

CHAPTER 17

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
17-1	P8	R&R	Step G added.
17-2	P1	None	
17-3	PB14	R&R	Edited parts list.
17-4 thru 17-7	P1	None	
17-8	PB18	R&R	Redrew figure.
17-9	P8	R&R	Step A10 Revised.
17-10 & 17-11	PB15	R&R	Added instructions.
17-12 & 17-13	PB15	R&R	Redistributed text and figures.
17-14 thru 17-17	P1	None	
17-18	P3	R&R	Added NOTE after Fig. 17:B:4
17-19 thru 17-29	P1	None	
17-30 thru 17-32	PB17	R	Pages are deleted.
17-33	P1	None	
17-34 thru 17-37	P3	R&R	Added Section G (Aileron stops).

LANCAIR® IV

17-i

Chapter 17 REV. PB18/7-15-98

Aileron Controls

CHAPTER 17

(PRESSURIZED VERSION)

AILERON CONTROLS



REVISIONS

From time to time, revisions to this assembly manual may be deemed necessary. When such revisions are made, immediately replace all outdated pages with the revised pages.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. INBOARD AILERON BELL CRANKS
 - B. AILERON TORQUE TUBES
 - C. AILERON PUSHROD COMPLETION
 - D. CONTROL STICK INSTALLATION
 - E. AILERON STOPS
4. PHOTO PAGES



17-1

Chapter 17

REV. FB18/7-15-98

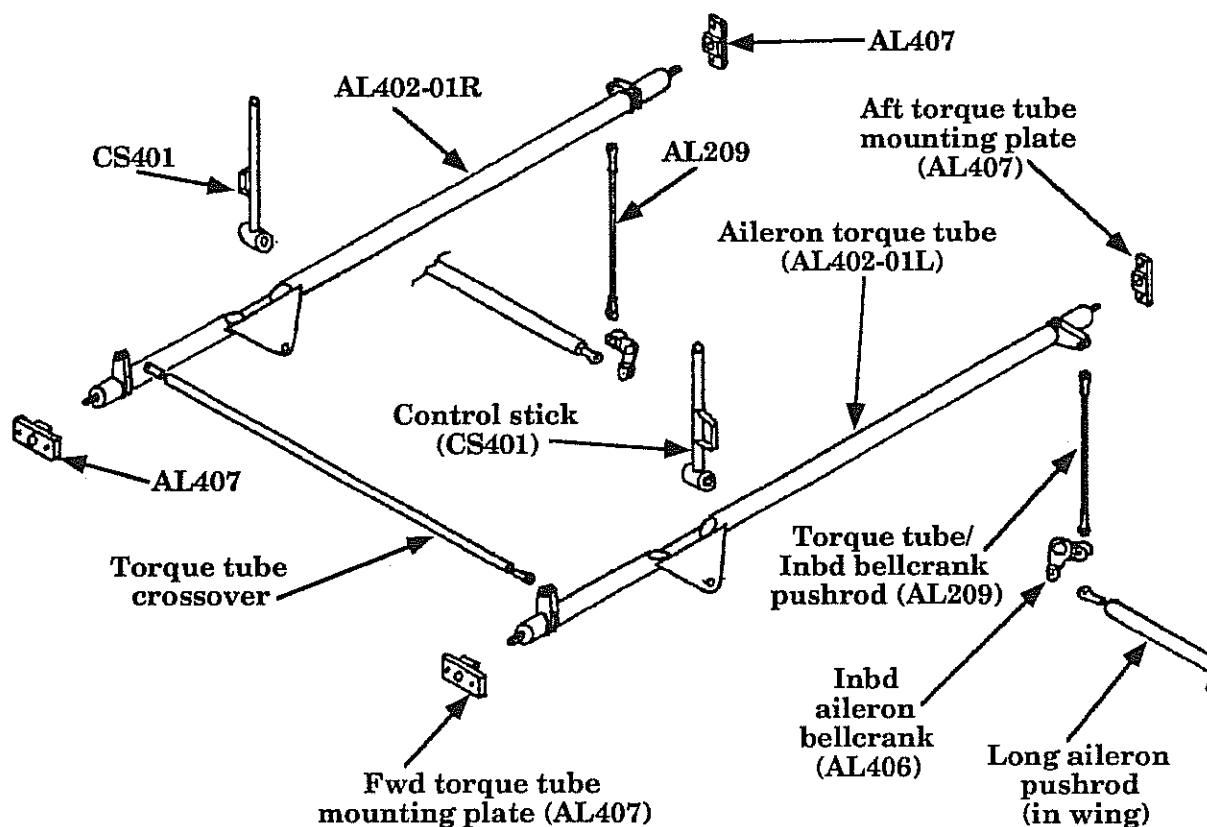
AILERON CONTROLS

1. INTRODUCTION

This chapter deals with the completion of the aileron control system. The remaining aileron control hardware is installed inside the fuselage.

Aileron control system (in fuselage)

Figure 17:i:1



2. SPECIAL PARTS, TOOLS, AND SUPPLIES LIST

A. PARTS

Left wing assembly
Right wing assembly
Fuselage
3 BID prepreg panel
1/4" thick phenolic
2 - Inboard aileron bellcranks
1 - Aileron torque tube (left)
1 - Aileron torque tube (right)
2 - 5/16" dia. x 10" long pushrods
4 - Torque tube mounting plates
2 - Control sticks
2 - Control stick bushings (plastic)



17-3

Chapter 17

REV. PB14/8-26-96

AILERON CONTROLS

B. TOOLS

Tube cutter
Drill motor
Drills
Deburring tool
Rivet squeezer (or rivet gun)
Dremel tool



17-4

Chapter 17

REV.

P1/ 9-28-93

AILERON CONTROLS (Pressurized)



C. SUPPLIES

Paint brushes

MC

Fiberglass

Epoxy

Micro

Flox

Paper towels

40 grit sandpaper

Mixing sticks

Mixing cups



LANCAIR® IV

17-5

Chapter 17

REV.

P1/ 9-28-93

AILERON CONTROLS (Pressurized)



3. CONSTRUCTION PROCEDURE

A. INBOARD AILERON BELLCRANK

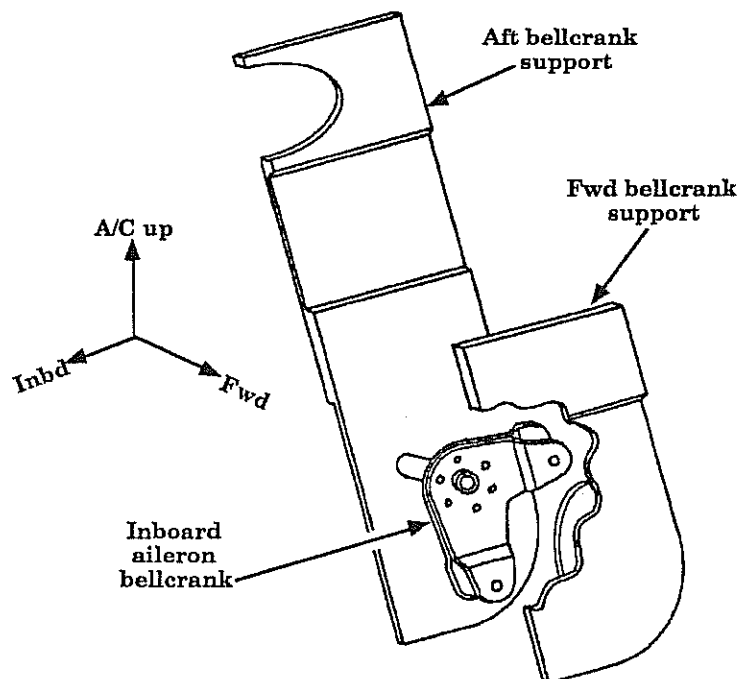
As the long aileron pushrod enters the fuselage, it connects to the inboard aileron bellcrank. The inboard bellcrank is a pre-assembled item, like the outboard bellcrank (mounted to the BL 114 rib).

NOTE: For the pressurized Lancair IV, the bottoms of the bellcrank supports are slightly modified. The modifications are shown in Section F of this chapter. The drawings in this section all show the unmodified supports, so keep this in mind. You'll probably want to incorporate the modified support shape before bonding the supports into the fuselage. If you have already bonded unmodified supports into the fuselage, it is easy to trim them in place.

NOTE: Depending on the date your fuselage was shipped, you may or may not have to add a 6 BID carbon fiber laminate to the inside of the fuselage under the cabin door area. Read Section E of this chapter before continuing. If you have to add the carbon fiber reinforcement, it is easier to apply the laminate **BEFORE** the bellcrank supports are installed.

Inboard aileron bellcrank

Figure 17:A:1



LANCAIR® IV

17-6

Chapter 17

REV.

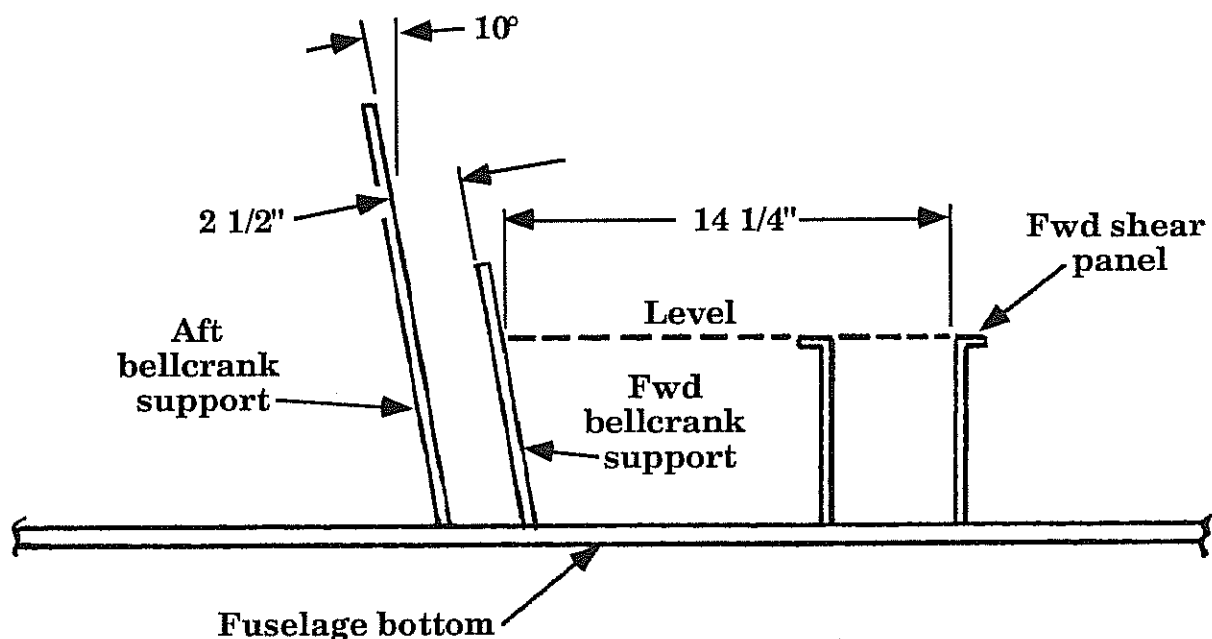
P1/9-28-93

AILERON CONTROLS (Pressurized)

- A1. Insert the long aileron pushrods into the wings and connect them to the outboard (BL 114) bellcranks. The ailerons should also be connected to the outboard bellcranks so you can move both ailerons by pushing and pulling the long pushrods.
- A2. Slide the wings into the fuselage. To do this, you will have to grind out a hole in both fuselage sides for the long aileron pushrods. The pushrod should be centered in the 2" diameter BL 25.5 rib hole. Start with a small fuselage transit hole to see that you are properly centered on the pushrod. Then slowly expand the hole to a slightly oblong shape, 2 1/2" high by 2 1/4" wide. Complete the wing installation by sliding the wing bolts through the bushings and resting the rear spar on the wood locating block.
- A3. Each inboard aileron bellcrank is mounted to two supports, one forward, one aft. The forward bellcrank support is shorter than the aft. Use the templates on Blueprint A-252 to cut the supports from the 3 ply per side prepreg panel.
- A4. Position and fit the bellcrank supports as shown in Figure 17:A:2.

Bellcrank support locations

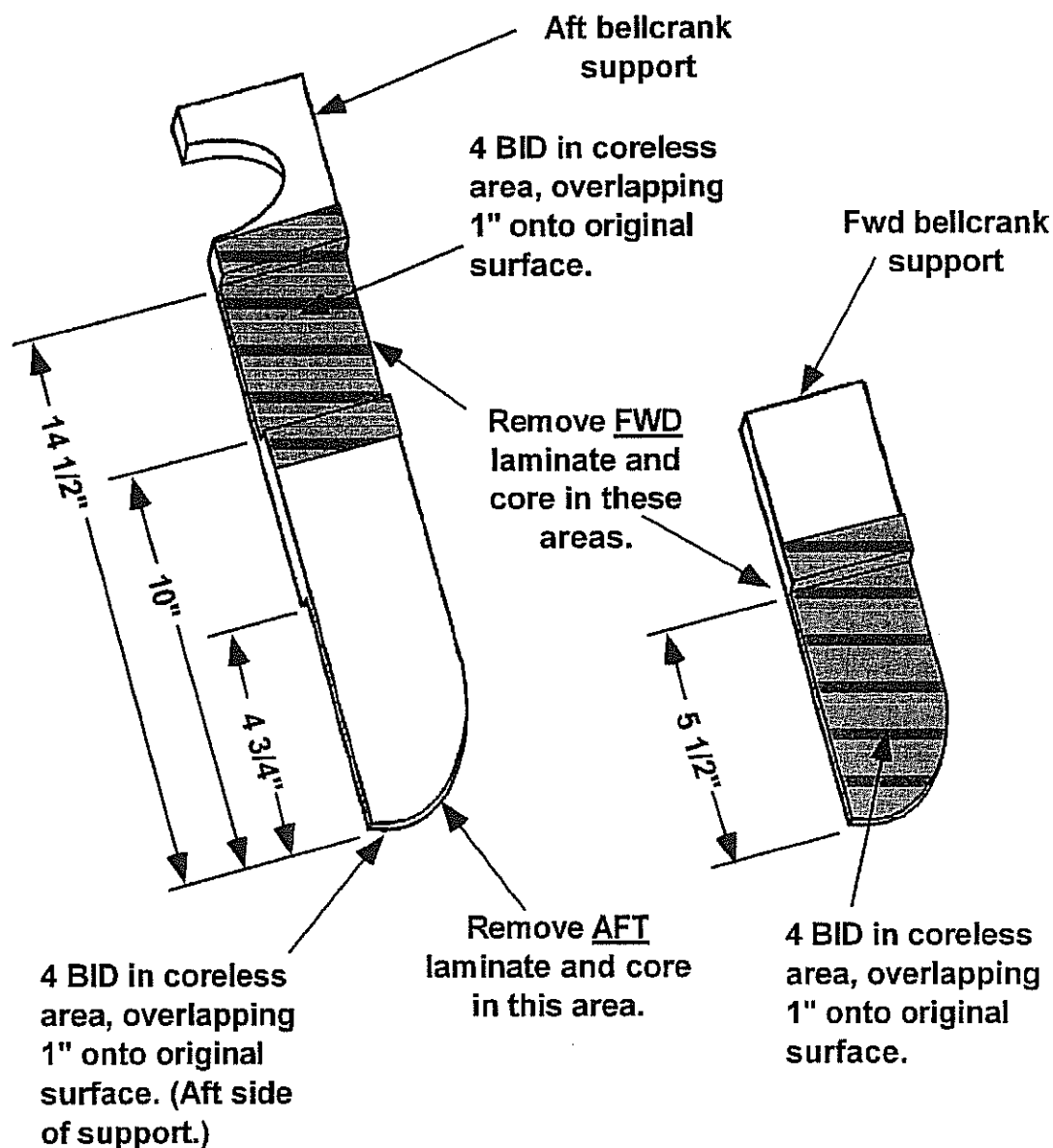
Figure 17:A:2



- A5. Remove the core from the bellcrank supports as shown in Figure 17:A:3.
- A6. Reinforce the coreless areas of the bellcrank supports with 4 BID, overlapping 1" onto the original laminates.

Coreless Areas of Bellcrank Supports

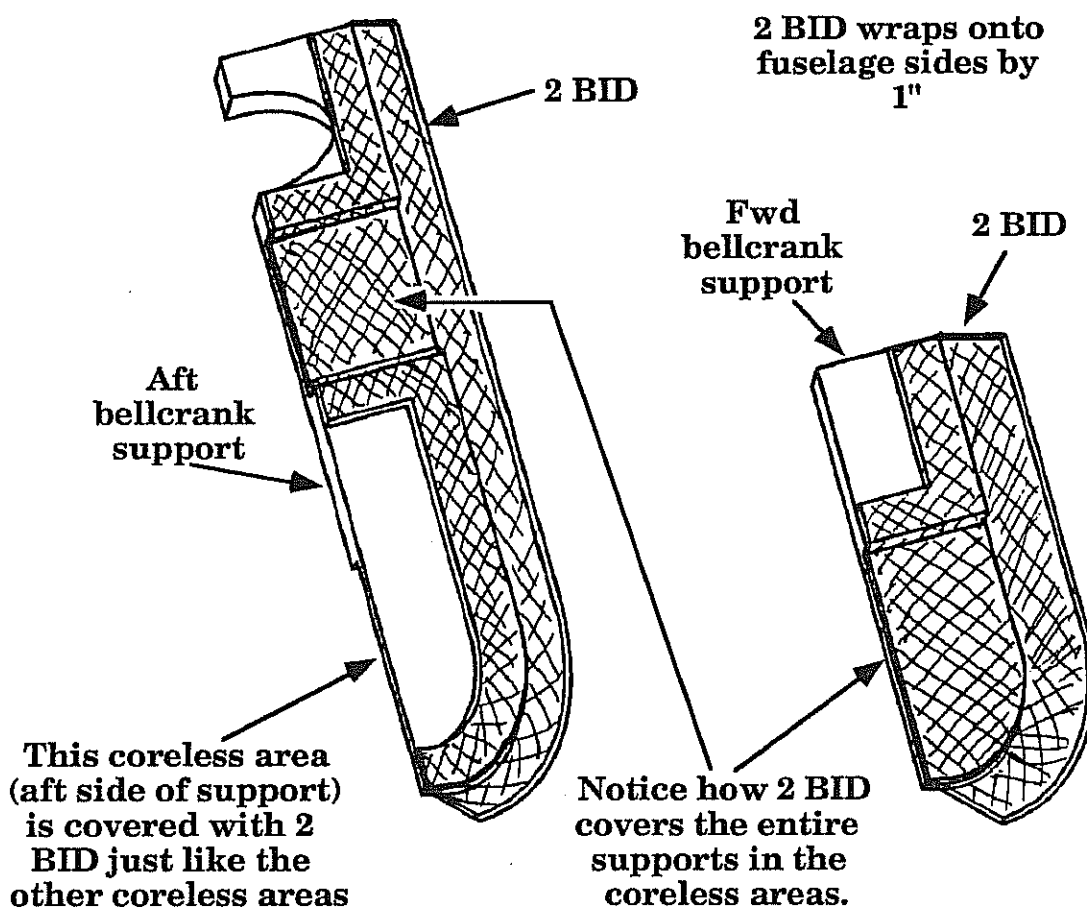
Figure 17:A:3



- A7. Form a 1/8 - 1/4" deep trough in the core of the bellcrank supports where they will be bonded to the fuselage sides.
- A8. With 40 grit, sand the areas of the fuselage sides where the bellcrank supports will be located. Clean these areas with MC.
- A9. Bond the bellcrank supports to the fuselage sides with a thick epoxy/micro mixture.
- A10. Secure the bellcrank supports to the fuselage with 2 BID as shown in Figure 17:A:4. Cover the entire faces of the bellcrank supports with the 2 BID in the coreless areas and overlap onto the fuselage sides 1".

Securing bellcrank supports to fuselage sides

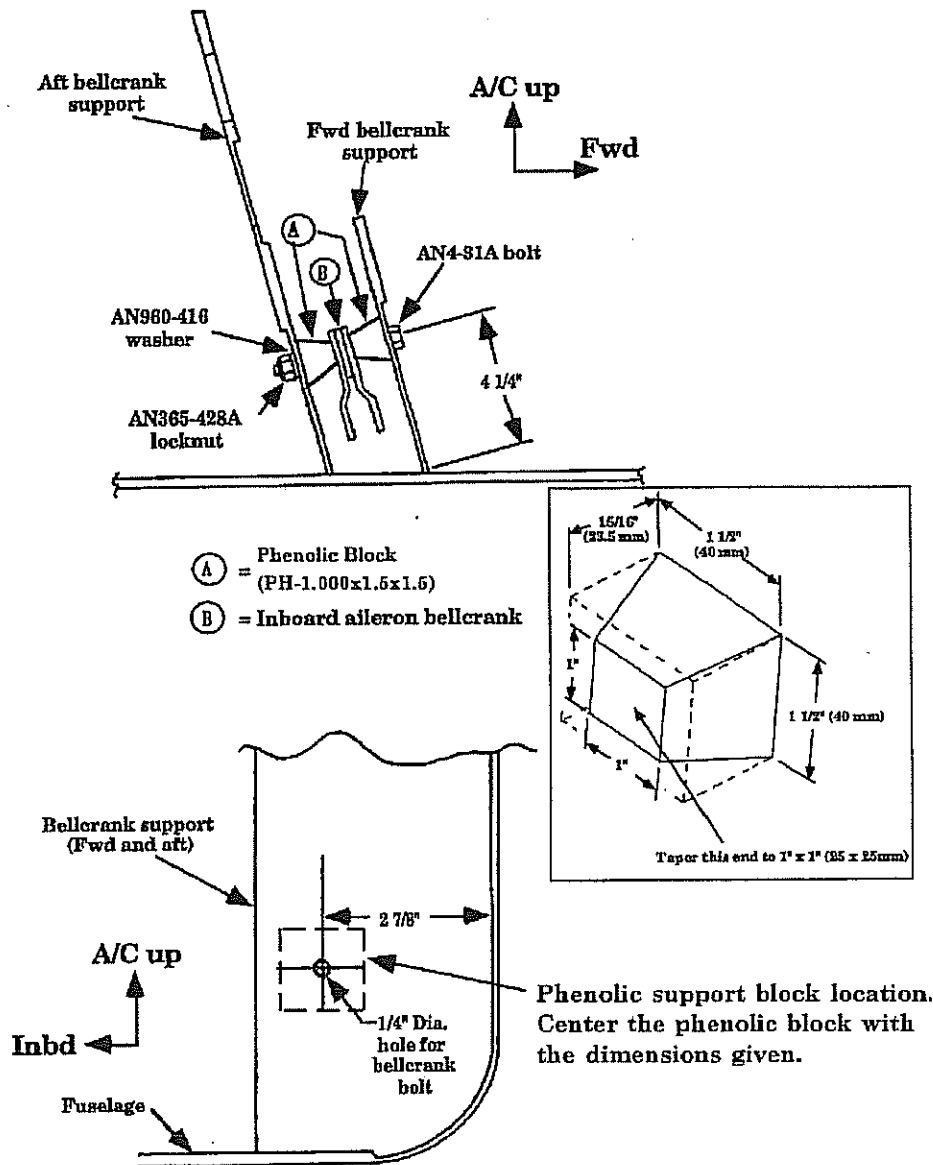
Figure 17:A:4



- A11. Align the inboard aileron bellcrank as shown in Figure 17:A:5. Find the center of the phenolic blocks and align by drilling 1/4" diameter holes through the blocks, and the bellcrank supports for the bellcrank mounting bolts. The holes should be drilled perpendicular to the bellcrank supports.

Installing the Inboard Aileron Bellcranks

Figure 17:A:5



NOTE: If the bellcranks have already been installed, previous instructions are acceptable. This is not a mandatory change.

LANCAIR® IV

17-10

Chapter 17

REV. PB15/11-29-96

AILERON CONTROLS

1. Prepare the phenolic block and the bellcrank support for the bonding of the block. Clean with MC.
2. Bond the aft support block to the aft bellcrank support 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. Prepare the forward phenolic block and the forward bellcrank support.
4. Align the forward support block with the block already bonded on the bulk-head support. One easy method of aligning the block is to drill a 1/4" hole through the center of the forward phenolic block and through the forward bellcrank support. Slide the AN4-31A bolt through the phenolic blocks and through the forward bellcrank support.
5. Bond the forward support block to the forward bellcrank support with Hysol. Clamp the support in place during bonding.
6. Reinforce the support blocks with 2 BID.

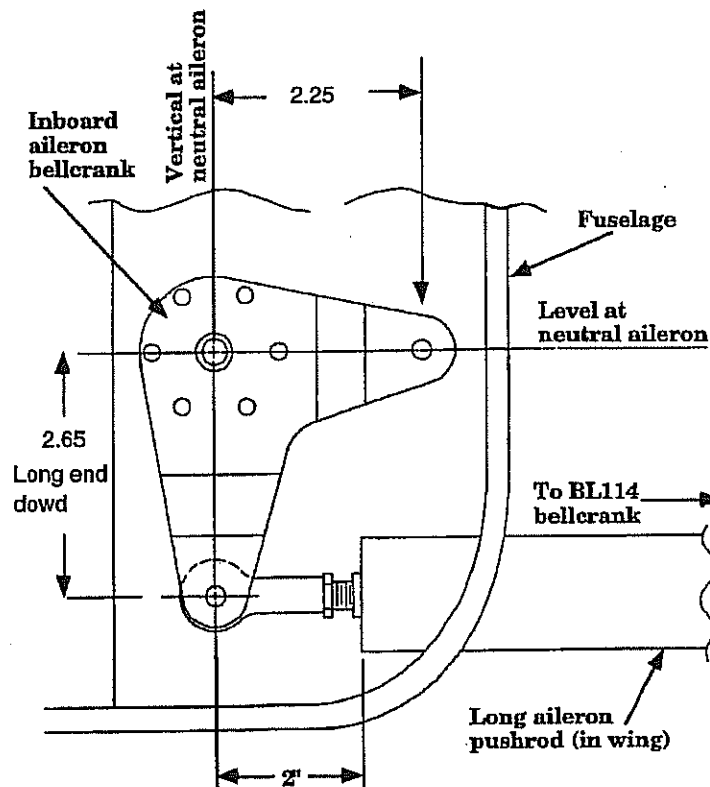
A12. Mount the bellcranks using AN4-31A bolts, AN960-416 washers, and AN365-428A nuts. Be sure the phenolic blocks are preventing the bolts from squeezing the supports together.

A13. Now that the inboard bellcrank has been located, determine the final length of the long aileron pushrod. Rotate the bellcranks so the top two holes are horizontal as shown in Figure 17:A:6. The long aileron pushrod should be cut so its inboard end is 2" from the center of the mounting hole. This will allow enough room for the rod end insert and bearing. Be sure that the aileron is in the neutral position and the other rod end bearings in the wing are all threaded past their safety inspection holes.

NOTE: Cutting the long aileron pushrods to length will require removal of the wings. We know this is a lot of work for just two cuts, but finding the proper length of the long aileron pushrod is an important step for proper aileron set up.

Finding the Length of the Long Aileron Pushrod

Figure 17:A:6

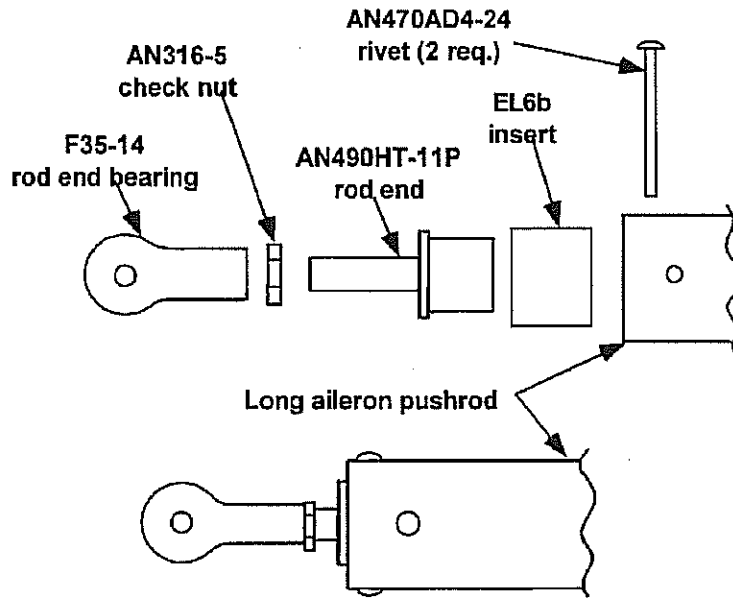


Cut long aileron pushrod 2" short of the inboard bellcrank bolt hole to provide enough clearance for rod end bearing.

- A14. While the wing is removed for cutting the long aileron pushrod to length, this is a good time to install the EL6b aluminum insert and AN490HT-11P rod end. Refer back to Chapter 8 (section K) and "Rod End Hints" in Chapter 7 (Section K) for more hints on drilling and installing the rod end and aluminum insert.

Installing Rod End and Aluminum Insert

Figure 17:A:7

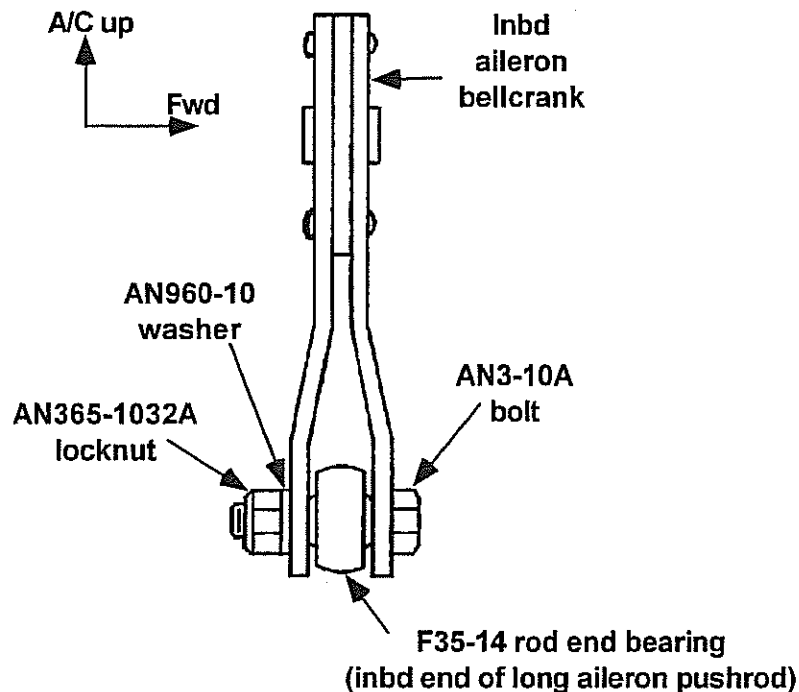


A15. Reinstall the wings to the fuselage.

A16. The long aileron pushrod is connected to the inboard bellcrank with an AN3-10A bolt, AN365-1032A locknut, and AN960-10 washer.

Connecting Pushrod to the Inboard Bellcrank

Figure 17:A:8



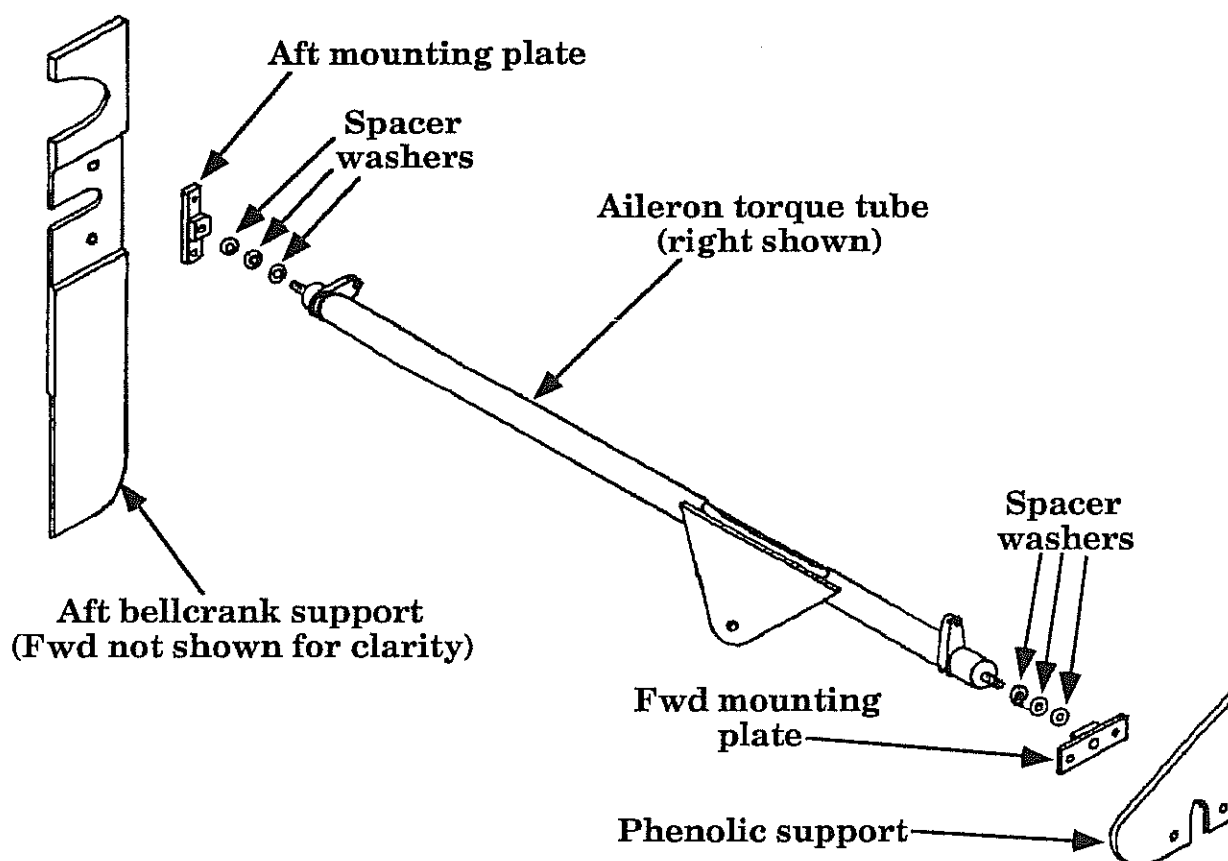
B. AILERON TORQUE TUBES

The aileron torque tubes are mounted on each side of the fuselage under the armrests. They transfer the control stick movement (left and right) to the inboard aileron bellcrank.

NOTE: In this section, the instructions will describe installation of one aileron torque tube. There are, of course, two torque tubes, and both left and right torque tubes are installed in the same manner.

Aileron torque tube

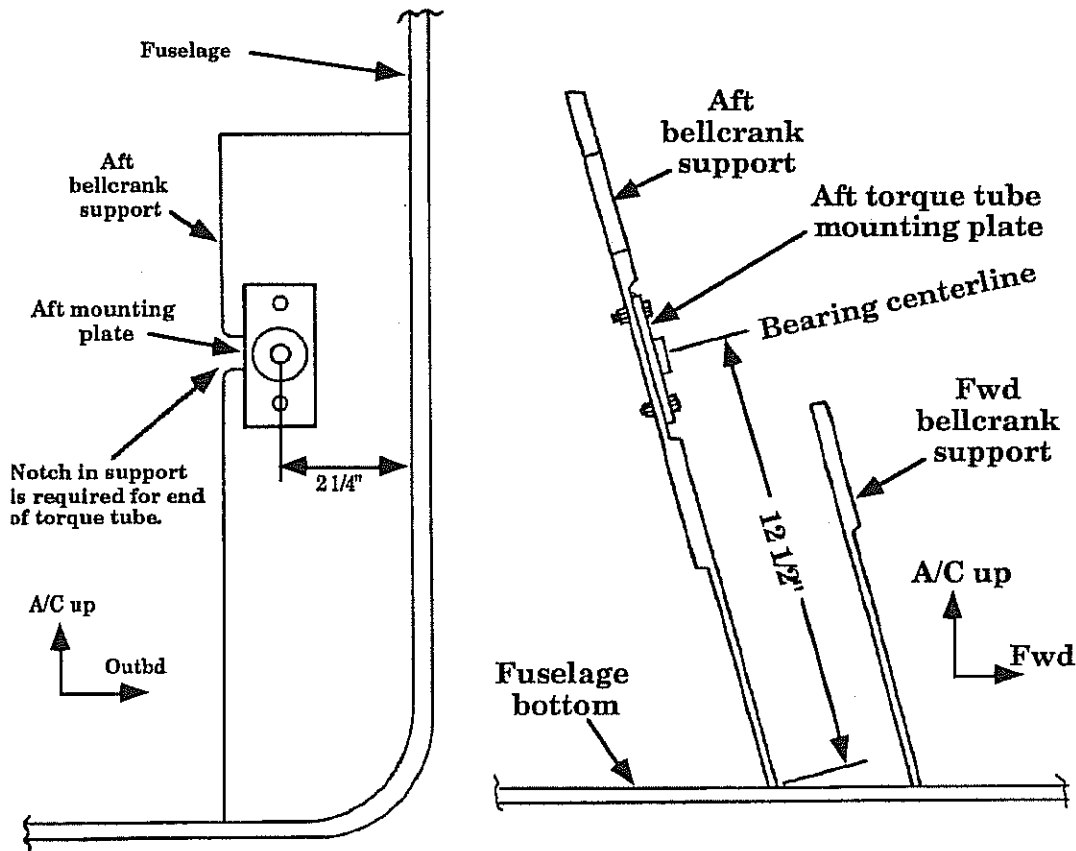
Figure 17:B:1



- B1. Position the aft torque tube mounting plate on the aft bellcrank support as shown in Figure 17:B:2.
- B2. Use the holes in the aft torque tube mounting plate as guides to drill #12 holes through the aft bellcrank support.

Aft torque tube mounting plate

Figure 17:B:2

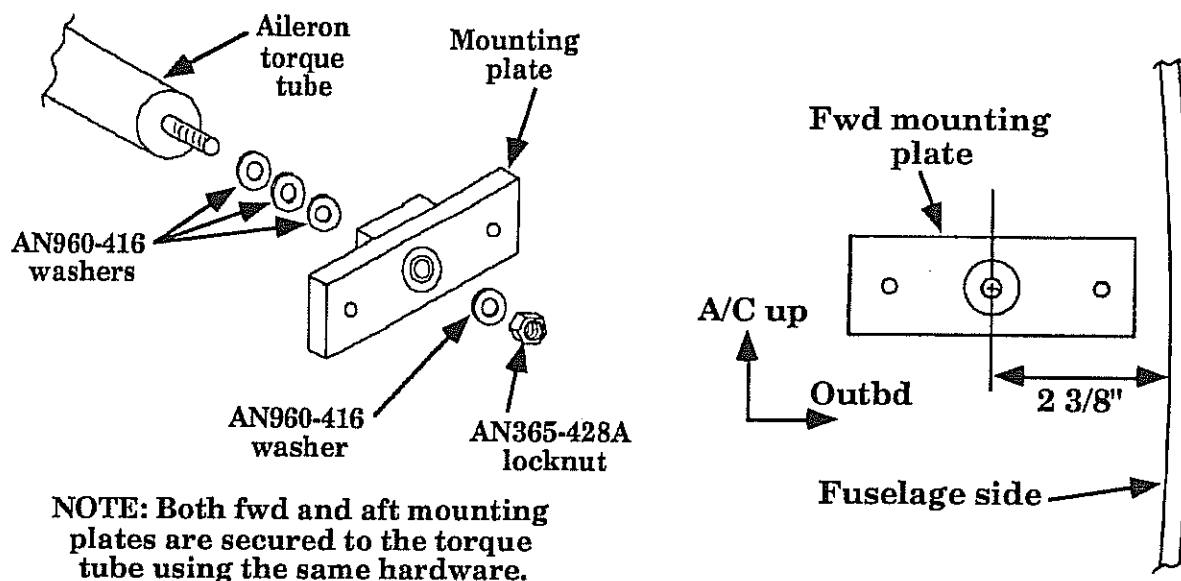
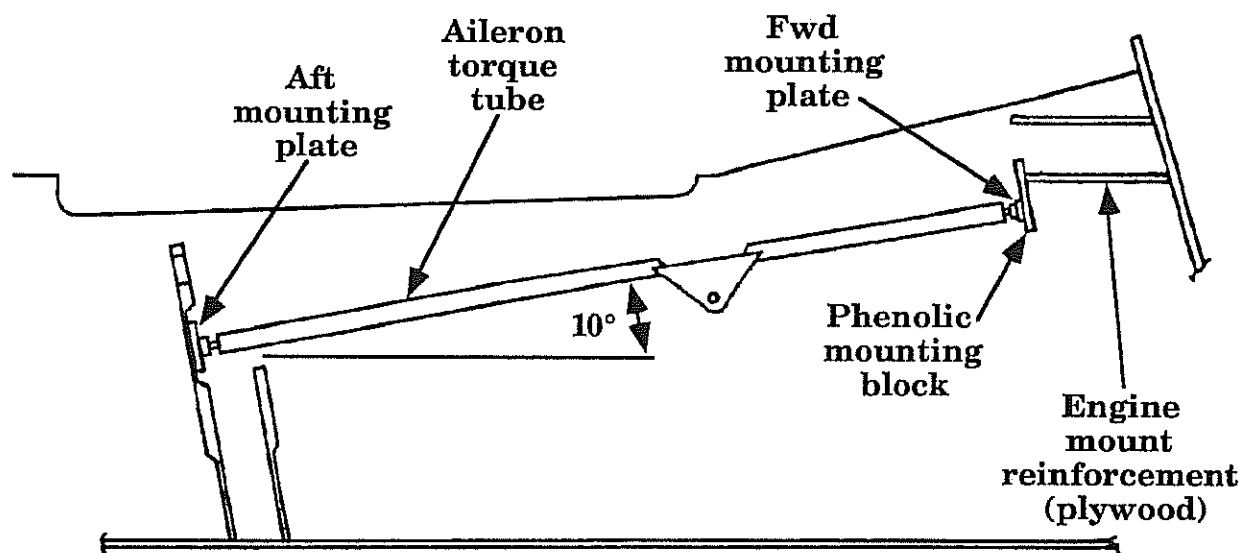


- B3. The aft bellcrank support needs to be notched so the torque tube and aft mounting plate can be slid into position from the inboard edge. It is best to grind a small notch first, then enlarge it as required while you fit the torque tube.

- B4. Secure the aft torque tube mounting plate to the aft bellcrank support with AN3-5A bolts, AN960-10 washers, and AN365-1032A locknuts. Notice that there are three washers between the torque tube and the bearing.

Locating torque tube

Figure 17:B:3



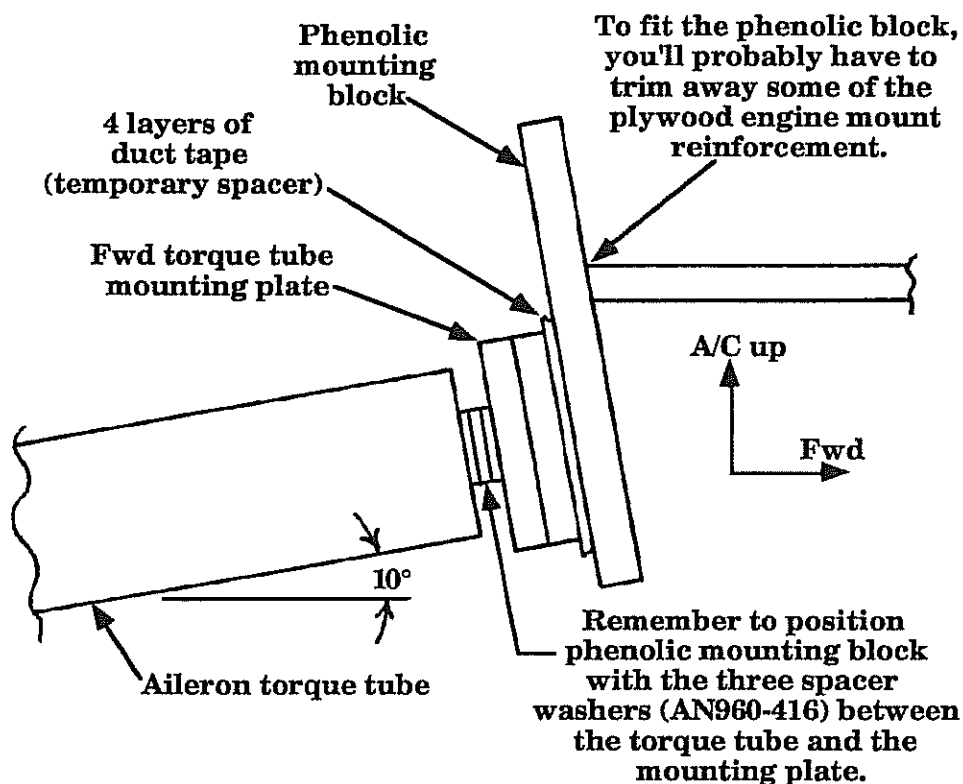
NOTE: Both fwd and aft mounting plates are secured to the torque tube using the same hardware.

- B5. Insert the aft end of the torque tube into the aft mounting plate and secure with an AN365-428A locknut. The forward end of the torque tube should be centered 2 3/8" inboard of the fuselage sides as shown in Figure 17:B:3. The torque tube is angled up 10° (higher forward). When you are satisfied with your torque tube position, use instant glue and a couple wood blocks to temporarily brace it against the fuselage.
- B6. Bolt the forward torque tube mounting plate to the torque tube as shown in Figure 17:B:3.
- B7. Apply four layers of duct tape to the forward side of the forward mounting plate to simulate the thickness of 3 BID. (This is the same spacing method used to locate the elevator and aileron spars.)
- B8. Use the templates on Blueprint A-252 to cut two 1/4" thick phenolic mounting pads. These pads will support the forward end of the torque tubes.
- B9. Fit the phenolic mounting pad to the fuselage side. The phenolic pad should rest flat against the forward mounting plate and 90° to the torque tube. You may have to trim the bottom engine mount plywood angle forward a bit to fit the phenolic pad in position. Be sure to notch the bottom of the phenolic pad so the torque tube and forward mounting plate can be removed. See Figure 17:B:4.



Locating phenolic mounting pad

Figure 17:B:4



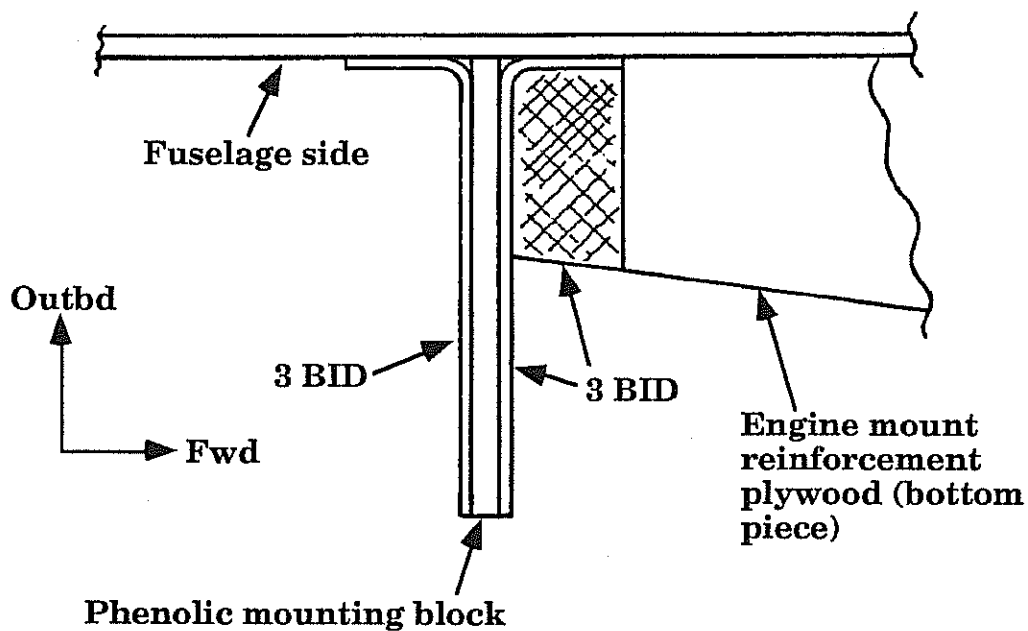
NOTE: The first production run of AL407 aileron torque tube mounting plates had a very tight tolerance around the three AN960-416 spacer washers. To enable the torque tube to twist and for easier alignment, grind down a special set of washers to about .470" diameter for use in these areas. Save the washers by taping them to the torque tube when not installed. Later AL407 mounting plates have a larger hole on the torque tube side of the bearing, so modified washers will not be required.

- B10. Sand both sides of the phenolic mounting pad with 40 grit. Also sand the area of the fuselage side where the mounting pad will be bonded. Clean these areas with MC.
- B11. Bond the phenolic mounting pad to the fuselage side with a thick epoxy/flox mixture.
- B12. After the flox has cured, remove the torque tube from the fuselage. If possible, try not to break your temporary wood locating block loose because you'll need to reposition the torque tube for drilling the mounting plate. Remove the four layers of duct tape from the mounting plate.

- B13. Secure the phenolic mounting pad to the fuselage with 3 BID covering both sides of the pad and overlapping 1 1/2" onto the fuselage. Also overlap the 3 BID onto the plywood reinforcement that butts against the forward face of the phenolic.

Securing phenolic pad to fuselage

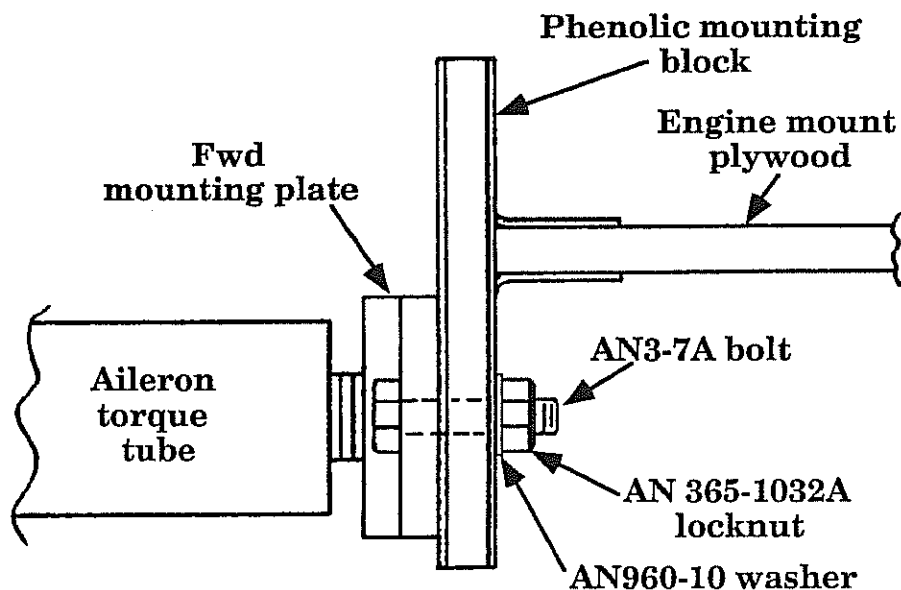
Figure 17:B:5



- B14. Reposition the torque tube and its mounting plates in the fuselage. Secure the aft mounting plate with the correct hardware. When the torque tube is positioned, is there a gap between the forward mounting plate and the phenolic block? If there is, you must fill the gap with an epoxy/flox shim. If the fit is too tight, try removing one of the spacer washers between the torque tube and forward mounting plate. You can also replace one of these washers with a thin one (AN960-416L) if needed.
- B15. Use the holes in the forward mounting plate as guides to drill two #12 holes through the phenolic mounting pad.
- B16. Secure the forward mounting plate to the phenolic pad using AN3-7A bolts, AN960-10 washers, and AN365-1032A locknuts.

Securing forward mounting plate

Figure 17:B:6

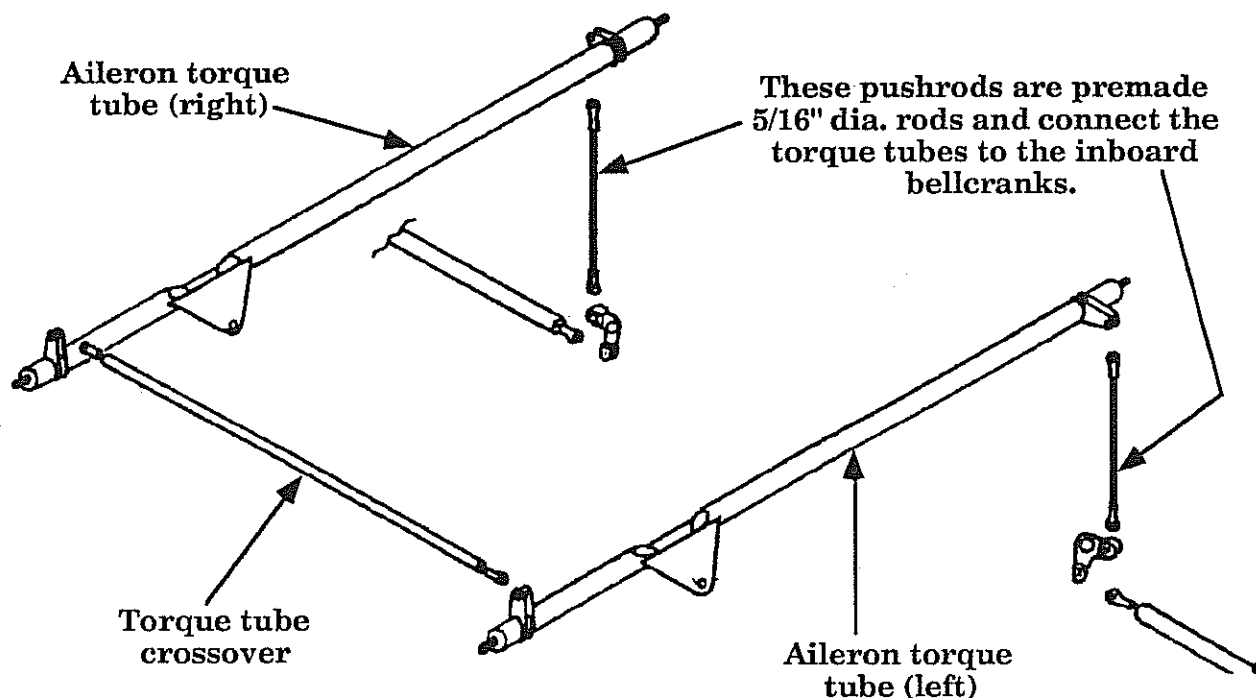


C. AILERON PUSHROD COMPLETION

Three more pushrods are needed to complete the aileron control system. Two of these pushrods are identical and connect the torque tubes to the inboard aileron bellcranks. These are premade, 5/16" diameter pushrods. The last pushrod is assembled from aluminum tubing and rod ends. It connects the two aileron torque tubes and allows both control sticks to work as one.

Aileron pushrods (inside fuselage)

Figure 17:C:1



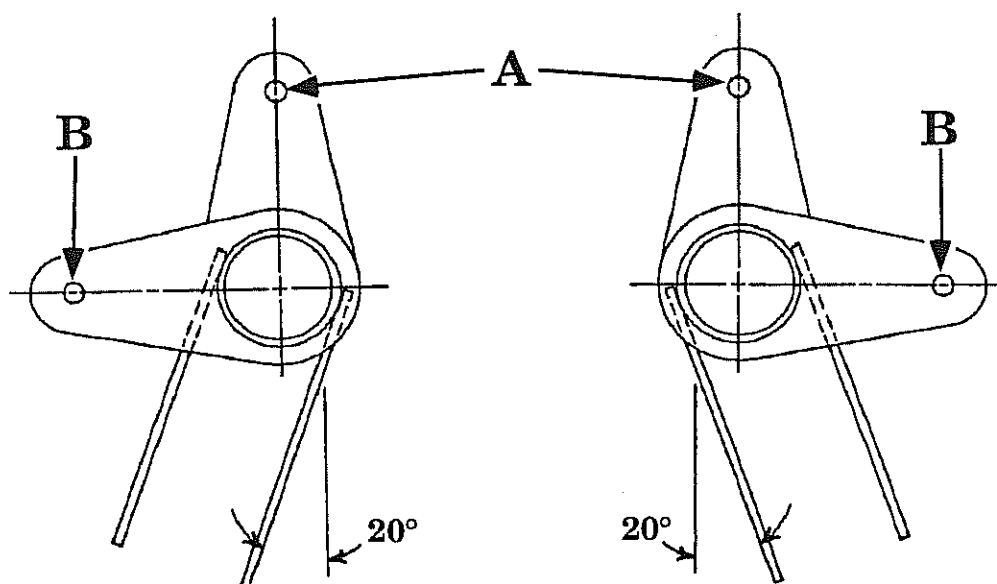
- C1. Install the aileron torque tubes and connect the long aileron pushrods to the inboard bellcranks. Be sure the ailerons and the inboard bellcranks are in the neutral position.

C2. Brace the aileron torque tubes in the neutral position as shown in Figure 17:C:2.

Aileron torque tubes in neutral position

Figure 17:C:2

Aileron torque tubes in neutral aileron position.



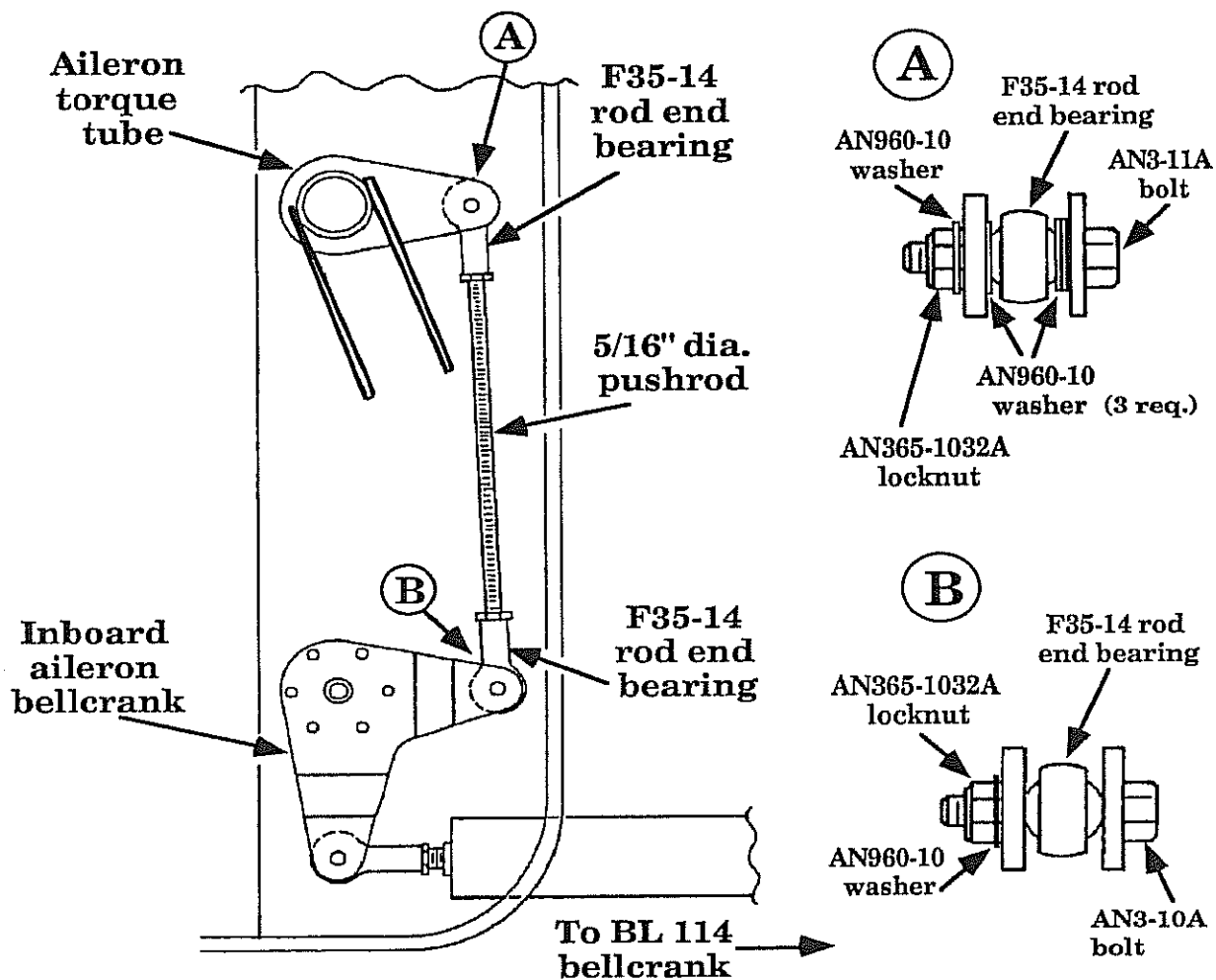
*Torque tube crossover connects the vertical (fwd) forks of the two tubes at points "A".

*Horizontal forks (aft) connect to the inboard bellcranks at points "B".

- C3. As shown in Figure 17:C:3, assemble the two pushrods that connect the torque tubes to the inboard bellcranks.
- C4. Bolt the pushrods to the torque tubes using AN3-11A bolts, AN365-1032A locknuts, AN960-10 washers. Use AN3-10A bolts to secure the pushrods to the inboard bellcranks.

Connecting torque tubes to bellcranks

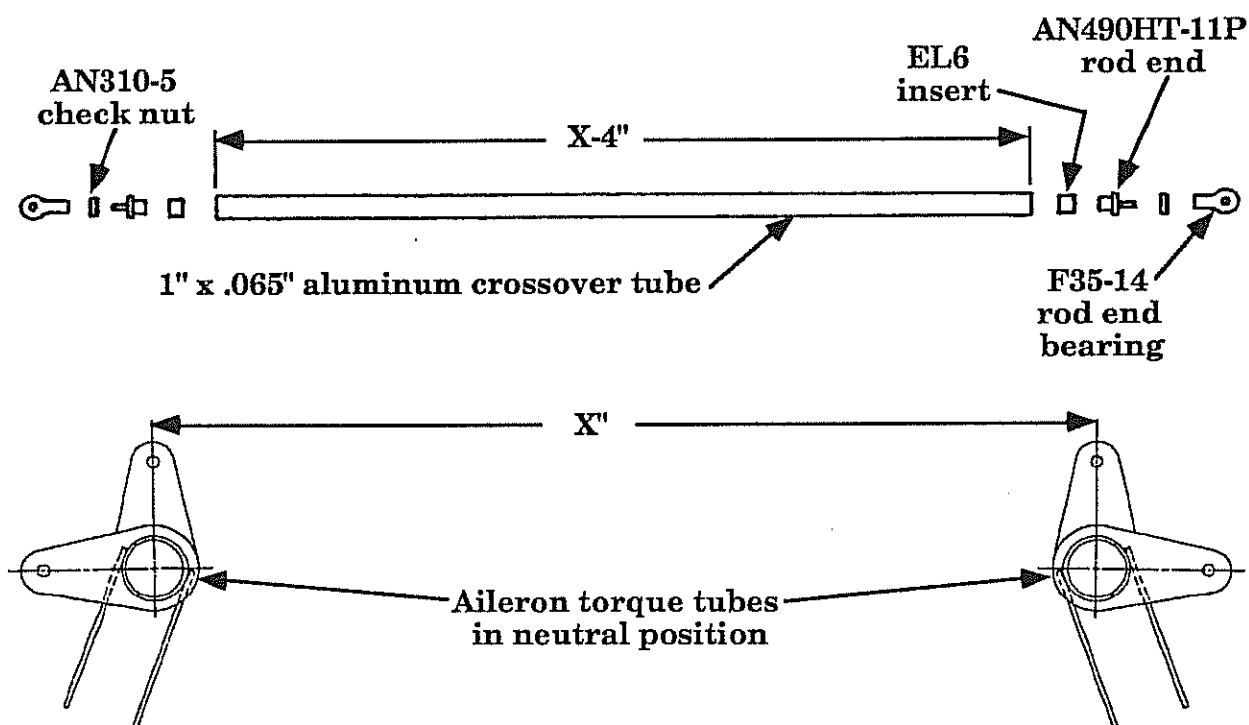
Figure 17:C:3



- C5. Measure the distance between the torque tube forks where the crossover tube will be installed. Measure from hole center to hole center. Subtract 4" from this distance and cut a 1" dia., .065" wall aluminum tube to that length. (For example, if the distance between the hole centers is 42", then cut the aluminum tube to 38".)
- C6. Slide EL6 inserts and AN490HT-11P rod ends into both ends of the aluminum crossover tube and rivet them in place with AN470AD4-20 rivets. Again, refer to the previous sections dealing with pushrod construction for more info on riveting, deburring, etc..

Torque tube crossover

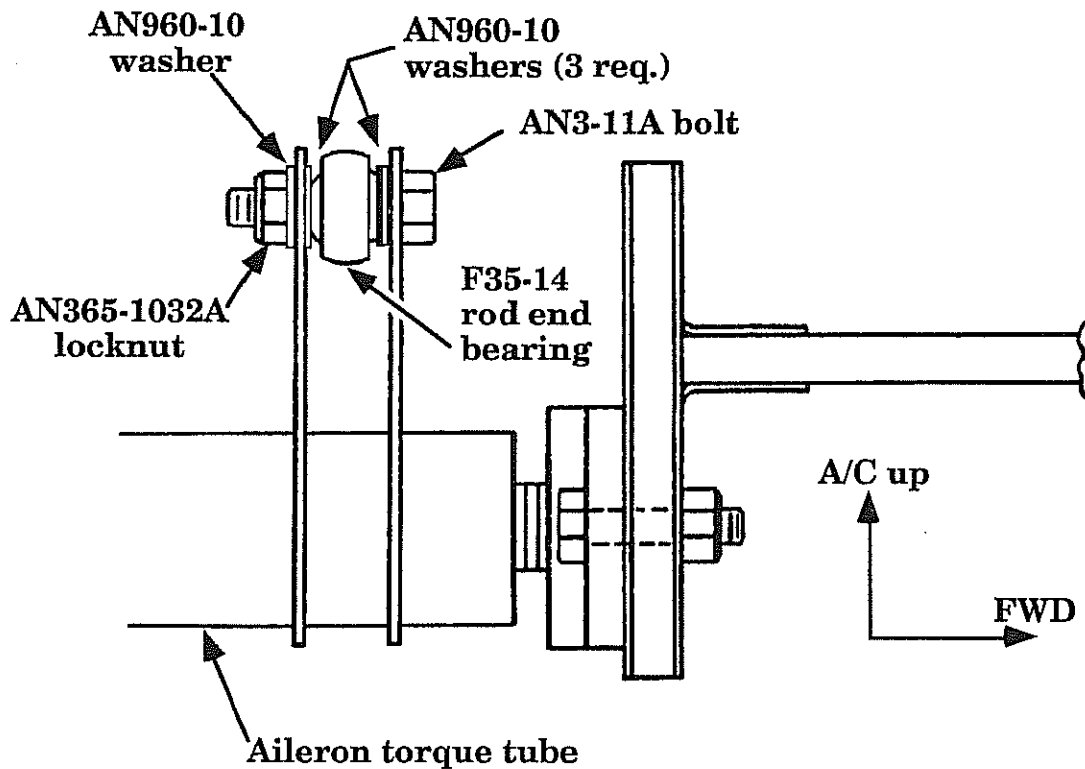
Figure 17:C:4



- C7. Bolt the crossover tube to the torque tubes with AN3-11A bolts, AN365-1032A locknuts, and AN960-10 washers.

Securing crossover to torque tubes

Figure 17:C:5

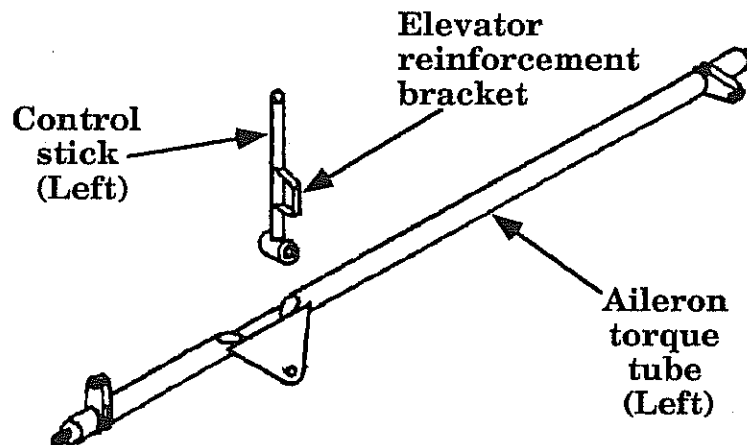


D. CONTROL STICK INSTALLATION

Although the control sticks are not needed at this time, you can go ahead and install them just to say your aileron control system is complete. Like the aileron torque tubes and bellcranks, both control sticks are installed in the same manner.

Control sticks

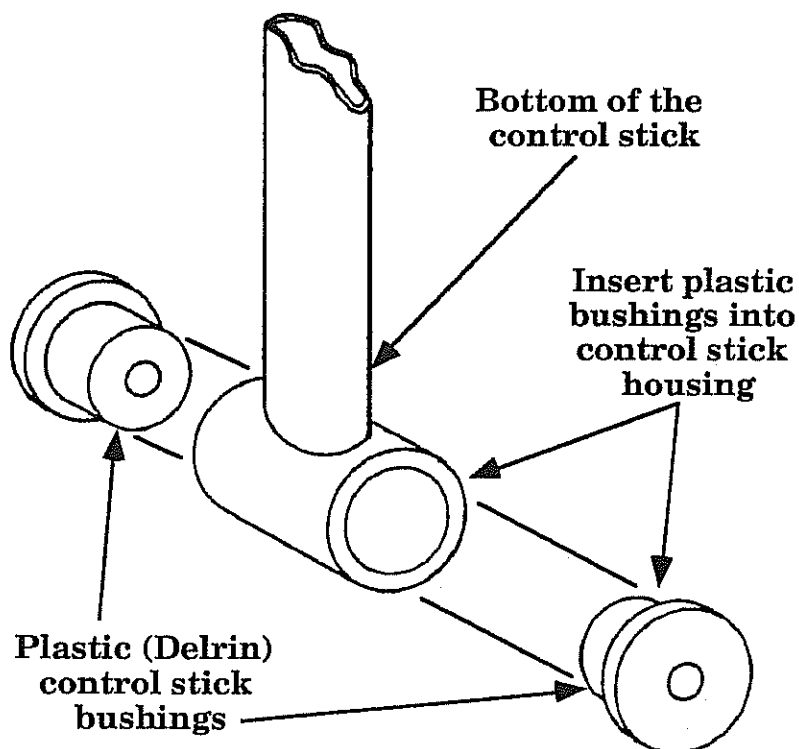
Figure 17:D:1



- D1. Insert the plastic bushings into the large, bottom hole of the control sticks.

Nylon control stick bushing

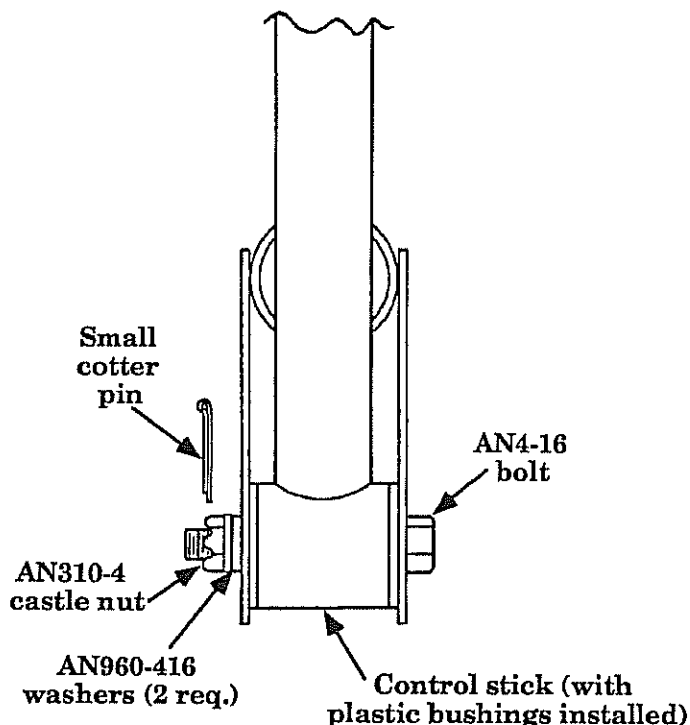
Figure 17:D:2



- D2. Place the control sticks into the aileron torque tube as shown in Figure 17:D:3. The elevator reinforcement brackets should be on the outboard side of both control sticks.

Installing control sticks

Figure 17:D:3



NOTE: Tighten castle nut only until there is no slop in the stick. Tightening too much will prevent easy elevator movement.

- D3. Secure the control sticks to the torque tubes with AN4-16 bolts, AN960-416 washers, AN310-4 castle nuts, and small cotter pins. Tighten the castle nuts until there is no slop in the sticks, but they can be easily moved without binding. You may want to hold off on inserting the cotter pins until later in construction because you'll probably remove and install the sticks a few times. Remember though, secure the castle nuts with the cotter pins **before the first flight**.

Okay, go ahead and move the control stick and watch as one aileron goes up and the other goes down. It's amazing how this simple function can keep a builder entertained for hours. Enjoy.

E. FUSELAGE SIDE REINFORCEMENT

NOTE: The procedures in this section apply to earlier model Lancair IV pressurized fuselages only. If the small section of core material shown in Figure 17:E:1 has already been removed at the factory, you have a later model fuselage and do not need to add the 6 ply carbon fiber reinforcement (as this has also been done for you at the factory).

For the pressurized Lancair IV, a 6 BID carbon fiber reinforcement is required to stabilize the fuselage side in the cabin door area. A small section of core material must also be removed from the fuselage side to accomodate the gear box corner bracket (see Chapter 19). As noted in Section A, this layup is easier if you do it before installing the inboard aileron bellcrank mounts, but if you have already installed these pieces, the inconvenience is minor. Simply slice the carbon fiber laminates to fit around the bellcrank mounts as shown in Figure 17:E:2



17-29

Chapter 17

REV.

P1/ 9-28-93

AILERON CONTROLS (Pressurized)

This page has been deleted!



17-30

Chapter 17

REV. PB17/10-15-97

AILERON CONTROLS



This page has been deleted!



This page has been deleted!

***LANCAIR*® IV**

17-32

Chapter 17

REV. PB17/10-15-97

AILERON CONTROLS

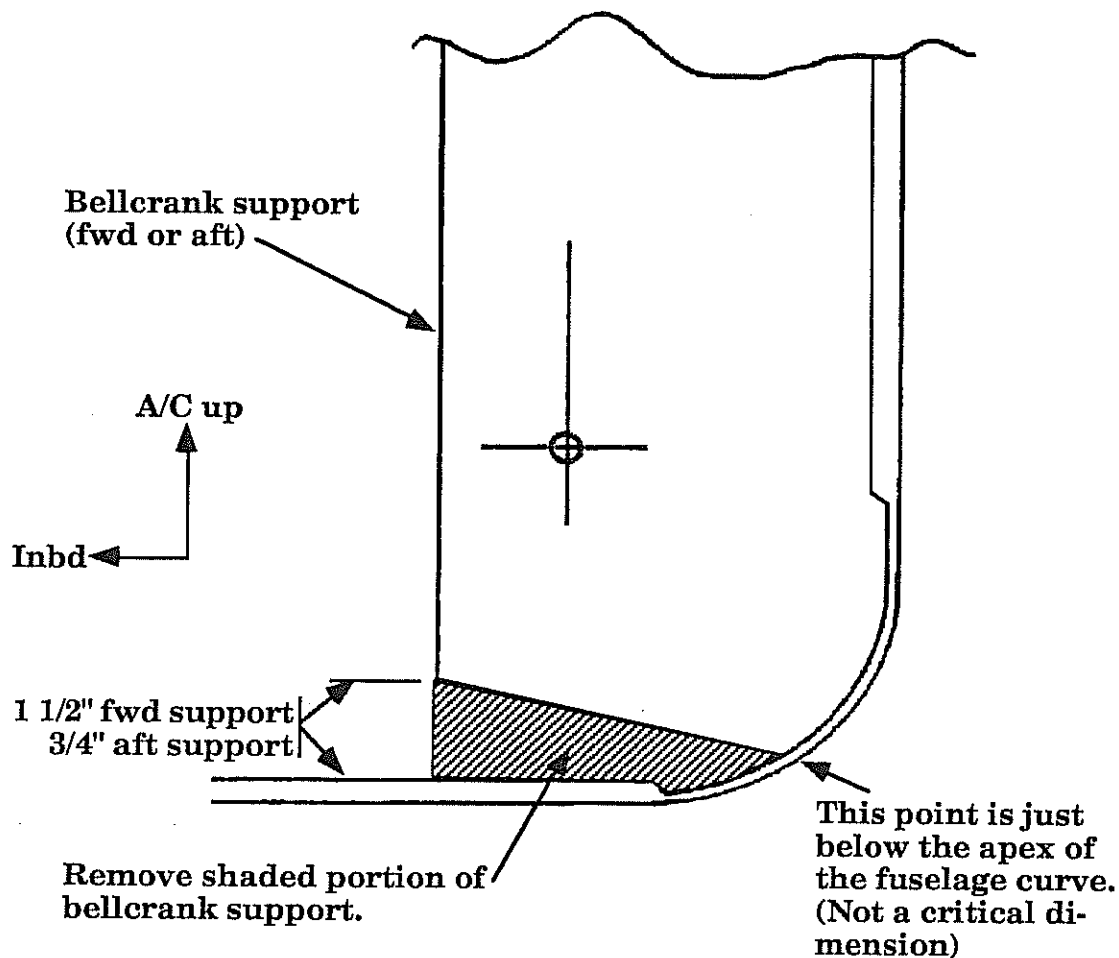
Lancair International Inc., Represented by Neico Aviation Inc., Copyright © 1997, Redmond, OR 97756

F. BELLCRANK SUPPORT MODIFICATIONS

Because of expansion and contraction of the fuselage during the pressurization cycle, the bottoms of the AL406 bellcrank supports must be trimmed to prevent delamination. This can be done quickly and requires no re-glassing.

AL406 bellcrank supports

Figure 17:F:1



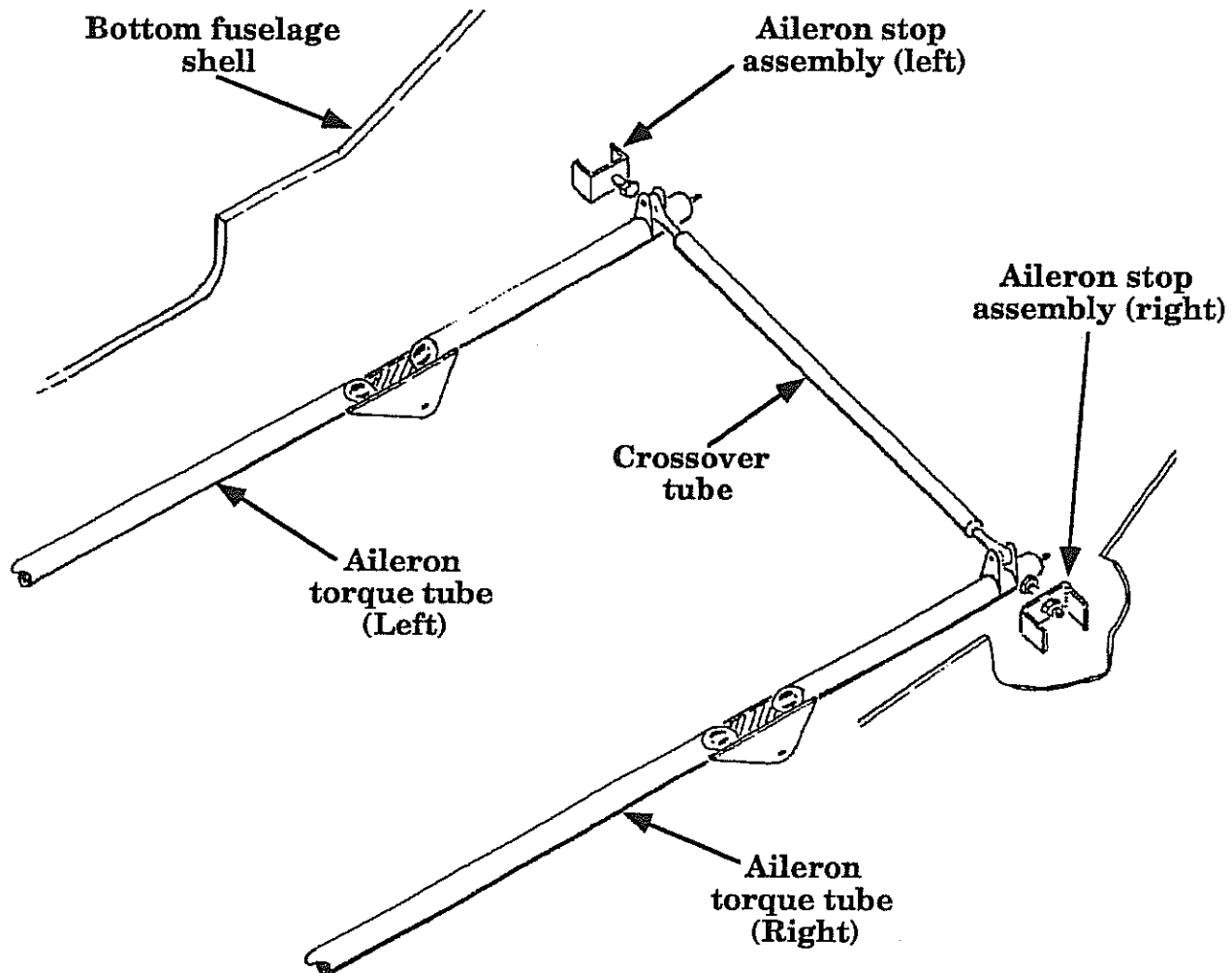
- F1. Trim the forward and aft bellcrank supports as shown in Figure 17:F:1. A Dremel tool with a pointed carbide bit will make fast work of this.
- F2. To provide a finished look to the trimmed supports, remove 1/4" of core from the area you just cut out and fill the trough with micro.

G. AILERON STOPS

The aileron stops are bonded to both sides of the fuselage, fwd of the instrument panel. The torque tube crossover strikes the stops, which are adjustable.

Aileron stops

Figure 17:G:1

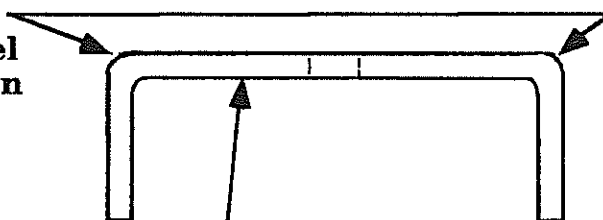


- G1. There are two pieces of aluminum "C" channel, each 1" wide, provided in the kit. Drill a 1/4" D. hole in each piece as shown in Figure 17:G:2.
- G2. Use a file to round the outer corners of the "C" channel pieces as shown in Figure 17:G:2. This will allow fiberglass to be laid over the "C" channel.
- G3. Scuff the outer surface of the "C" channel with 40 grit sandpaper.

"C" channel used for aileron stops

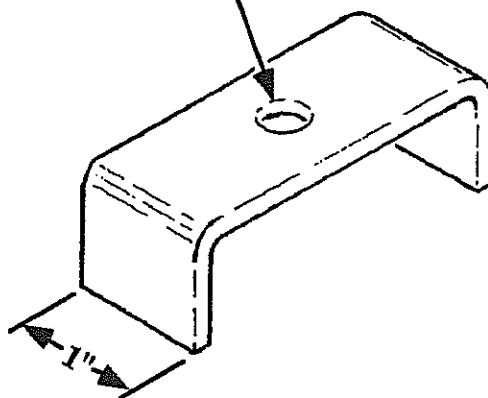
Figure 17:G:2

Round outside corners
of aluminum "C" channel
with a file in preparation
for applying BID.



1 1/4" x 1 5/8" x 1 1/4"
Alum. "C" channel (6061-T6)

1/4" D. hole,
centered on channel

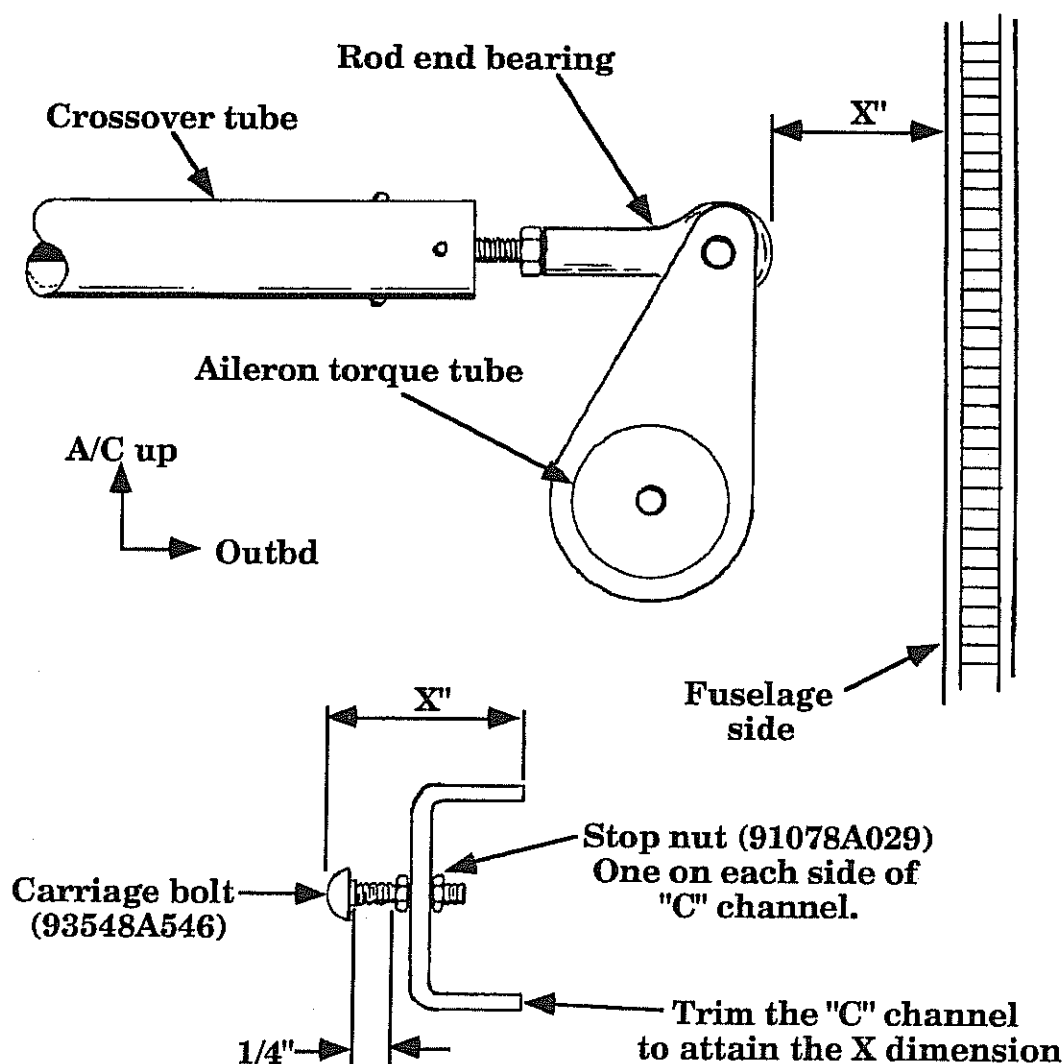


- G4. Install a 1/4-20 carriage bolt (93548A546) into the two 1/4" D. holes you drilled in Step E1. Lock the bolts in position with 1/4-20 stop nuts (91078A029), leaving 1/4" of thread exposed under the head of the bolt for later adjustment. See Figure 17:E:3.

- G5. Adjust the control sticks to a neutral position of 20-21°. The ailerons should be in neutral in this condition. At full aileron throw, the control sticks will move 25° each side of neutral. Do not adjust the sticks to a more vertical position (less than 20°) at neutral because your hand would hit the side of the fuselage before full aileron travel is reached.
- G6. With the control stick at full deflection measure the distance between the ends of the torque tube crossover and the sides of the fuselage. These dimensions, which may be slightly different left and right, will give you the overall length of the aileron stop assemblies. Cut the "C" channel so the aileron stop assemblies match the dimensions, as shown in Figure 17:G:3.

Trimming aileron stop assemblies to length

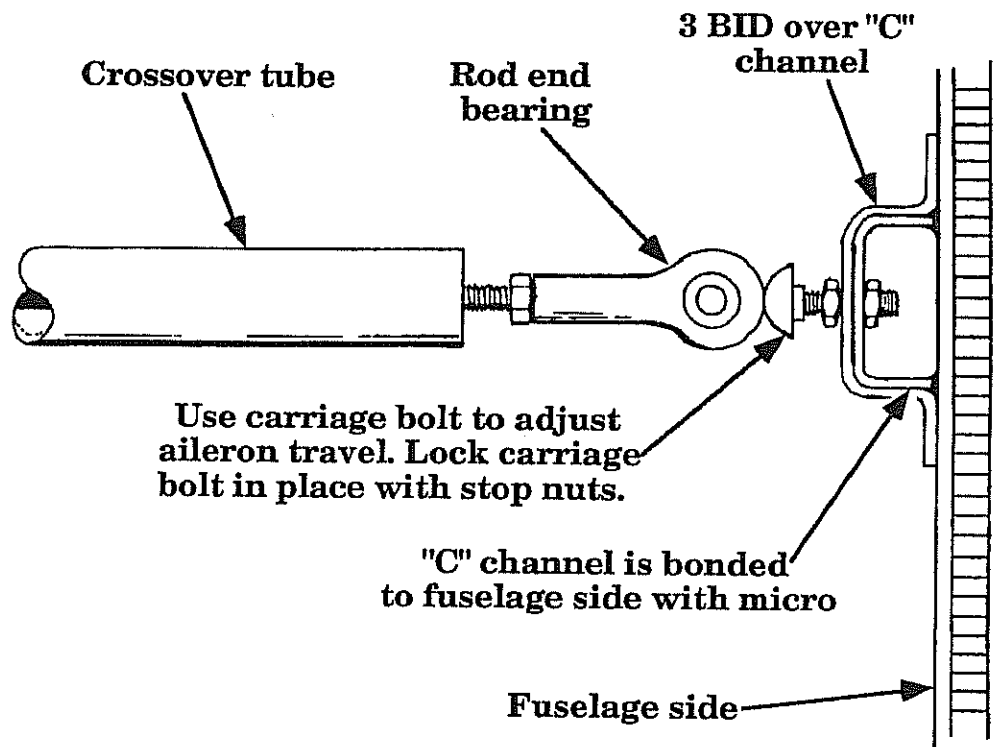
Figure 17:G:3



- G7. Double check the lengths of the aileron stop assemblies by temporarily bonding them to the fuselage side with instant glue. The heads of the crossover tube rod end bearings should strike the center of the carriage bolt head at full aileron deflection (control stick 25° left and right).
- G8. Use epoxy/micro to permanently bond the aileron stop assemblies to the sides of the fuselage.
- G9. Remove the carriage bolts and stop nuts from the aileron stop assemblies.
- G10. Apply 3 BID to the "C" channel pieces, overlapping onto the fuselage sides 1". The fiberglass adheres to the aluminum better if you spread a thin film of Hysol onto the aluminum before applying the glass.

Securing aileron stop assemblies to fuselage

Figure 17:G:4



- G11. When the 3 BID has cured, redrill the holes for the carriage bolts.
- G12. Install the carriage bolts and stop nuts again, adjusting the bolt for proper control stick and aileron deflection. Tighten the stop nuts to lock the stop bolts in position.