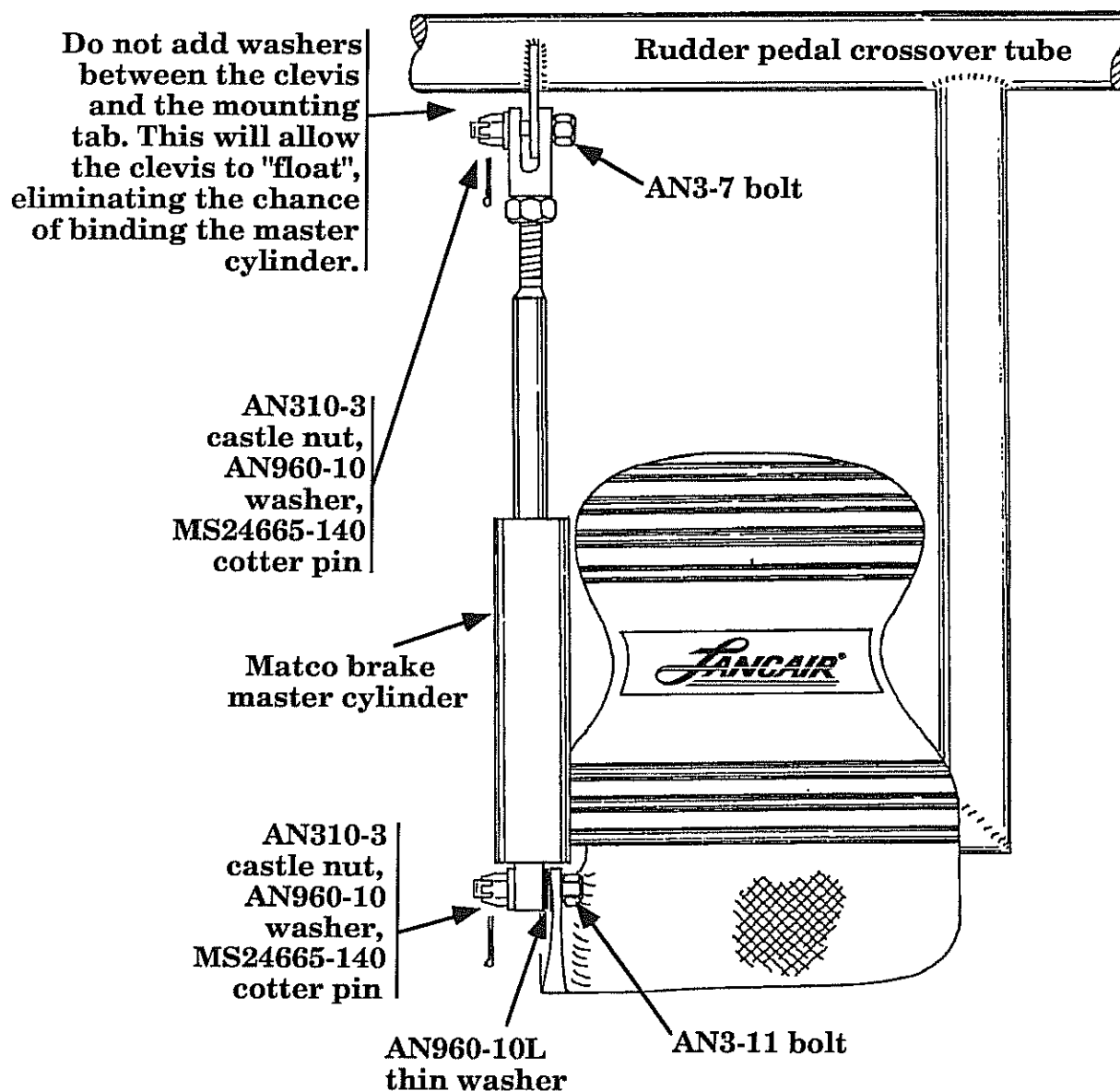
Figure 23:B:1



- B1. Secure the bottom of each master cylinder to the rudder pedal tab with an AN3-11 (-13 for Cleveland) bolt and AN310-3 castle nut. Notice that there is an AN960-10L *thin* washer between the Matco master cylinder and the rudder pedal casting. Do not tighten the castle nut so much that the master cylinder cannot rotate. See Figure 23:B:2:a for Matco and 23:B:2:b for Cleveland.

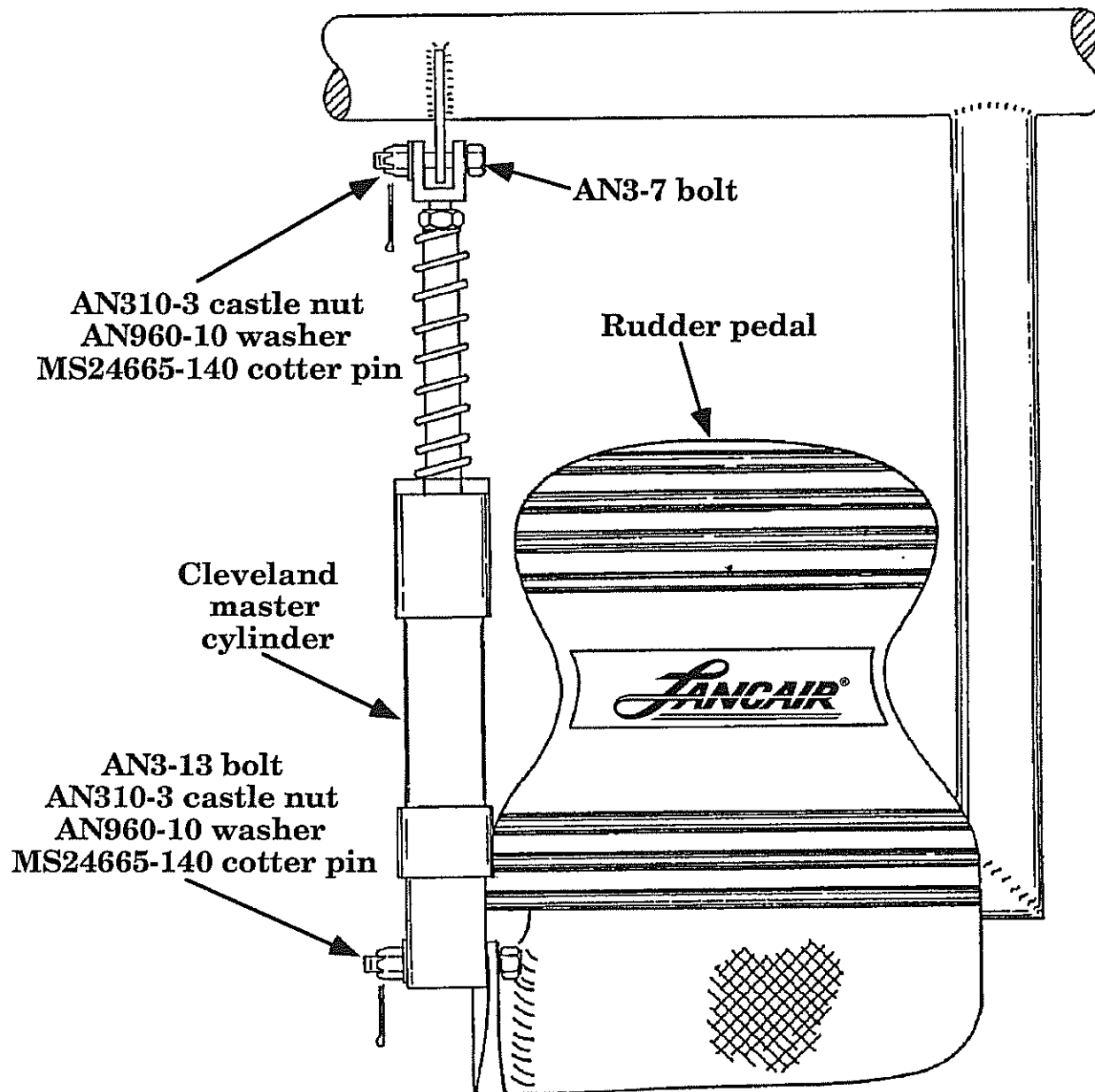
### Securing (MATCO) master cylinder to rudder pedal

Figure 23:B:2:a



## Securing (CLEVELAND) master cylinder to rudder pedal

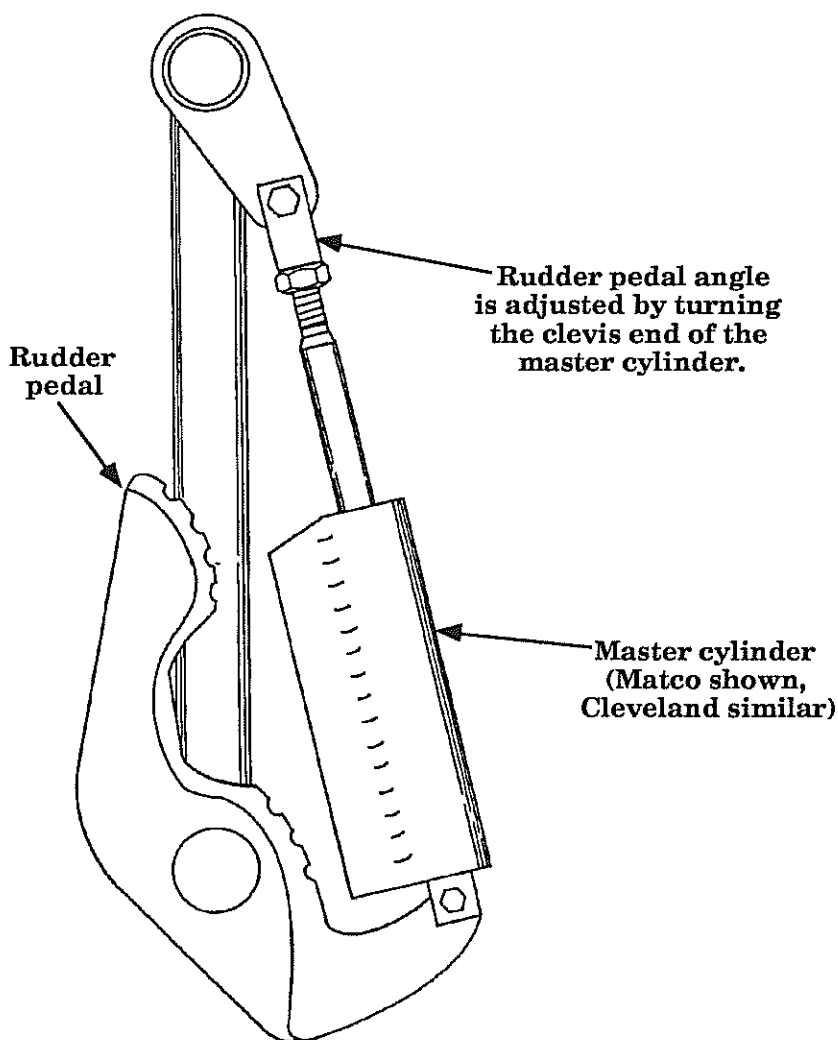
Figure 23:B:2:b



- B2. Adjust the upper end of the master cylinder until you can bolt the clevis to the tab on the crossover tube with the rudder pedal positioned as shown in Figure 23:B:3. Secure the master cylinder clevis to the tab with an AN3-7 bolt and AN310-3 castler nut. Notice that there are no washers between the clevis and the tab. This will leave some slop in the connection to avoid stressing the master cylinder from misalignment.
- B3. The final adjustment of the rudder pedal positions is done with the crossovers installed in the fuselage. With the clevis check nut loosened, you can spin the master cylinder shaft to change the angle of the rudder pedal when the rudder is neutral, the pedals should be roughly vertical, but the exact angle is not critical and can be changed a little to your preference.

### Adjusting rudder pedal angle

Figure 23:B:3

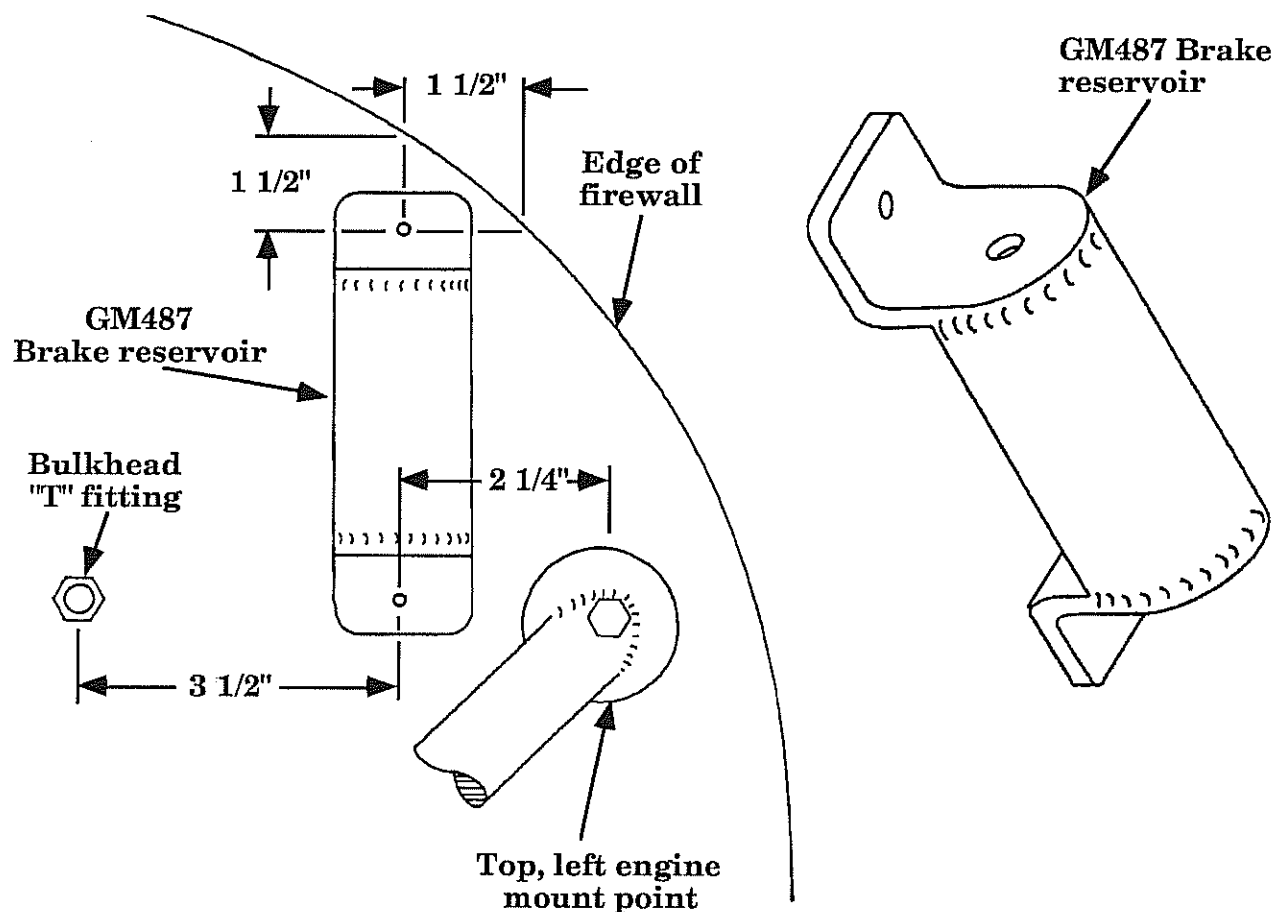


## C. BRAKE RESERVOIR

To fill and replace fluid in the brake system, a reservoir (GM487) is mounted to the fwd face of the firewall. The reservoir is positioned above all the rest of the brake system so refilling will not induce air bubbles.

### Brake reservoir

Figure 23:C:1

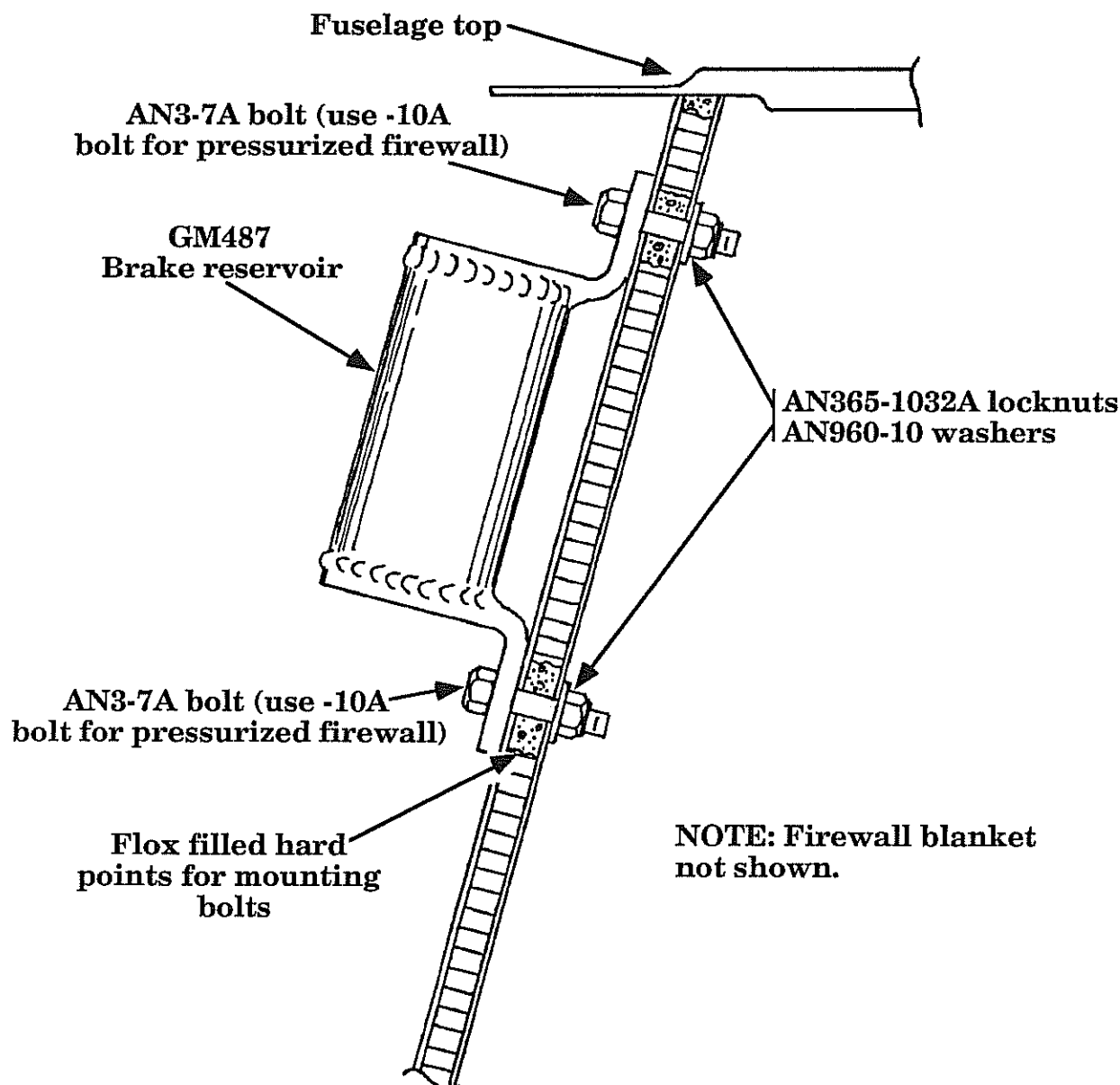


- C1. Position the GM487 brake reservoir on the fwd face of the firewall as shown in Figure 23:C:1. The threaded holes in the reservoir are the same size, so there is no specific up and down orientation of the can. Use the predrilled mounting holes in the reservoir flanges as guides to drill 3/16" diameter holes through the firewall.

- C2. Remove 1/4" of core around the perimeter of the two holes you just drilled in the firewall. Push a thick epoxy/flox mixture into these coreless areas to form a hardpoint for the reservoir mounting bolts. After the flox is cured, you will probably have to redrill the holes to clean them up.
- C3. Secure the GM487 brake reservoir to the firewall with two AN3-7A (-10A for pressurized firewall) bolts, AN960-10 washers, and AN365-1032A locknuts.

### Securing brake reservoir to firewall

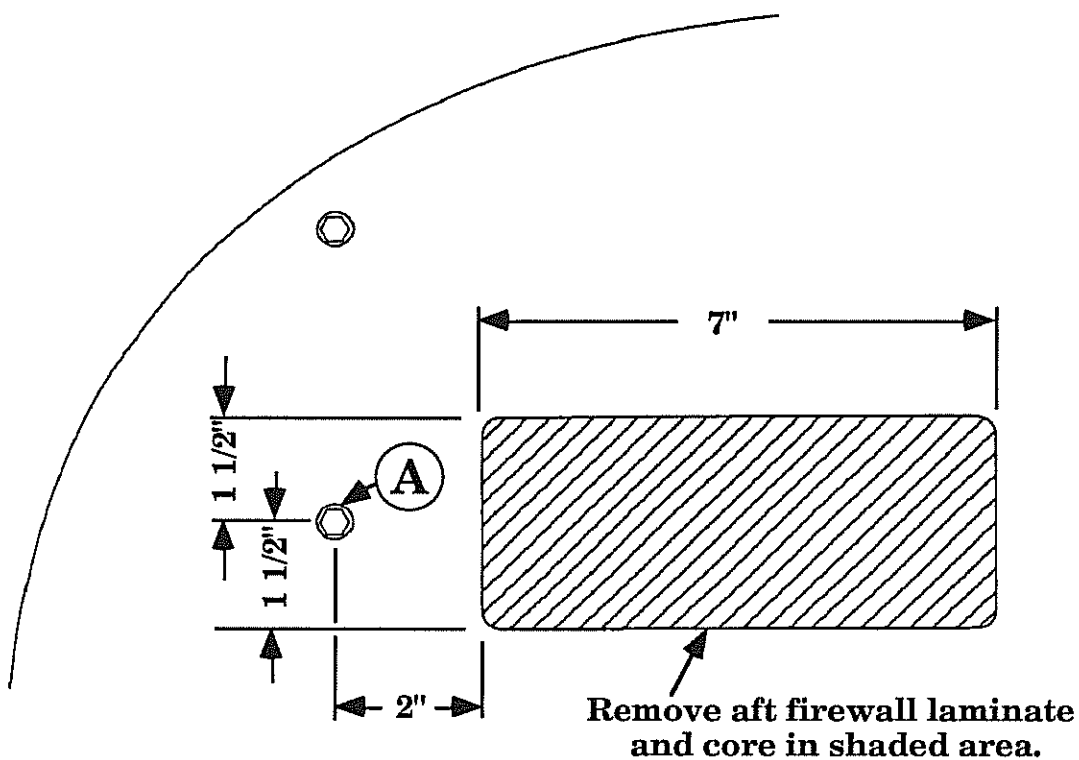
Figure 23:C:2



- C4. To form a "glass to glass" hardpoint for mounting the "T" fitting in the brake line, remove the aft laminate and core of the firewall as shown in Figure 23:C:3. Reinforce the coreless area from behind with 4 BID overlapping 1" onto the original aft surface of the firewall.

### Coreless area of firewall

Figure 23:C:3



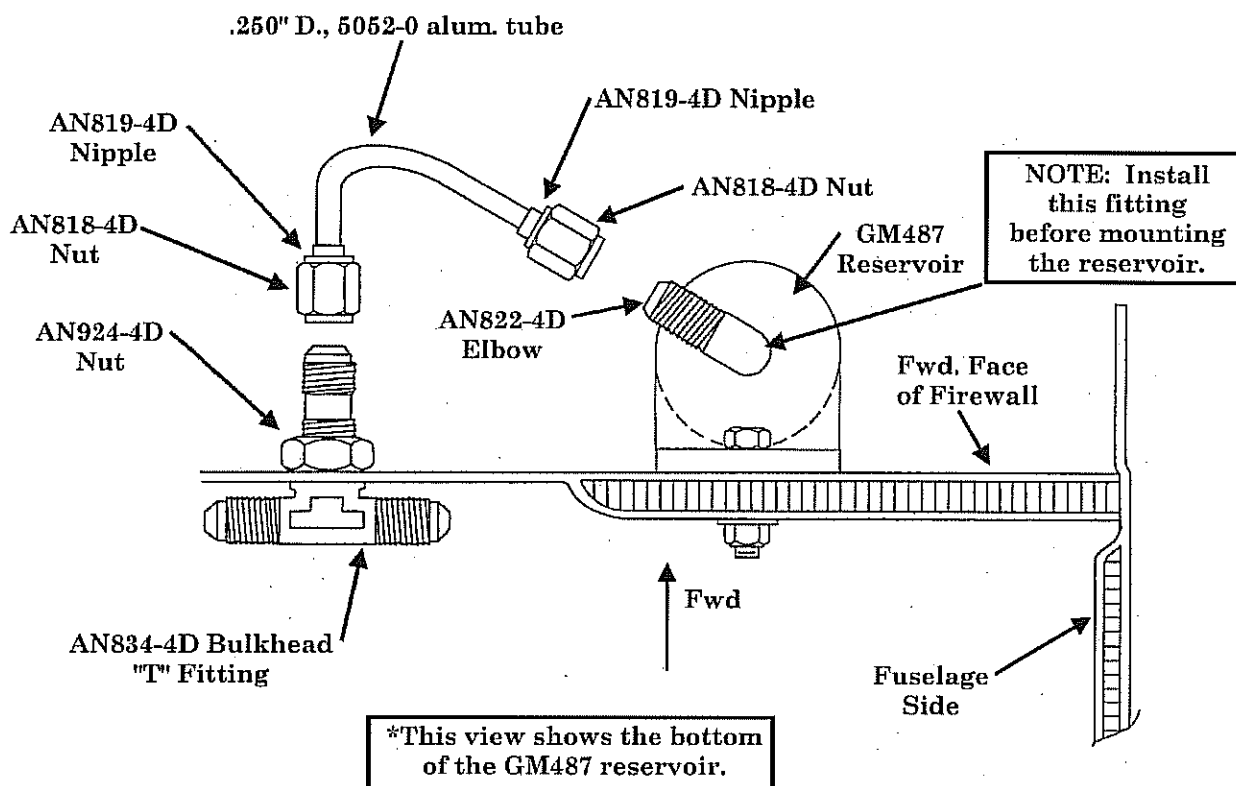
Ⓐ = Lower GM487 mounting point



- C5. Install an AN834-4D "T" fitting in your coreless hardpoint as shown in Figure 23:C:4. The fitting is secured with an AN924-4D nut. The right-hand portion of this hardpoint will be used for vacuum line fittings.
- C6. Screw an AN822-4D, 90° fitting into the bottom hole of the reservoir canister. Use a teflon sealant or teflon tape on the fitting for a complete seal. Point the bottom of the fitting inbd and 45° fwd.

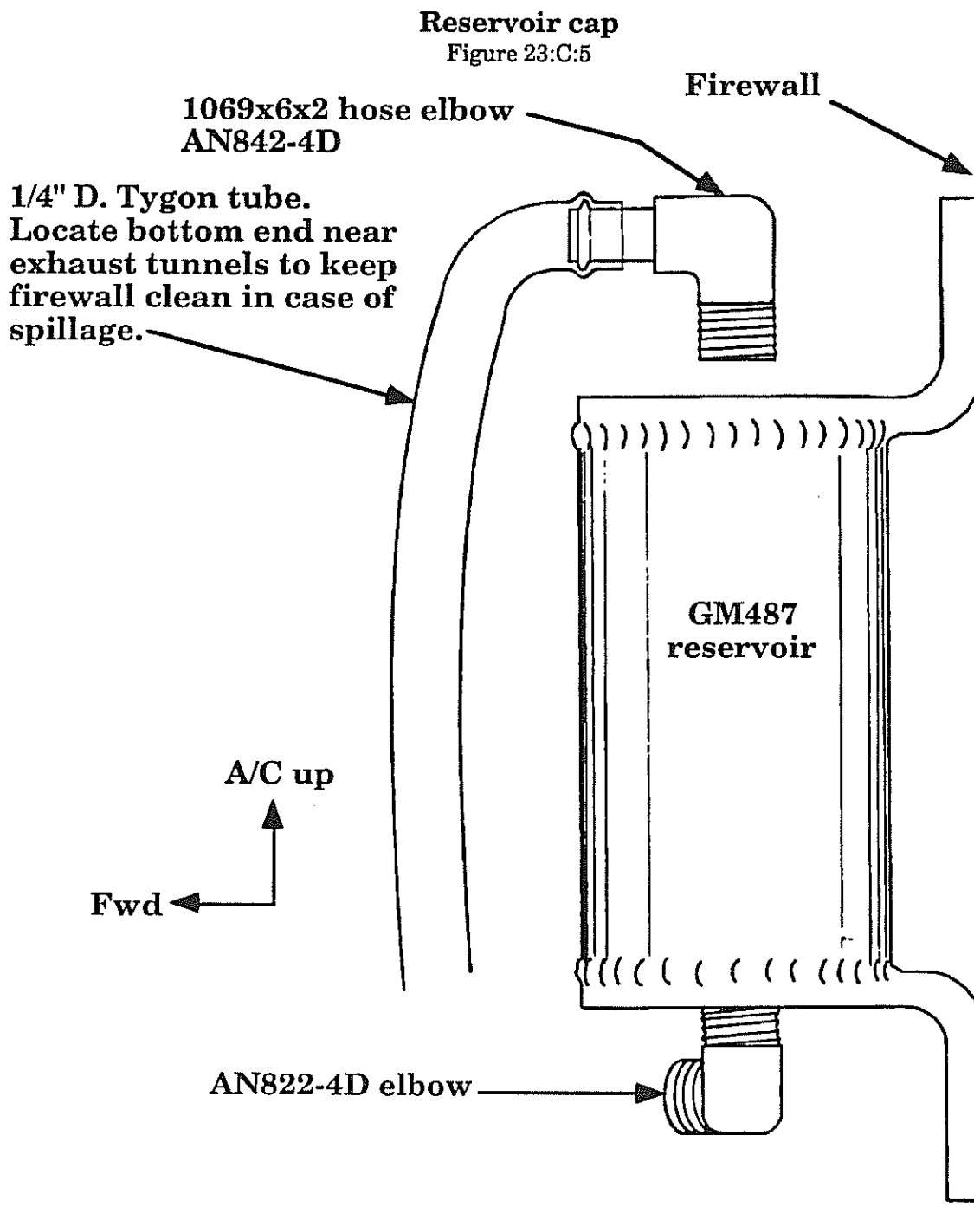
### Reservoir - Firewall brake line

Figure 23:C:4



- C7. Connect the AN822-4D fitting on the reservoir can to the firewall "T" fitting using 1/4" diameter, .035" wall, 5052-0 aluminum tubing. Use AN819-4D nipples and AN818-4D nuts at both ends of the tube. If you want to wait on this step, a better description of cutting, flaring and joining this type of aluminum line will be given in a later chapter dealing with hydraulics.

- C8. Screw a 1069x6x2 hose elbow into the top of the reservoir can, as shown in Figure 23:C:5. No need to use teflon tape on this fitting as it will be removed and replaced for maintenance. Connect a length of 1/4" I.D. Tygon tubing to the hose elbow to direct any overflow or discharge to the bottom of the cowling in the exhaust tunnel area. This tube will be discussed in the later firewall forward chapter.



- C9. The brake system is now complete from the firewall forward.

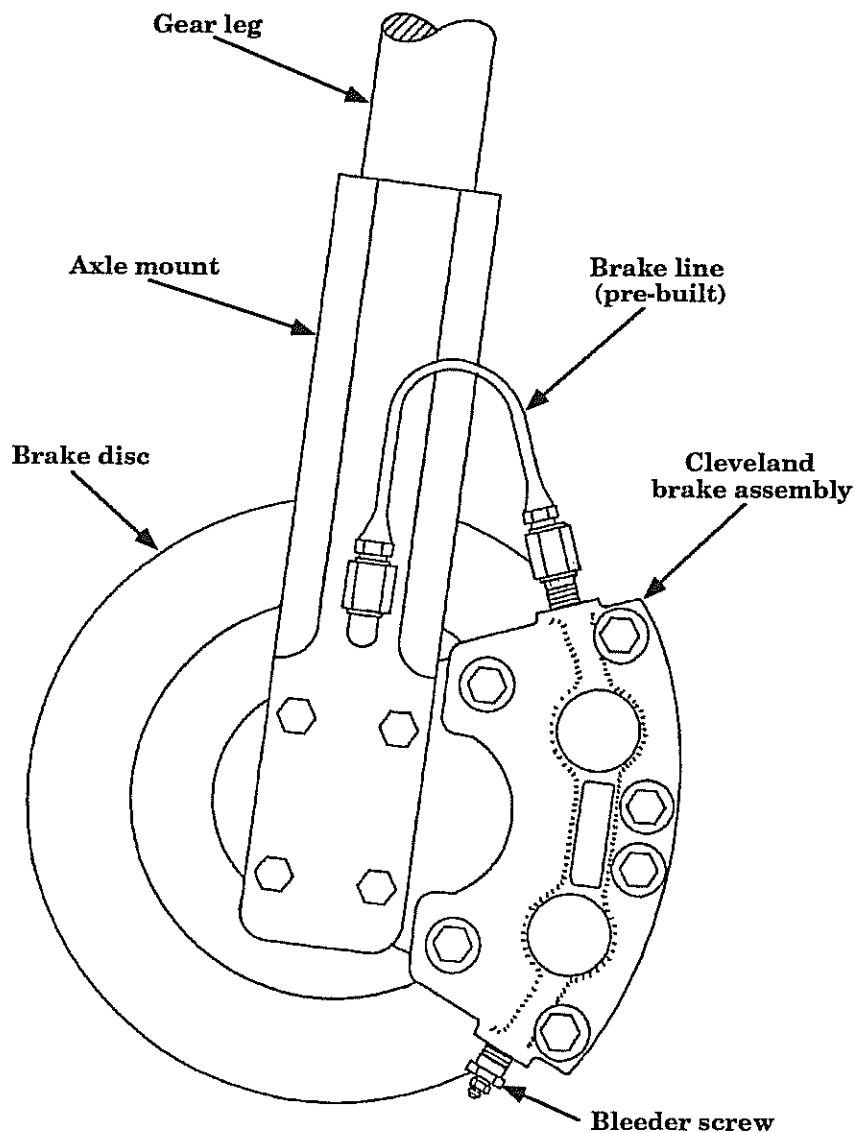
## D. INSTALLING BRAKE ASSEMBLIES

The brake assemblies are mounted just inboard of both main wheels. The brake assemblies should always "float" in their mounts to avoid excessive brake wear. When the brakes are *not* being applied, you should be able to wiggle (for lack of a technical term) the brake assembly on the brake disc.

A short, flexible brake line connects the brake assembly to the internally mounted brake line inside the gear leg. Installation of this short line will be detailed in the next section.

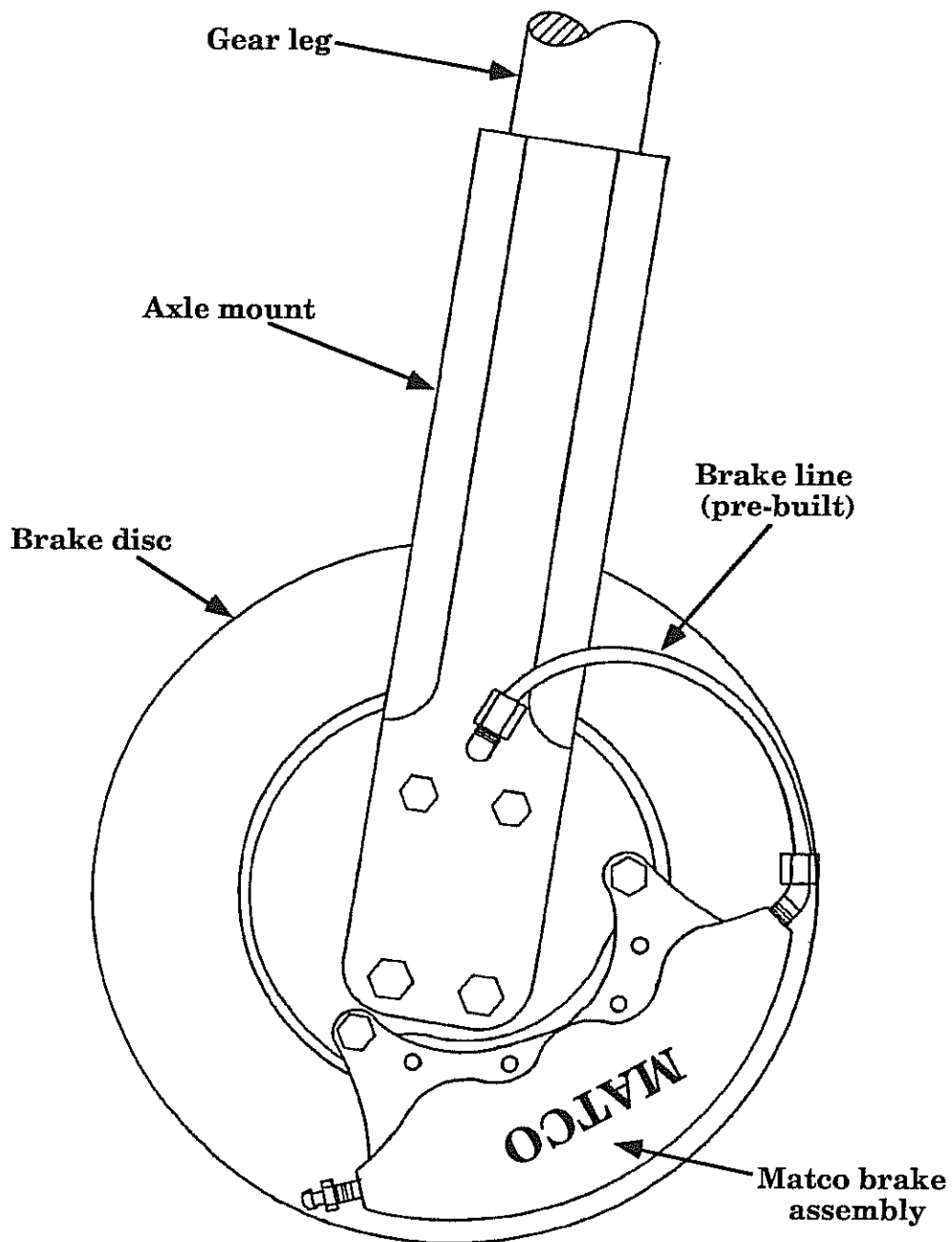
### Brake assemblies (Cleveland)

Figure 23:D:1:a



## Brake assemblies (Matco)

Figure 23:D:1:b



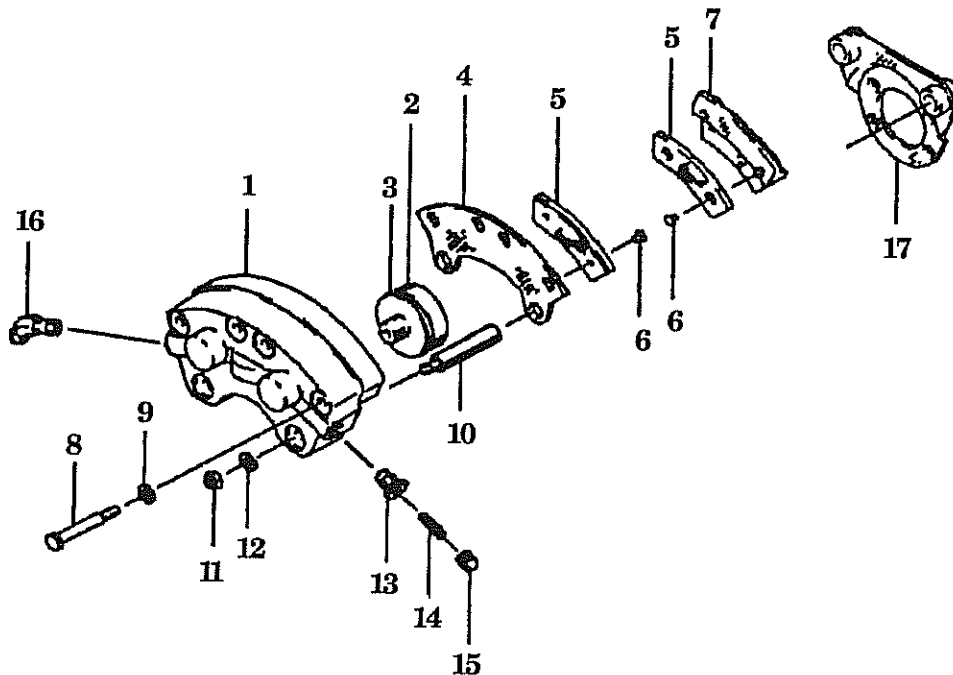
- D1. An exploded view of the brake assembly is provided in Figure 23:D:2:a & b. Keep in mind that you do not have to assemble all these pieces (i.e. The brake linings are already riveted to the pressure plates, etc.). The drawing is good for future maintenance.

### INSTALLING MATCO BRAKES

- D2. To install the Matco brake assemblies, the wheels must be separated from the brake discs. Three socket head screws secure the disc to the wheel.
- D3. Secure the brake assembly to the mounting flange (the piece already mounted to the axle) using the hardware provided with the brake system. There are two bushings between the inbd and outbd brake pads. Be sure the brake assembly can slide inbd and outbd on these bushings.
- D4. Use safety wire to secure the four socket head screws on the outbd side of each brake assembly. Twist and tie the safety wire so it will prevent each screw from loosening. Now would be a good time to get a safety wiring lesson from that A&P friend of yours.
- D5. Slide the wheel onto the axle and secure it with the axle nut. Then secure the wheel to the brake disc with the three socket head screws. There is a small hole drilled through the disc next to each screw location. Secure each screw with safety wire using the hole for an anchor point. Be sure the safety wire does not interfere with the brake assembly or the wheel.

## Brake assembly parts (Cleveland)

Figure 23:D:2



- |                    |                         |
|--------------------|-------------------------|
| 1 - Cylinder assy. | 10 - Bolt, anchor       |
| 2 - Piston         | 11 - Nut                |
| 3 - O ring         | 12 - Washer             |
| 4 - Pressure plate | 13 - Bleeder, seat      |
| 5 - Lining         | 14 - Bleeder, screw     |
| 6 - Rivet          | 15 - Bleeder, cap       |
| 7 - Black plate    | 16 - Fitting, tube      |
| 8 - Bolt           | 17 - Torque plate assy. |
| 9 - Washer         |                         |

### INSTALLING CLEVELAND BRAKES

- D6. To install the Cleveland brake assemblies, the brake discs must already be secured to the wheels. The wheel should be mounted on the axle.
- D7. Slide the inbd half of the brake assembly (the part with the fluid fittings) onto the axle mount. This assembly just floats on the two mounting pins.
- D8. Secure the outbd brake pressure plate to the inbd half of the brake assembly. These bolts must be safety wired.

**LANCAIR® IV**

23-21

Chapter 23

REV.

0 / 12-9-93

Brake System / Rudder Controls

Lancair International Inc., Represented by Nelco Aviation Inc., Copyright © 1994, Redmond, OR 97756

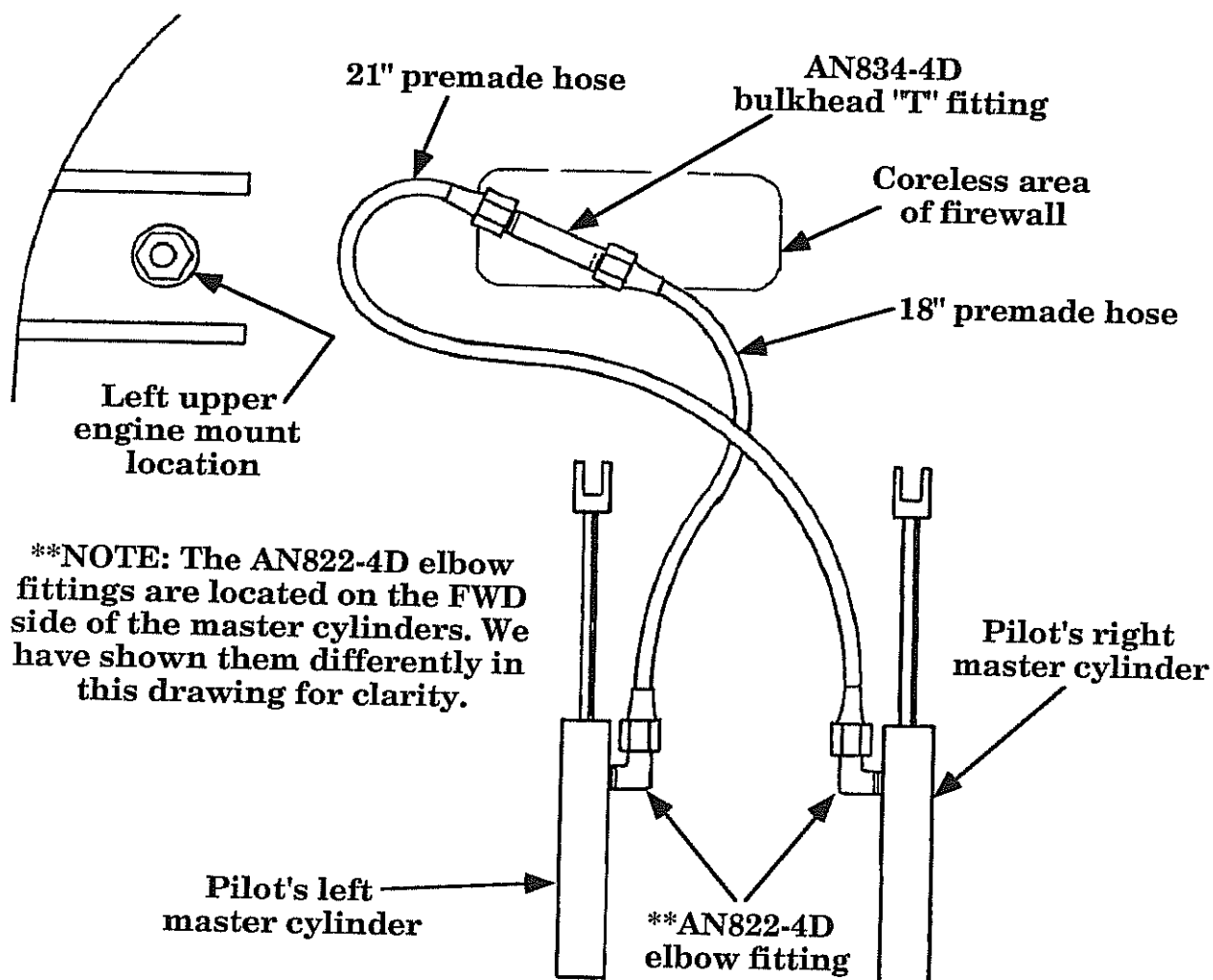
## E. INSTALLING BRAKE LINES

The brake system uses both aluminum tubing and flexible plastic line to connect the master cylinders to the two brake assemblies. The brake line inside the gear leg is pre-installed.

- E1. To connect the firewall bulkhead "T" fitting to the pilot's side master cylinders, premade flexible hoses are provided in the kit. Connect the flexible hoses to the AN834-4D bulkhead "T" fitting, then connect the hoses to the TOP ports of the pilot's master cylinders with AN822-4D elbow fittings. Notice that the flexible hoses are looped to prevent kinking. See Figure 23:E:1.

### Connecting firewall "T" to master cylinders

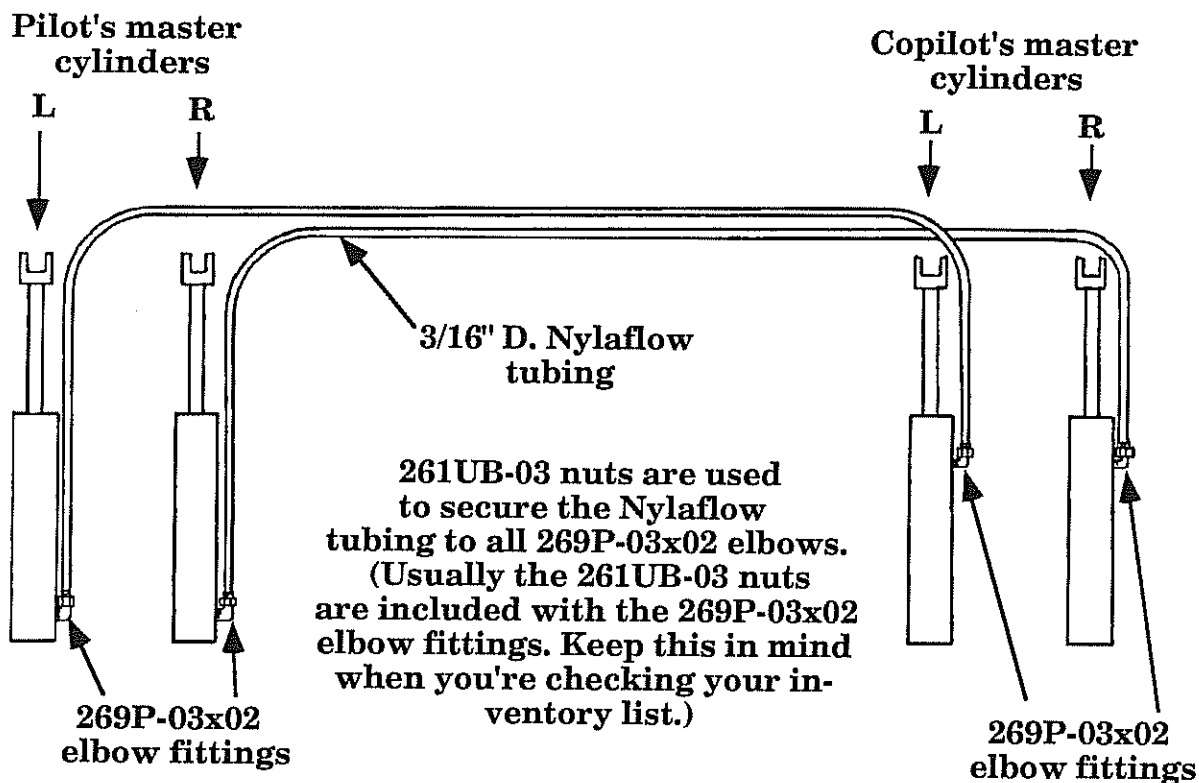
Figure 23:E:1



- E2. The BOTTOM ports of the pilot's master cylinders must be connected to the TOP ports of the co-pilot's master cylinders. Screw 269P-03x02 elbow fittings into these master cylinder ports.
- E3. Cut lengths of 3/16" D. Nylaflo tubing to connect the pilot's master cylinders to the co-pilot's master cylinders. Cut the tubing long enough so they won't prevent the rudder pedals from reaching full travel. Of course, the pilot's right side master cylinder is connected to the co-pilot's right cylinder, and left to left.
- E4. Connect the Nylaflo tubes to the appropriate ports of the master cylinders with 261UB-03 nuts. To do this, the nut is slid onto the end of the tube, then the tube is butted up to the elbow fittings in the master cylinders. The nut is then slid down and threaded onto the elbow fitting. When you tighten the nut, it will expand and grab the end of the Nylaflo tube.

### Connecting master cylinders

Figure 23:E:2

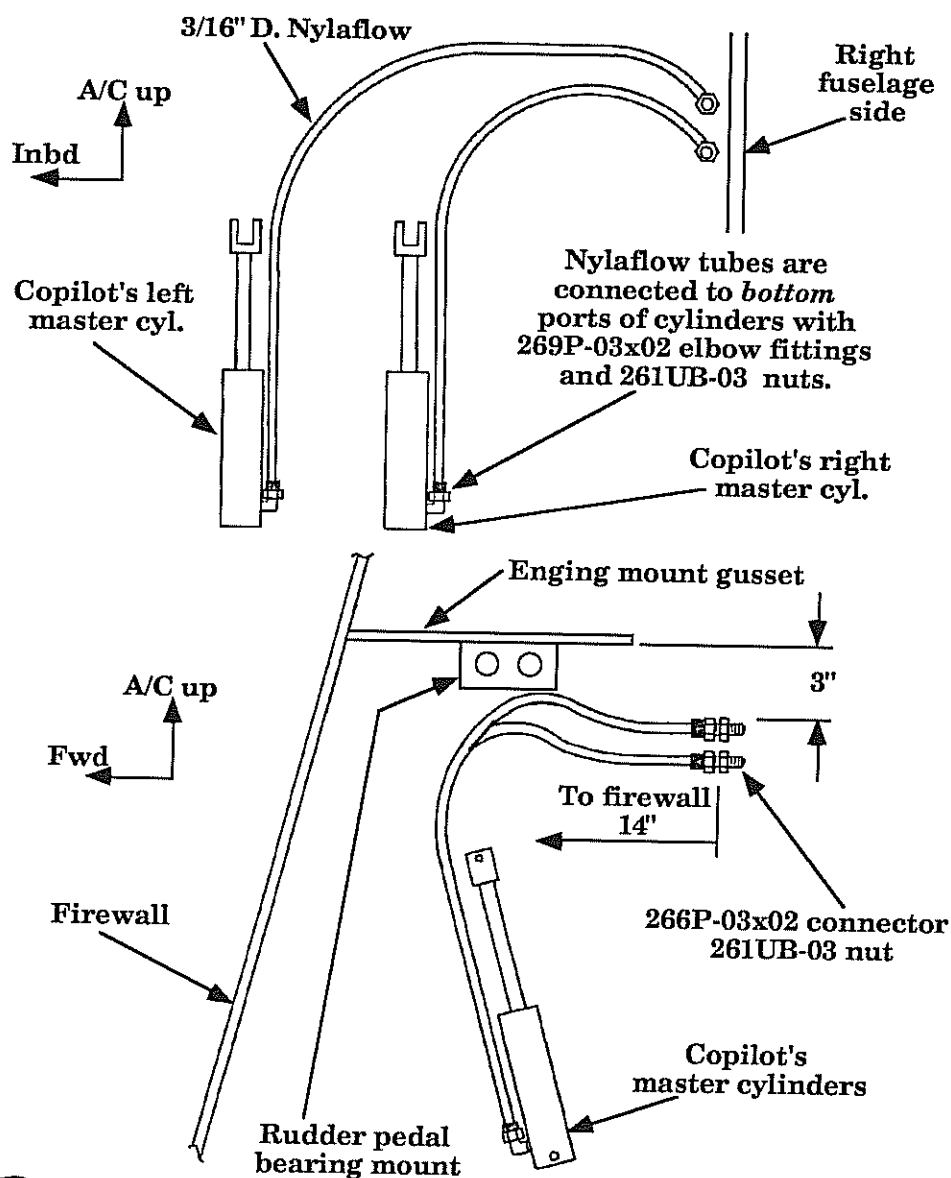




- E5. Screw 269P-03x02 elbow fittings into the bottom ports of the co-pilot's master cylinders.
- E6. From the co-pilot's master cylinders, the brake lines begin to head aft to the brake assemblies. Cut two more lengths of Nylaflo tubing to connect the co-pilot's master cylinders to 266P-03x02 fittings located on the fuselage side. Connect the Nylaflo lengths to the co-pilot's master cylinders and 266P-03x02 fittings using 261UB-03 nuts. Secure the fittings to the fuselage side with MS21919-DG8 clamps as shown in Figure 23:E:3:b, or use a variation of this method.

### Connecting co-pilot's master cylinders to unions

Figure 23:E:3:a



**LANCAIR® IV**

23-24

Chapter 23

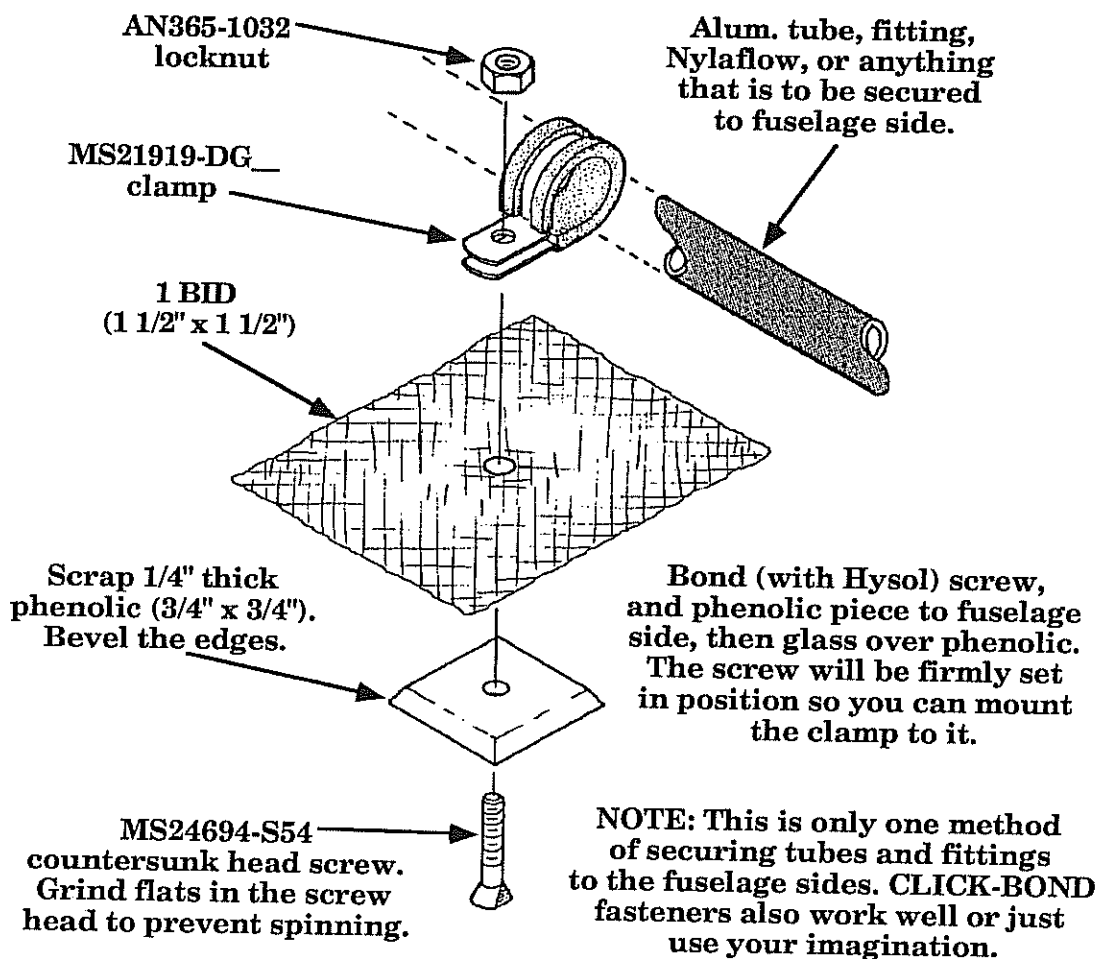
REV.

PC4/3-9-94

Brake System / Rudder Controls

## Securing hoses/fittings to fuselage

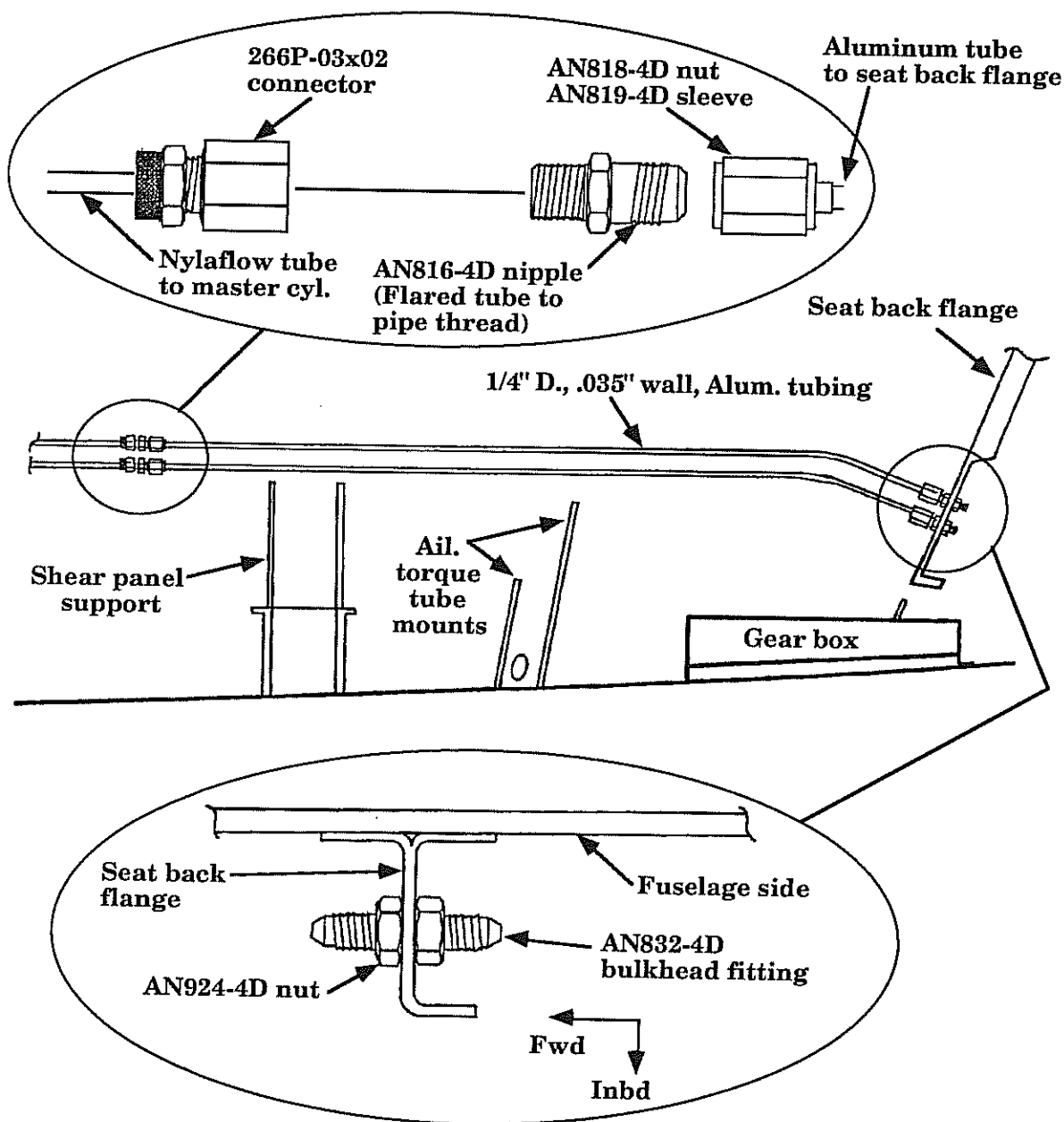
Figure 23:E:3:b



- E7. From the 266P-03x02 fittings aft to the rear seat flange, 1/4" diameter x .035" wall, 5052-0 aluminum tubing is used for brake lines. Yes, we know you haven't installed the rear seat flange yet, but we will explain the brake line installation through this structural member for later reference. Cut two pieces of the 1/4" aluminum tubing, 75" long. This will leave you plenty of extra to trim when you finally do install the pressure seat flange.
- E8. Install two AN832-4D bulkhead unions through the seat back flange, centered 7" and 8 1/2" above the gear box, as shown in Figure 23:E:4.
- E9. Connect the AN816-4D nipples to the AN832-4D bulkhead unions with the 1/4" D. aluminum tubing. You'll have to flare both ends of the tubing and use AN818-4D nuts with AN819-4D sleeves.

# Aluminum brake line through cabin area

Figure 23:E:4



- E10. Screw an AN816-4D union into a 266P-03x02 fitting and center this assembly about 9" forward of the gear box aft bulkhead. Do this on both sides of the gear box as shown in Figure 23:E:5. Secure the two fittings to the bottom flanges of the gear box sides with an MS21919-DG9 clamp. (It's easier to leave the fittings loose in the clamps for later mounting of brake lines.)
- E11. Cut and bend 1/4" diameter, .035" wall, 5052-0 aluminum tubes to connect the bulkhead fittings in your seat back flange to the AN816-4D fittings you just clamped in your gear box. This step will require a little freestyle tube bending, so what out for kinks. You should route the left brake line along the aft, upper edge of the gear box, then through the upper, outbd corner of the left gear leg cutout. This routing will avoid any interference with later hydraulic lines. Secure the left brake line to the upper flange of the aft gear box bulkhead with MS21919-DG4 clamps, as shown in Figure 23:E:5 *Remember which tubes go to which rudder pedal!* Secure the aluminum tubes to the AN816-4D unions with AN818-4D nuts and AN819-4D sleeves.

**LANCAIR® IV**

23-27

Chapter 23

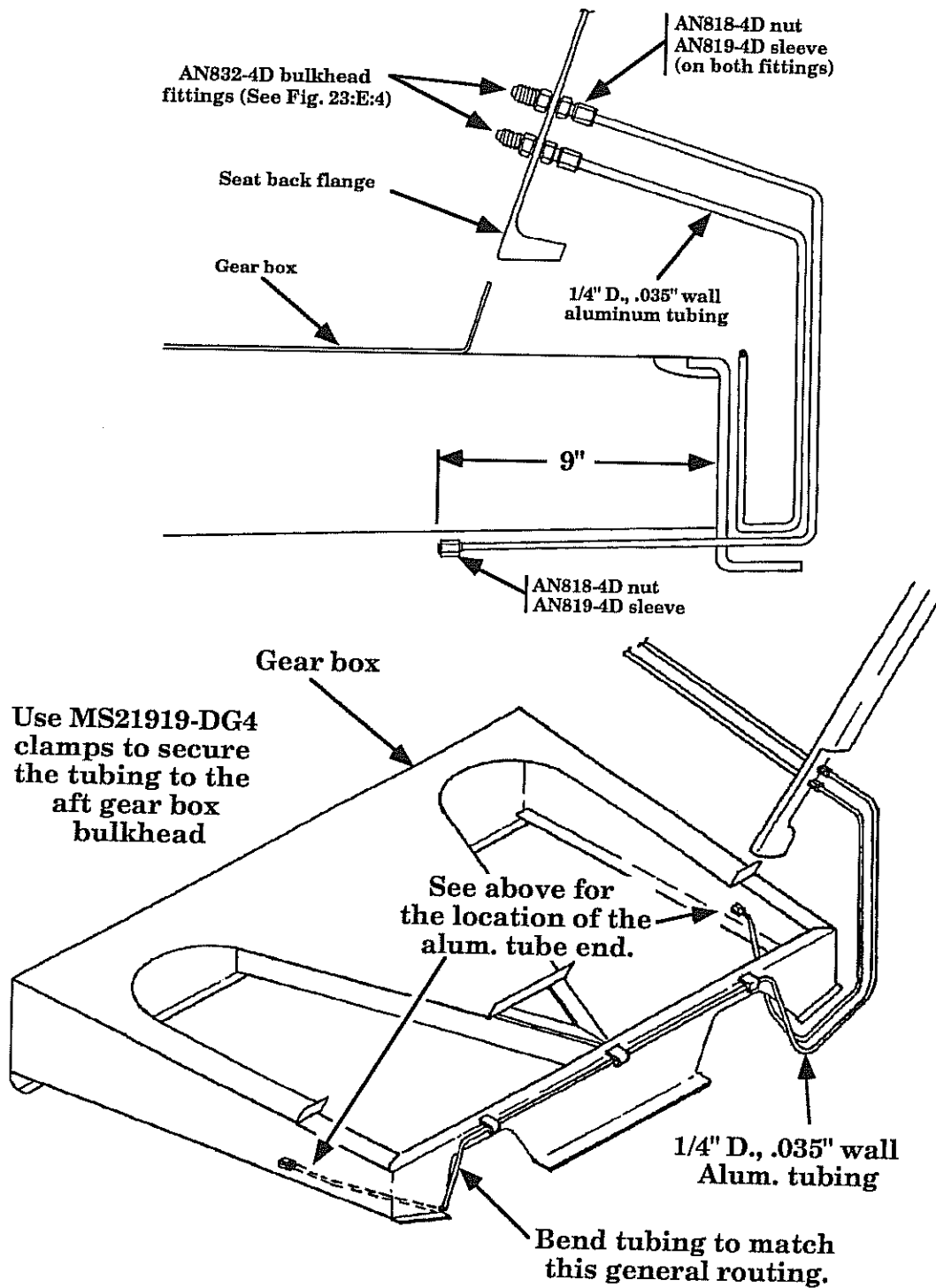
REV.

PC4/3-9-94

**Brake System / Rudder Controls**

## Seat flange to gear box brake lines

Figure 23:E:5



**LANCAIR® IV**

23-28

Chapter 23

REV.

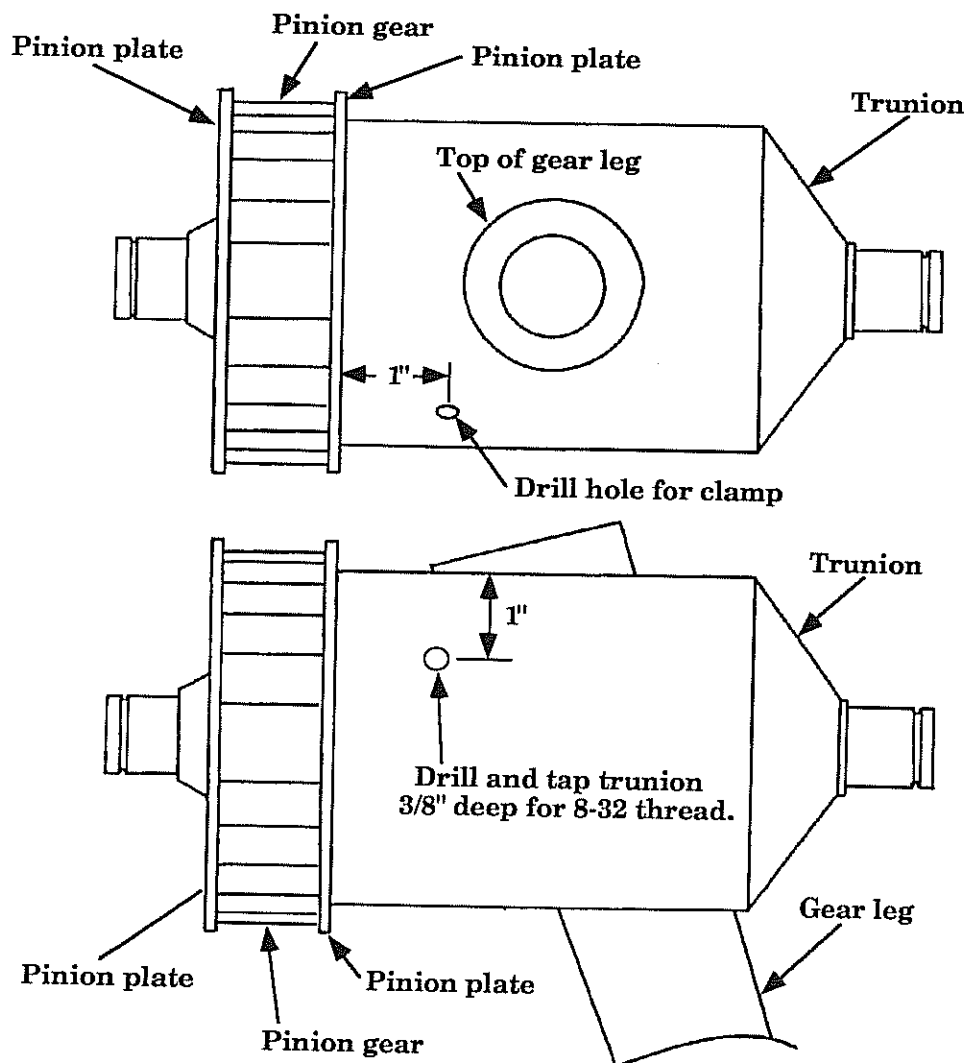
0 / 12-9-93

Brake System / Rudder Controls

- E12. Cut off the Nylaflo tubing that is installed in the gear legs so only 12" hangs out the back of each leg. This measurement can change if needed. The most important thing here is to have a brake line that does not kink during the gear retraction or extension. You may want to cut the line a bit long for now and test the length by cycling the gear. The Nylaflo lines are secured to the trunion using a MS21919-DG6 clamp. To secure the clamp to the trunion, you'll need to drill and tap the trunion for an AN526-832-R6 screw (8-32 thread). Remember, the clamp is AFT of the gear leg.
- E13. Use 261UB-03 nuts to secure the gear leg Nylaflo tubes to the 266P-03x02 fittings that you mounted to the gear box sides. Rotate the gear legs up and down to be sure the brake lines will not kink at the clamp.

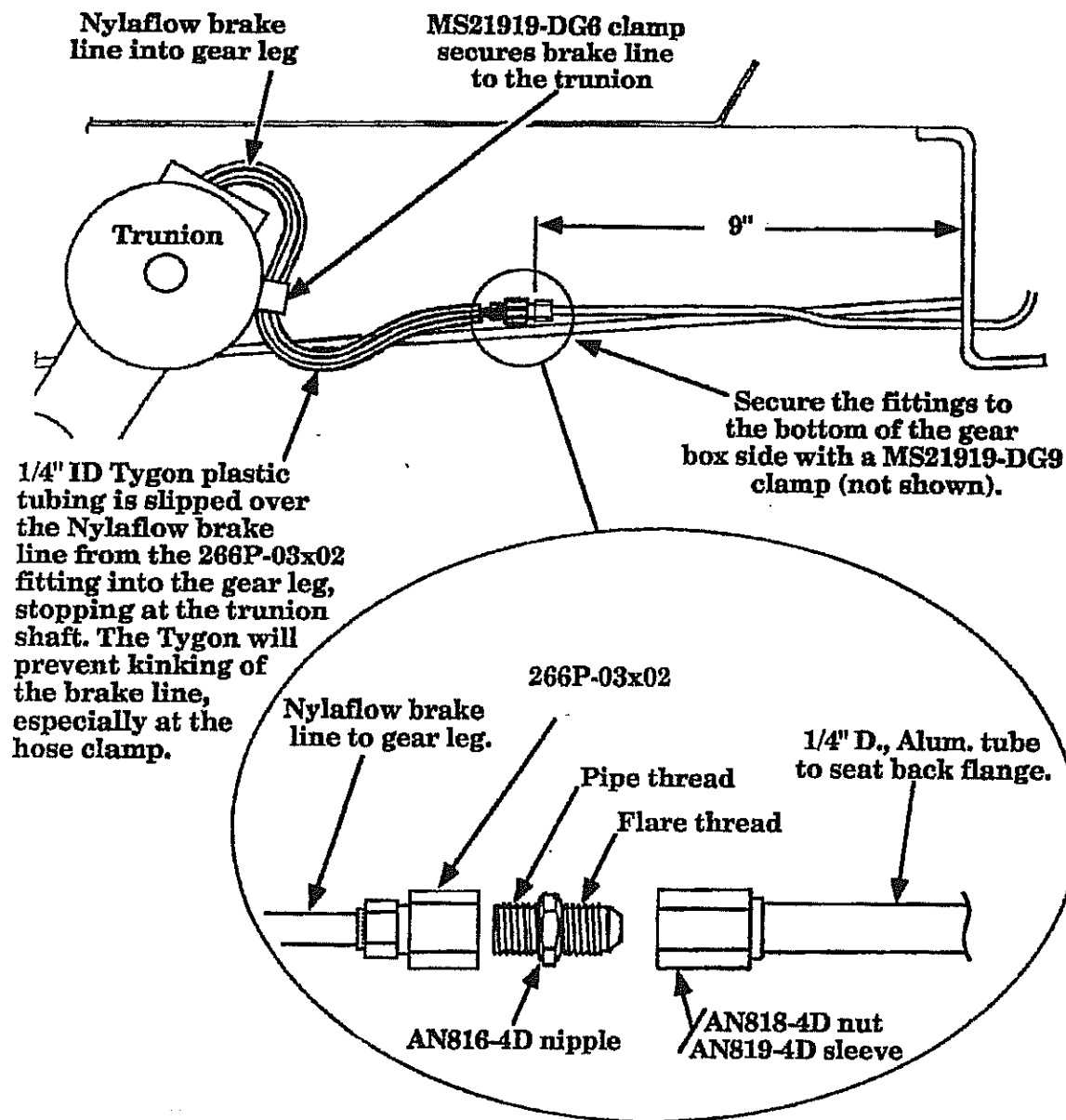
### Drilling and tapping trunion for clamp

Figure 23:E:6:a



# Gear box to gear leg brake lines

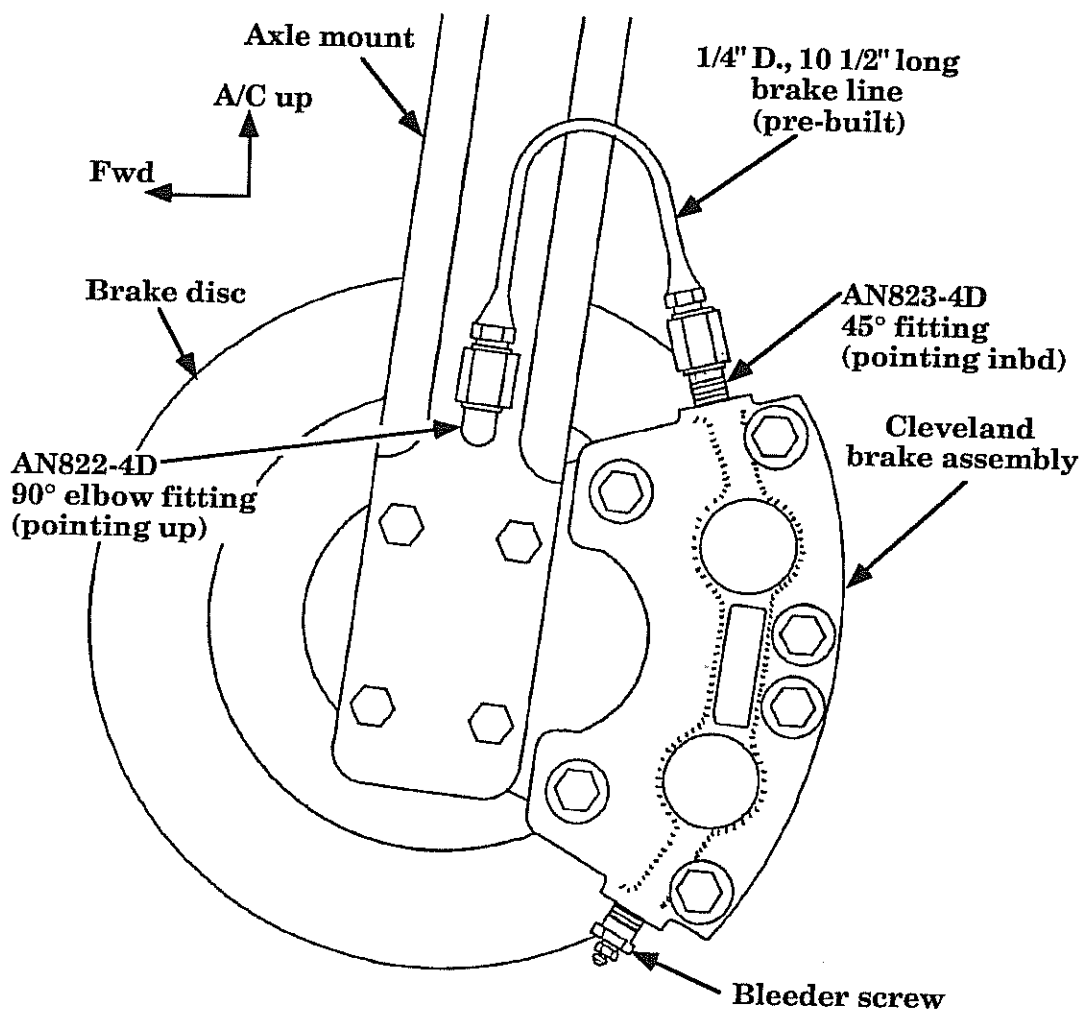
Figure 23:E:6:b



- E14. Screw an AN822-4D, 90° elbow fitting into the axle mounts of both gear legs as shown in Figure 23:E:7. The fitting should point up and back, but can be adjusted for best fit of the brake line. Matco and Cleveland brakes will require a different angle. Also screw an AN823-4D, 45° elbow fitting into the top hole of each brake assembly. Again, the fitting angle will vary between Matco and Cleveland installations, but will generally point inbd and fwd.
- E15. The last lengths of brake line that must be installed to complete the brake system are factory made (flexible hose, 1/4" diameter, 10 1/2" long). They connect the gear leg brake lines to the brake assemblies. Secure these lines as shown in Figure 23:E:7.

### Connecting gear leg brake lines to brake assemblies

Figure 23:E:7



**NOTE:** The 10 1/2" long brake line and fittings are similar for both Cleveland and Matco brakes.

**LANCAIR® IV**

23-31

Chapter 23

REV. 0 / 12-9-93

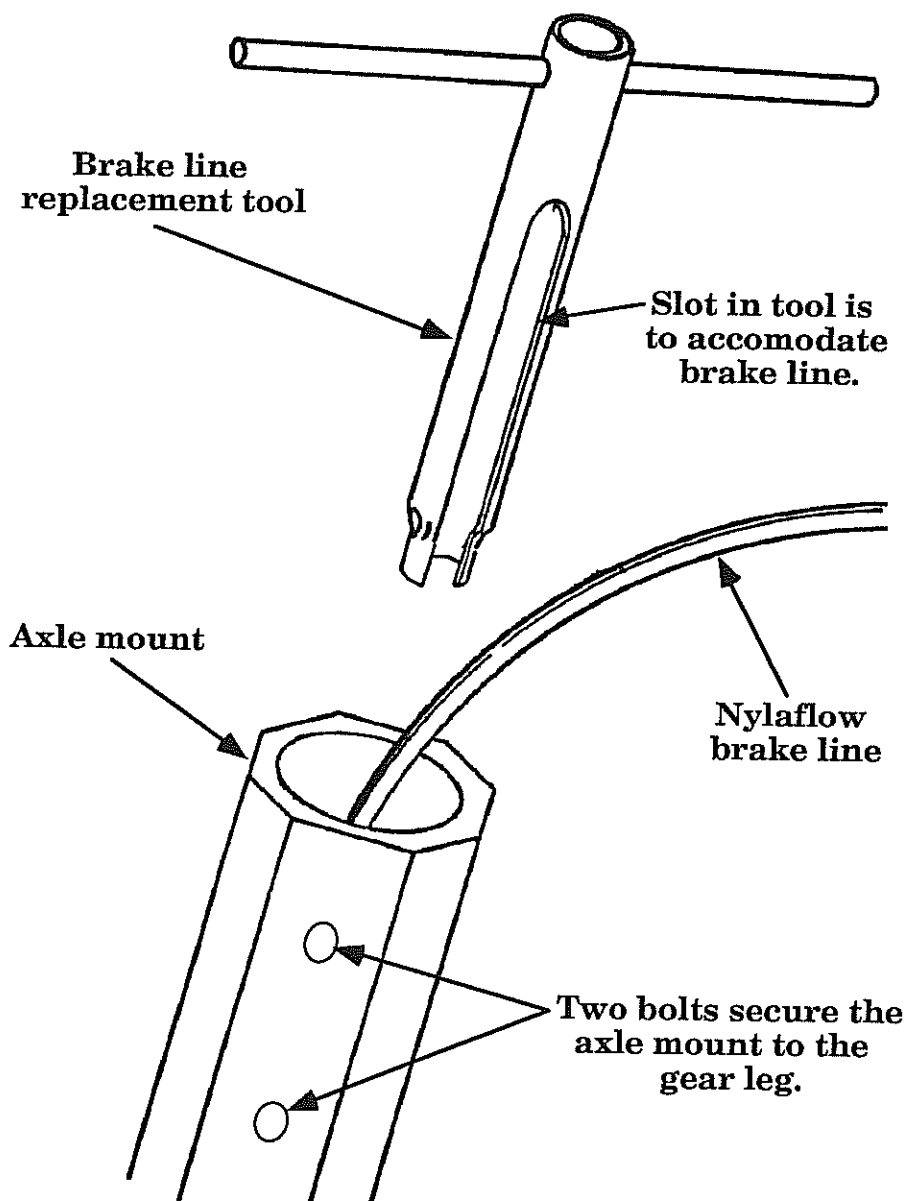
Brake System / Rudder Controls



- E16. Here's a maintenance tip on the brake lines. If the gear leg mounted brake line fails for some reason, replacement will require removal of the axle mount. The brake line is inset deep into the axle mount so removal with a normal socket or wrench is impossible. A slotted socket tool is available from Lancair for removal and installation of the brake line in the axle mount.

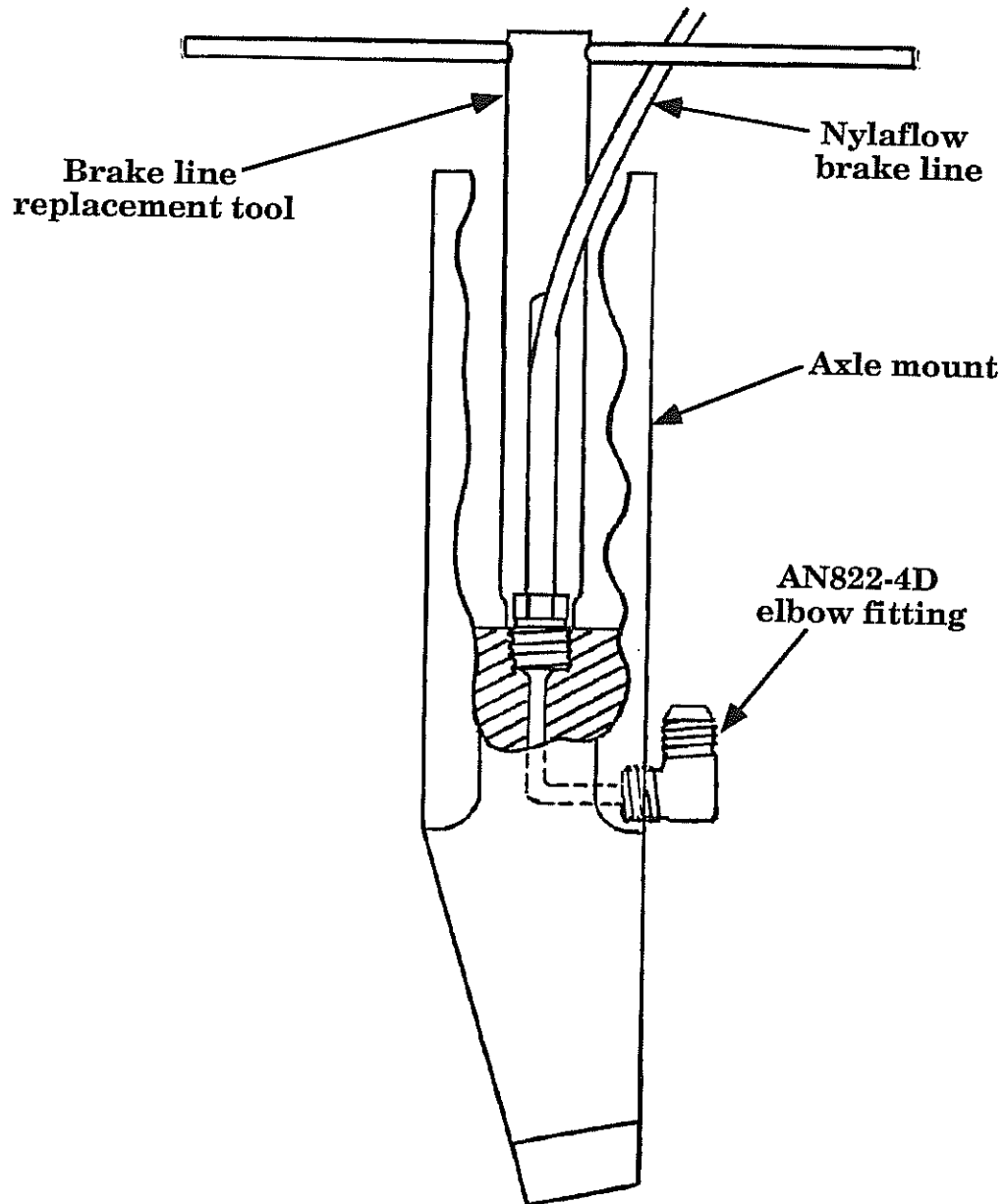
### Brake line to axle mount fitting

Figure 23:E:8:a



## Brake line to axle mount fitting

Figure 23:E:8:b



**LANCAIR® IV**

23-33

Chapter 23

REV. 0 / 12-9-93

Brake System / Rudder Controls

Lancair International Inc., Represented by Neico Aviation Inc., Copyright © 1994, Redmond, OR 97756

- E17. To finish the brake system, you'll have to fill the system with brake fluid and bleed the brakes. The standard fluid for both hydraulic and brake systems is MIL-H-5606 type and is available from Aircraft Spruce and Specialty, or your local FBO. Fill the reservoir with fluid and loosen the bleeder valves on the bottom of the brake assemblies. Pump the PILOT'S brakes until the system begins to fill, then close the bleeder valves. To get all the air out of the brake system, you'll have to have a friend pump up and hold the brakes until the lines are pressurized, then you will crack open the bleeder valve for a moment to release the air. Reclose the valve quickly though, to avoid allowing air back into the system. Repeat the "PUMP-HOLD-VALVE OPEN-VALVE CLOSE" until there is no air visible in the Nylaflo lines and the brakes feel normal. Remember to refill the reservoir as the fluid fills the lines and master cylinders. It is hard to get every little air bubble out of the lines, but this is normal and should not affect brake performance if kept to a minimum.



**LANCAIR® IV**

23-34

Chapter 23

REV.

0 / 12-9-93

**Brake System / Rudder Controls**

