REVISION LIST

CHAPTER 17: RUDDER COMPLETION

The following list of revisions will allow you to update the Legacy construction manual chapter listed above.

Under the "Action" column, "R&R" directs you to remove and replace the pages affected by the revision. "Add" directs you to insert the pages shows and "R" to remove the pages.

PAGE(S) AFFECTED	REVISION # & DATE	ACTION	DESCRIPTION
17-1	1/09-18-02	R&R	Corrected Bill of Materials
17-2 through 17-7	0/02-15-02	None	Current revision is correct
17-8	1/09-18-02	R&R	Text correction
17-9 through 17-14	0/02-15-02	None	Current revision is correct
17-15	1/09-18-02	R&R	Part # Correction
17-16 through 17-22	0/02-15-02	None	Current revision is correct
17-23	1/09-18-02	R&R	Text correction
17-24	0/02-15-02	None	Current revision is correct
17-25	1/09-18-02	R&R	Corrected Fig. 17:G:1
17-26 through 17-28	0/02-15-02	None	Current revision is correct
17-29	0/02-15-02	None	Current revision is correct
17-30	1/09-18-02	R&R	Corrected Fig. 17:I:4
17-31 through 17-32	0/02-15-02	None	Current revision is correct
17-1	3/12-15-04	R&R	Updated table of contents with page numbers.
17-2	3/12-15-04	R&R	Added floorboard parts, bellcrank parts and rivets.
17-14	3/12-15-04	R&R	Updated floorboard part numbers in figure 17:E:1.
17-22	3/12-15-04	R&R	Updated rivet part nbrs.
17-22	3/12-15-04	R&R	Updated part nbrs.
17-25	3/12-15-04	R&R	Updated bushing part, added washers and notes to figure 17:G:1.
17-27	4/09-30-06	R&R	Added drawing of the baggage bulkhead, #4039, to Fig:17:I:1.

PAGE(S) AFFECTED	REVISION # & DATE	ACTION	DESCRIPTION
17-2, 17-25	6/08-10-07	R&R	Part number changes only.

Chapter 17: Rudder Completion

Contents

1. INTRODUCTION

At the end of this chapter, you will be able to sit in the cockpit and operate the rudder. You will start by separating the rudder from the vertical and then install the rudder leading edge. You will install the rudder bellcrank in the back of the fuselage - not as bad as it sounds - but you might want to start looking for a long skinny guy! Finally you will install the rudder pedals. The brakes are installed in Chapter 18.

2. PARTS LIST

#	PART NO. (P/N)	QTY	DESCRIPTION	OPTIONAL ITEM *(not included with kit)*
RUDDER LEADING EDGE CLOSEOUT				
1)	4065	1	Rudder Leading Edge Closeout	
2)	4657	1	Rudder Actuator Arm, Pre-Installed	
3)	REH053-U	1	Upper Rudder Hinge, Pre-installed	
4)	REH053-U	1	Center Rudder Hinge, Pre-installed	
5)	REH053-U	1	Lower Rudder Hinge, Pre-installed	
6)	AN3-6A	2	Bolts	
7)	AN960-10	2	Washers	
RUDDER TRIM SYSTEM				
1)	5-020016	1	Access Panel, Pre-Installed	
2)	MS24693-S28	6	Machine Screw, Pre-Installed	
3)	T2-7A (S4A)	1	Rudder Trim Servo	**Yes
4)	TT-01	1	Trim Tab Actuator Arm, Pre-Installed	
RUDDER PEDAL INSTALLATION				
1)	4034-1	1	Floorboard Access Panels, Left Side	
2)	4034-2	1	Floorboard Access Panels, Right Side	
3)	4662	2	Clevis	
4)	4925-01	1	Adjustable Rudder Pedal Kit (Left Side)	**Yes
5)	4925-02	1	Adjustable Rudder Pedal Kit (Right Side)	**Yes
6)	6061-T6	1’	Alu. Tube, 1.65” Length x 0.875 Dia. x 0.058” Wall	
7)	RD-PD-01	2	Rudder Pedal Castings	
8)	RDP-02	4	Bushing, Nylon	
9)	AN3-6	2	Bolt, Drilled	
10)	AN3-6A	2	Bolt, Undrilled	
11)	AN3-11A	2	Bolt, Undrilled	
12)	AN316-5	2	Checknut	
13)	MS24665-132	2	Cotter Pin	
14)	10-88	2	Master Cylinder	
15)	AN310-3	2	Nut, Castle	
16)	K1000-3	4	Nutplate	
17)	BSPQ-44	2	Rivet, Pop	
18)	AN426A3-5	4	Rivets	
19)	AN960-10	2	Washer	
20)	AN960-10L	4	Washer	

Note:

Optional Parts available through :

(*) Lancair Avionics

(**) Kit Components, Inc.

#	PART NO. (P/N)	QTY	DESCRIPTION	OPTIONAL ITEM *(not included with kit)*
FLOORBOARD INSTALLATION				
1)	4034-01	1	Floorboard, left side	
2)	4034-02	1	Floorboard, right side	
3)	4034-03	1	Floorboard Acces Panel, left side	
4)	4034-04	1	Floorboard Acces Panel, right side	
5)	K1000-3	8	Nutplate	
6)	MSC-34	16	Rivets	
7)	AN526-1032-R10	8	Screw (For Version 1 Floorboard)	
8)	AN526-1032-R8	8	Screw (For Version 2 Floorboard)	
9)	AN960-10	8	Washer	
RUDDER BELLCRANK				
1)	4650	1	Rudder Bellcrank	
2)	4651	1	Rudder Bellcrank Bracket	
3)	4652	1	Rudder Bellcrank Bracket Shear Support	
4)	4653	1	Rudder Bellcrank Shear Support	
5)	4659	2	Rudder Bellcrank Bumper	
6)	4665	1	Rudder Bellcrank Shear Support Spacer	
7)	AN4-12	1	Bolt	
8)	AN4-13A	2	Bolt, Undrilled	
9)	AN3-13A	5	Bolt, Undrilled	
10)	**112-0037** ~~6381K412~~	1	Bushing	
11)	AN365-1032A	3	Locknut	
12)	AN960-416	2	Washer, Flat	
13)	AN960-416L	2	Washer, Thin	
14)	AN960-10	5	Washer, Flat	
15)	AN970-4	2	Washer	
16)	AN310-4	1	Castle nut	
17)	MS24665-132	1	Cotterpin	
RUDDER PUSHROD				
1)	4039-02	1	Aft Bulkhead	**Yes
2)	4658	1	Pushrod Rudder Pre-Fab.	
3)	AN3-12A	1	Bolt	
4)	AN3-13A	1	Bolt	
5)	AN365-1032A	2	Nut	
6)	AN960-10	2	Washer	

#	PART NO. (P/N)	QTY	DESCRIPTION	OPTIONAL ITEM *(not included with kit)*
RUDDER CABLE				
1)	AN3-10	4	Bolt, Drilled Shank	
2)	AN42-B11A	2	Bolt, Clevis	
3)	SHC-1010	3	Connector, Bulkhead	
4)	MS24665-132	4	Cotter Pin	
5)	AN310-3	4	Nut, Castle	
6)	18-3-M	2	Nicopress Sleeve	
7)	44P	9’	Poly Tubing	
8)	RDC-18	2	Rudder Cable	
9)	AN111-4	2	Thimble	
10)	AN960-10L	12	Washer	
11)	AN960-10	as required	Washer	

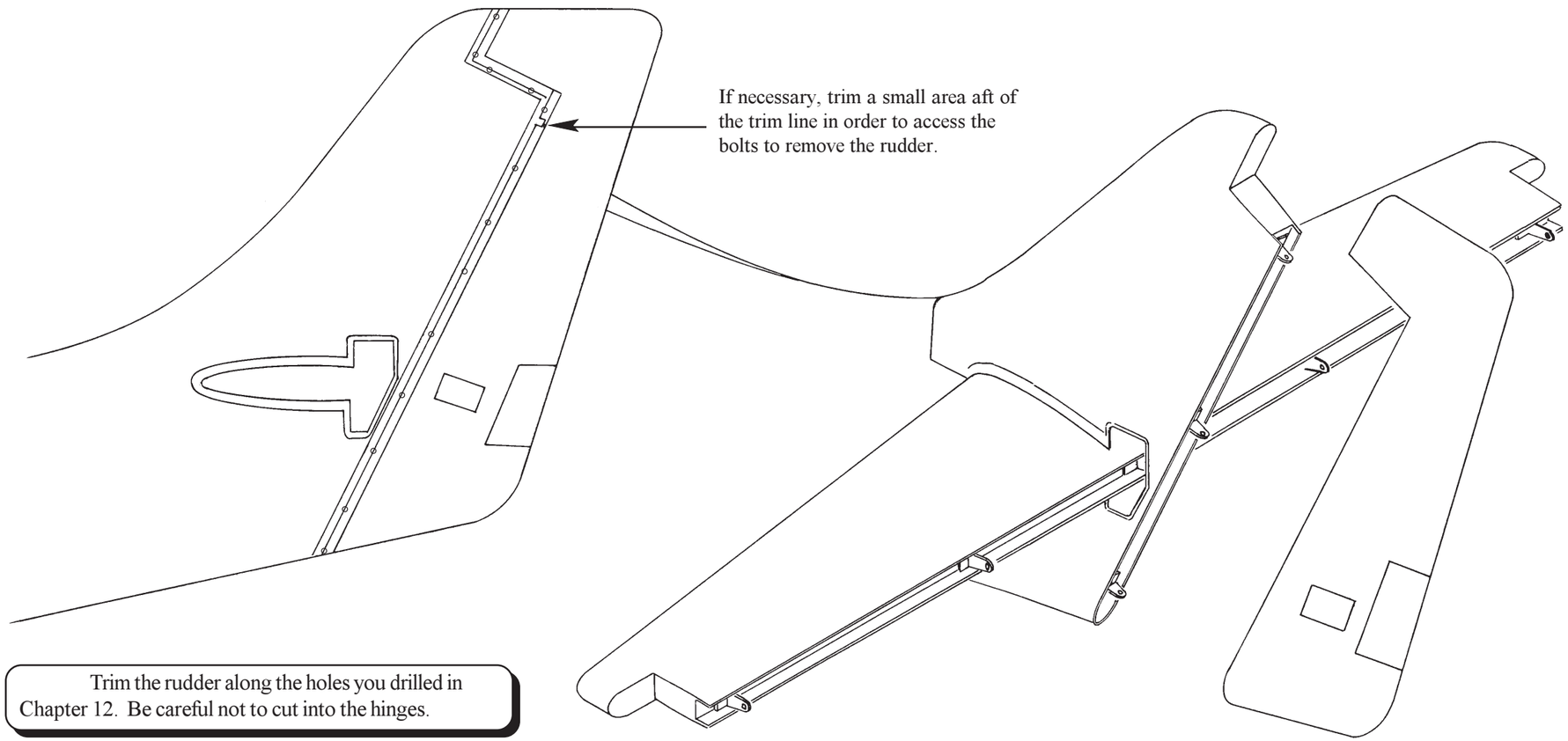
Note:

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

3. CONSTRUCTION PROCEDURES

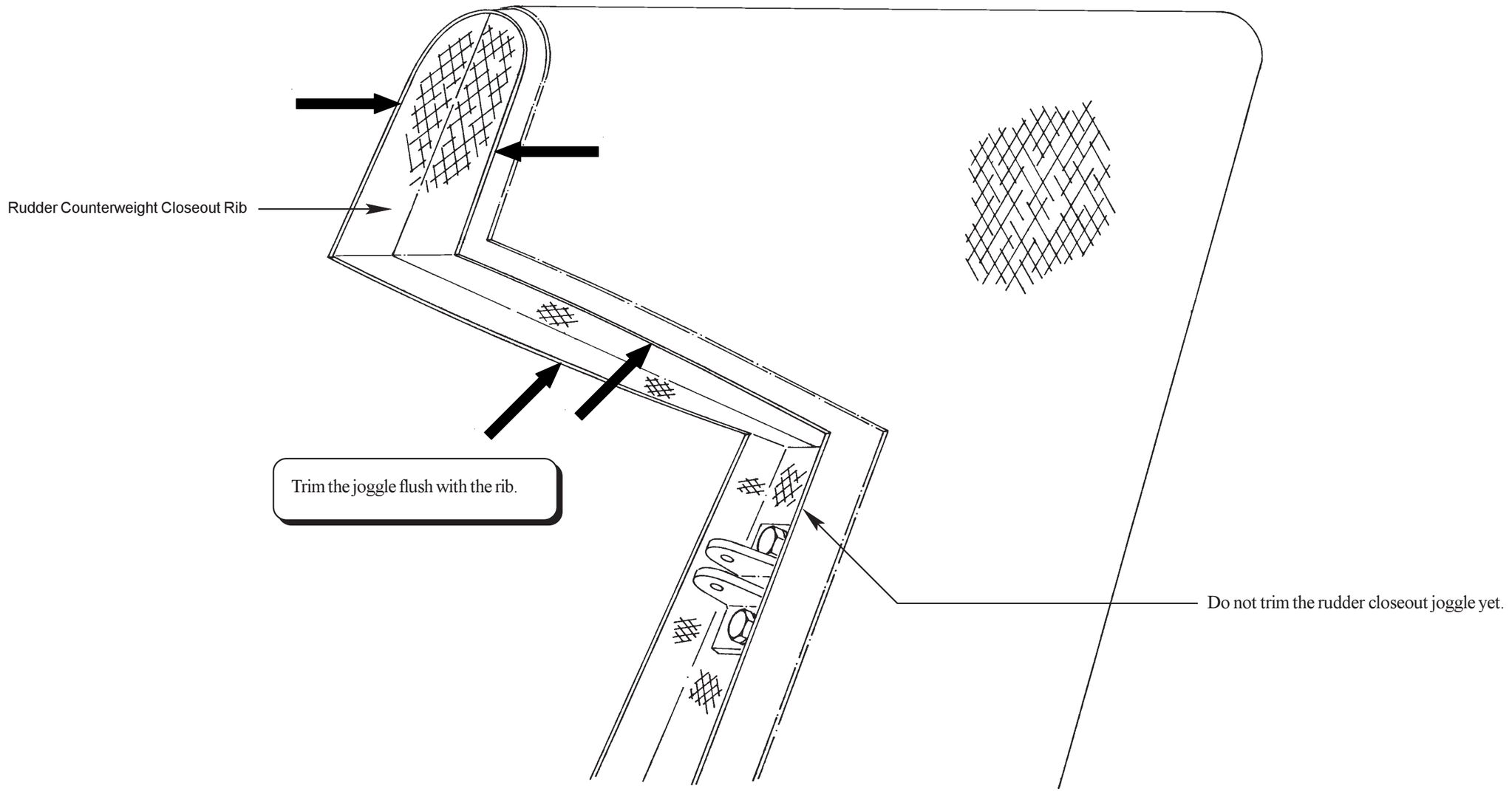
A. Trimming the Rudder

Trimming Rudder
Fig 17:A:1



Trim the rudder along the holes you drilled in Chapter 12. Be careful not to cut into the hinges.

Trimming Joggle in Rudder Counterweight Area
Fig 17:A:2

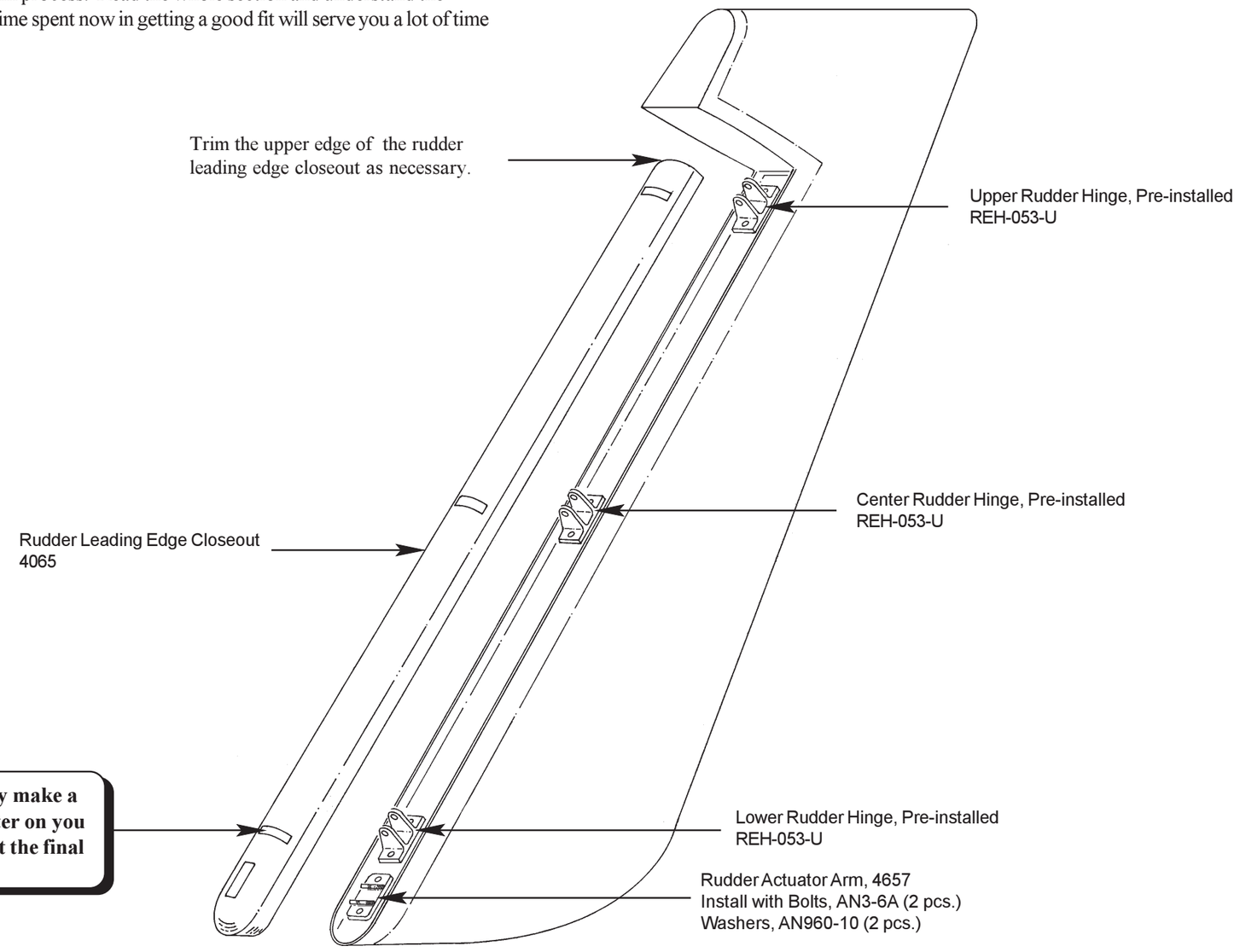


B. Rudder Leading Edge Closeout

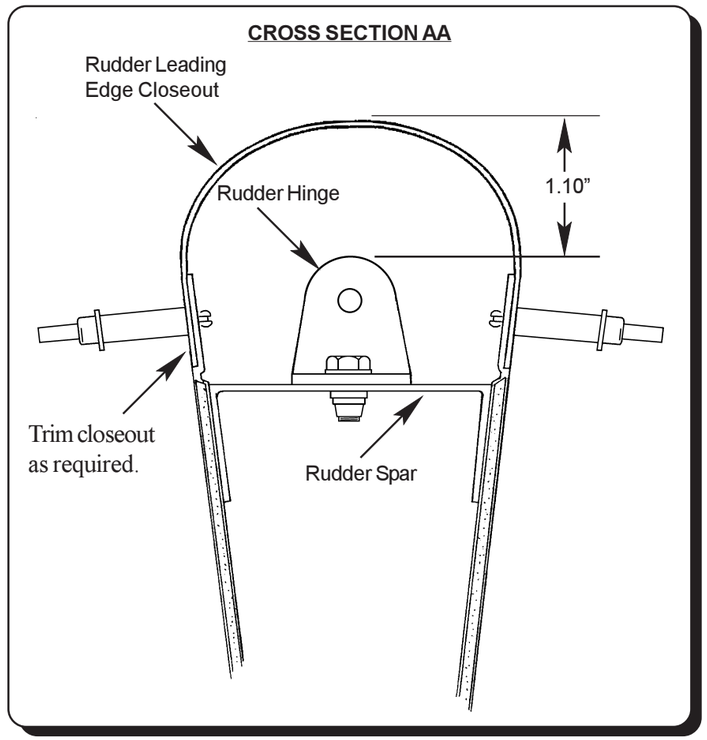
The rudder leading closeout completes the rudder structure. The pre molded shape provides a constant gap between the rudder and the vertical trailing edge through the rudder travel range.

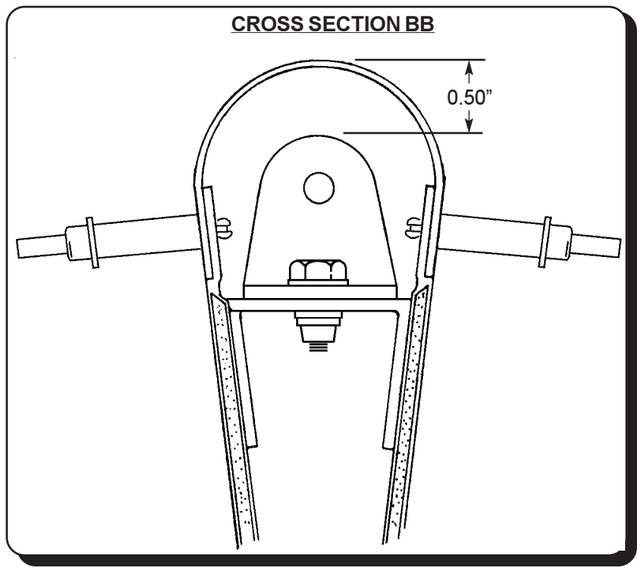
Fitting the closeout is a gradual fit and trim process. Read the whole section and understand the alignment criterias before starting. A little more time spent now in getting a good fit will serve you a lot of time later on in body works.

Rudder Leading Edge Closeout Installation
Fig 17:B:1

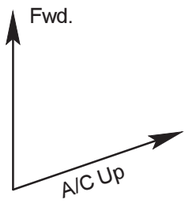


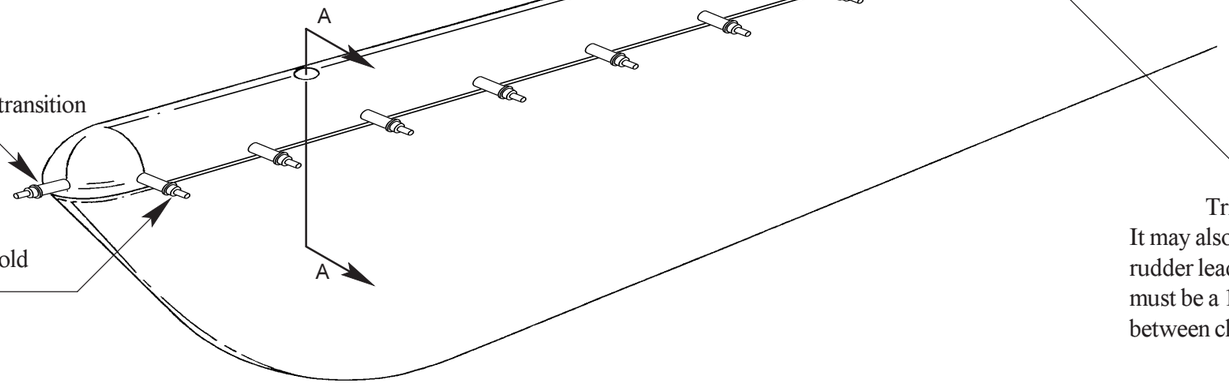
Rudder Leading Edge Closeout Alignment
Fig 17:B:2





NOTE: **Avoid drilling through spar or hinges when drilling cleco holes.**





The rudder closeout should transition smoothly to the rudder in this area.

Install clecoes every 2” to hold closeout in place when you bond.

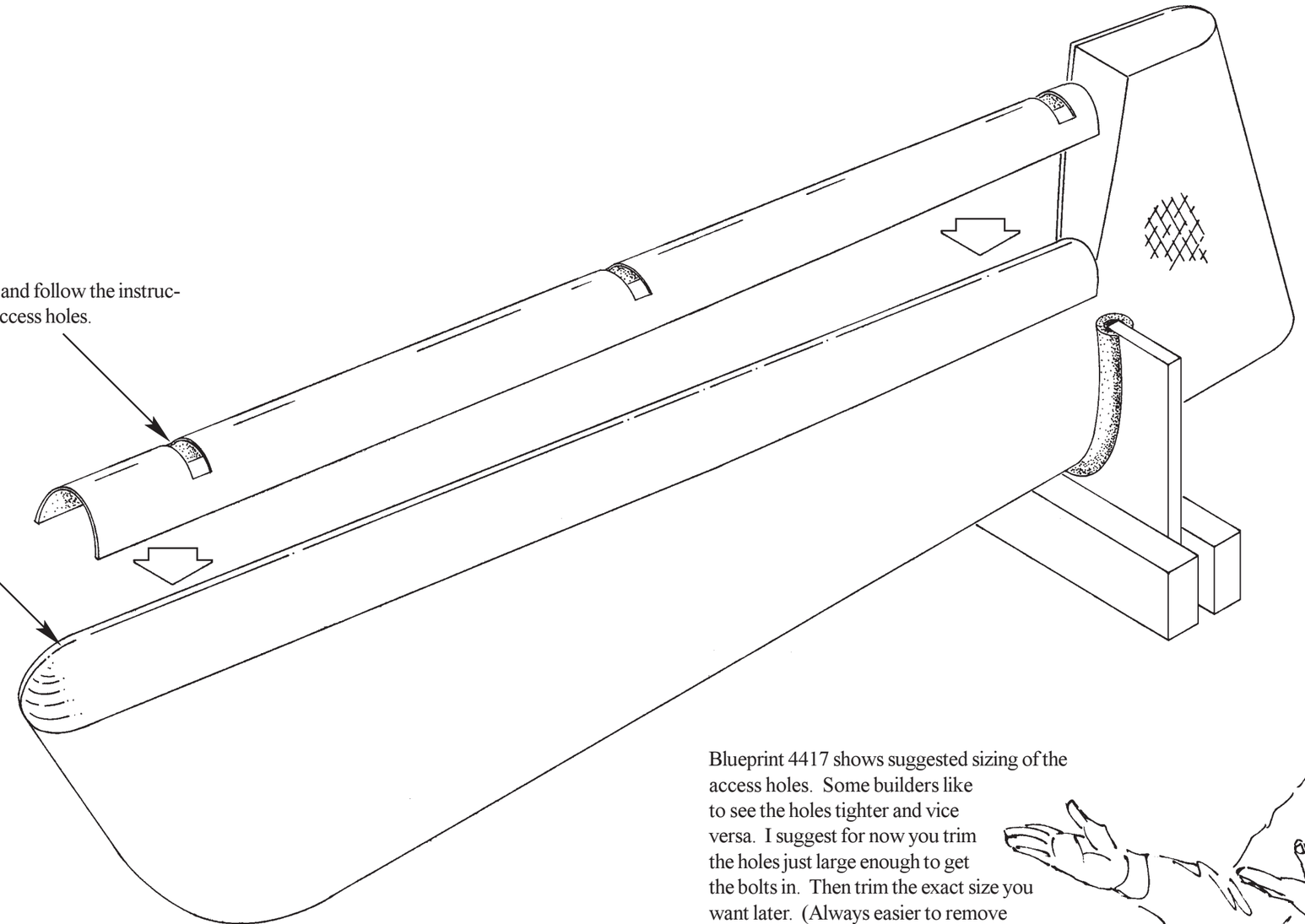
Trim the aft edge of the closeout as necessary. It may also be necessary to trim the joggle for the rudder leading edge. Refer to Figure 17:B:3. There must be a 1/2” minimum bond width (contact surface between closeout and joggle).

Bond the closeout using standard bonding procedures.

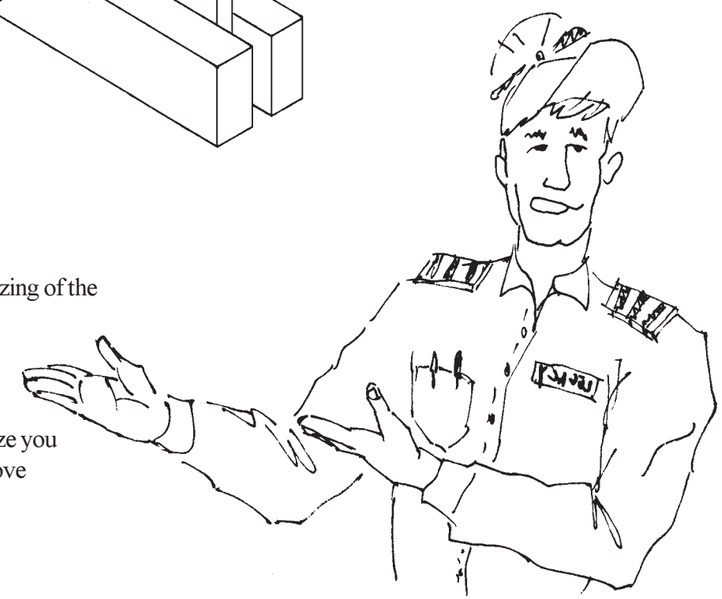
Trimming the Rudder Access Holes
Fig 17:B:3

Cut out blueprint 4417 and follow the instructions for trimming the access holes.

Accurately create a center line along the closeout leading edge.

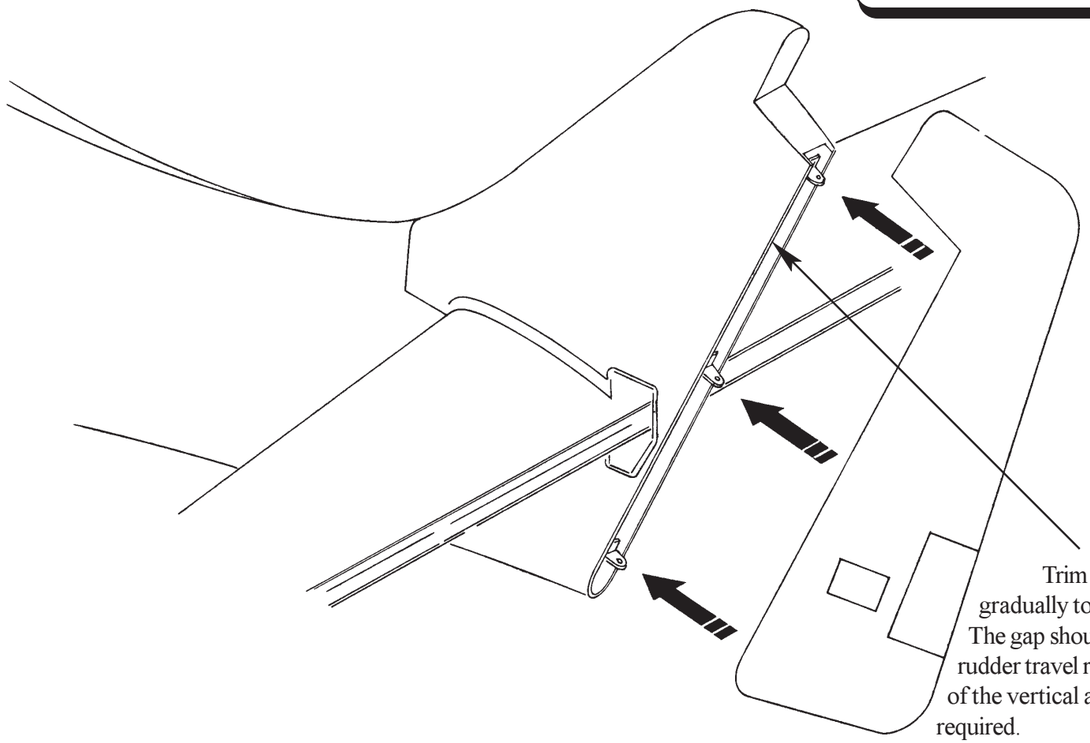


Blueprint 4417 shows suggested sizing of the access holes. Some builders like to see the holes tighter and vice versa. I suggest for now you trim the holes just large enough to get the bolts in. Then trim the exact size you want later. (Always easier to remove more later than to add).



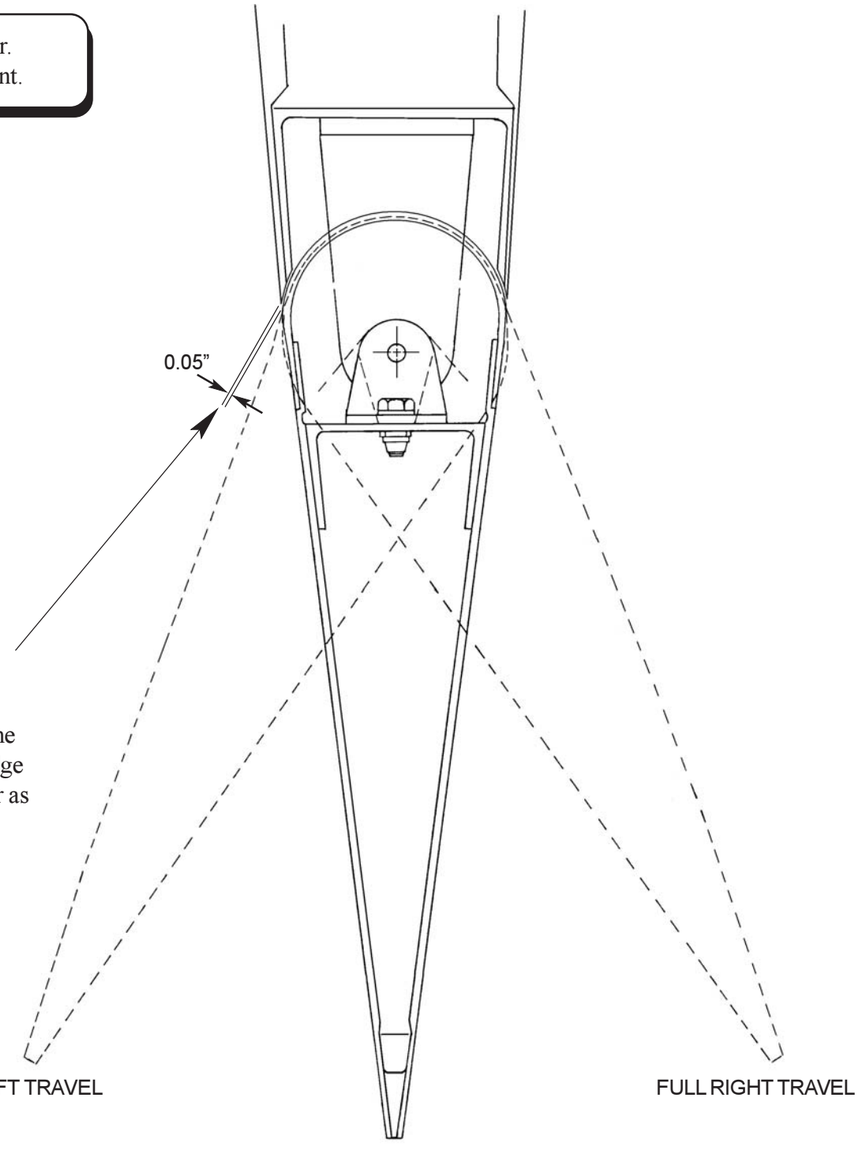
Trimming Vertical Trailing Edge
Fig 17:B:4

Use AN4-10A bolts to secure the rudder.
There is no need to install the locknuts at this point.

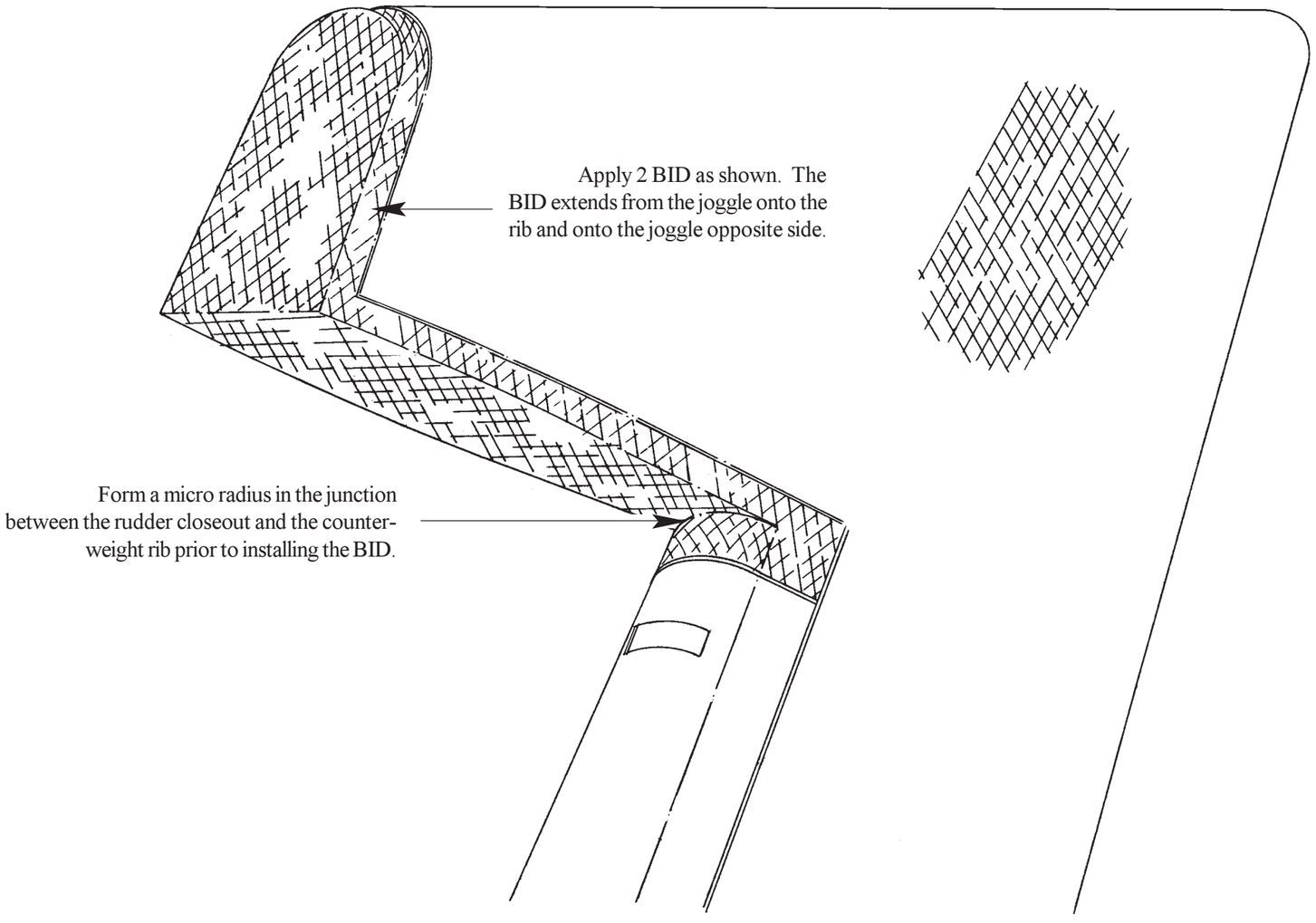


Trim trailing edge of vertical gradually to obtain an even .05" gap. The gap should remain even through the rudder travel range. Trim the trailing edge of the vertical and body work the rudder as required.

NOTE: The Legacy rudder travel is approximately 32° full left and full right. The exact degree of travel will ultimately be determined by the stops.

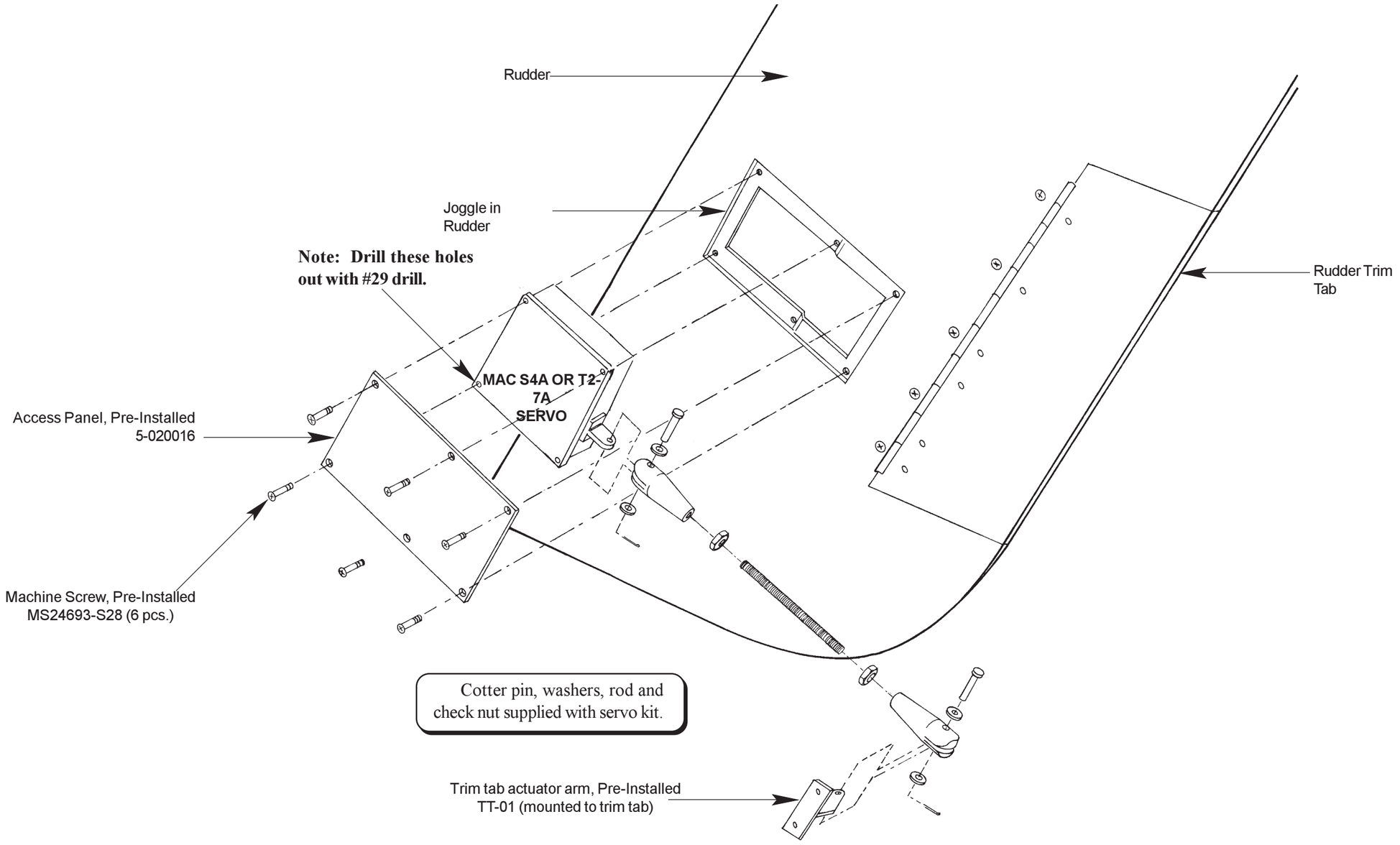


Closing Out Rudder Counterweight Area with BID
Fig 17:B:5



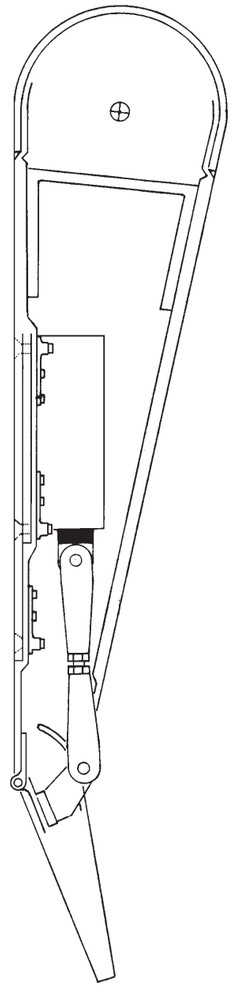
C. Rudder Trim System (Optional)

Rudder Trim System (Exploded View)
Fig 17:C:1

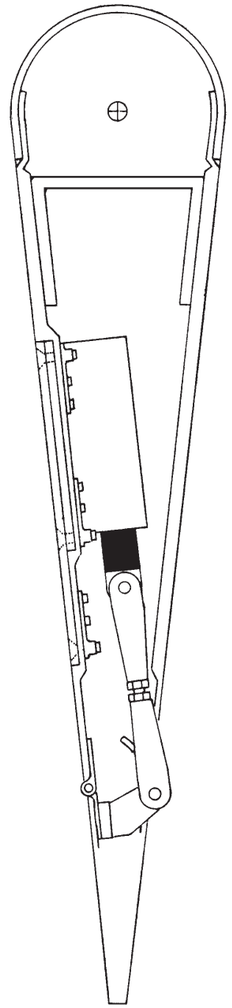


Adjusting Rudder Trim System
Fig 17:C:2

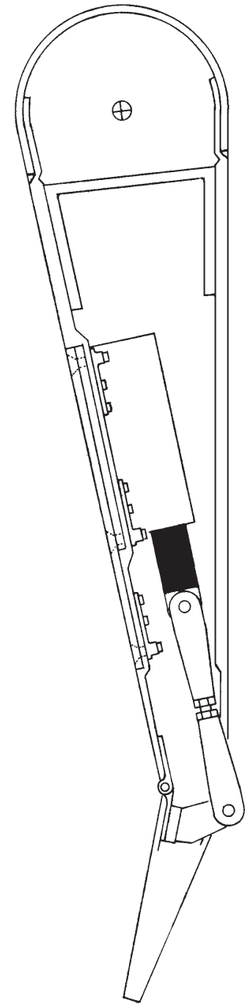
The total travel of S4A trim servo is 7/10". The rudder trim is set so that at the servo's neutral point (half travel) the trim tab is also in the neutral position. Use a 12 volt battery to operate the servo.



- Full Left Rudder
- Servo motor "in"
- The trim tab moves to the right causing the rudder to deflect left.

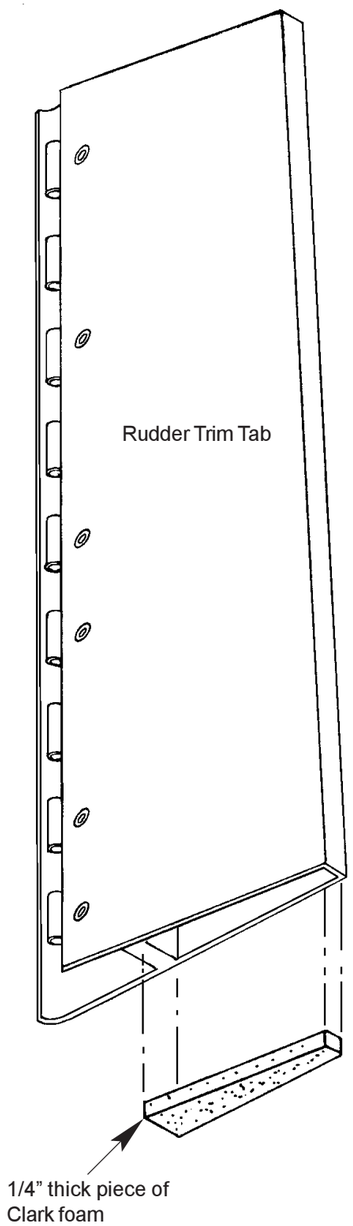


- Neutral Rudder
- Servo motor "centered"
- The trim tab centered causing no deflection of the rudder.

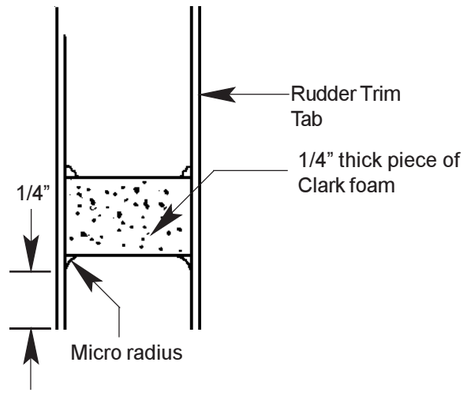


- Right Rudder
- Servo motor fully "extended"
- The trim tab moves to the left causing the rudder to deflect right.

Closing Out The Rudder Trim Tab
Fig 17:C:3

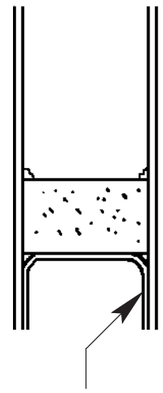


Step ①



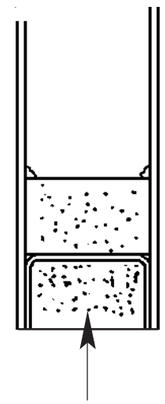
Fit and install a 1/4" thick piece of Clark foam. Install with epoxy/micro.

Step ②



Apply 1 BID 7781 as shown.

Step ③

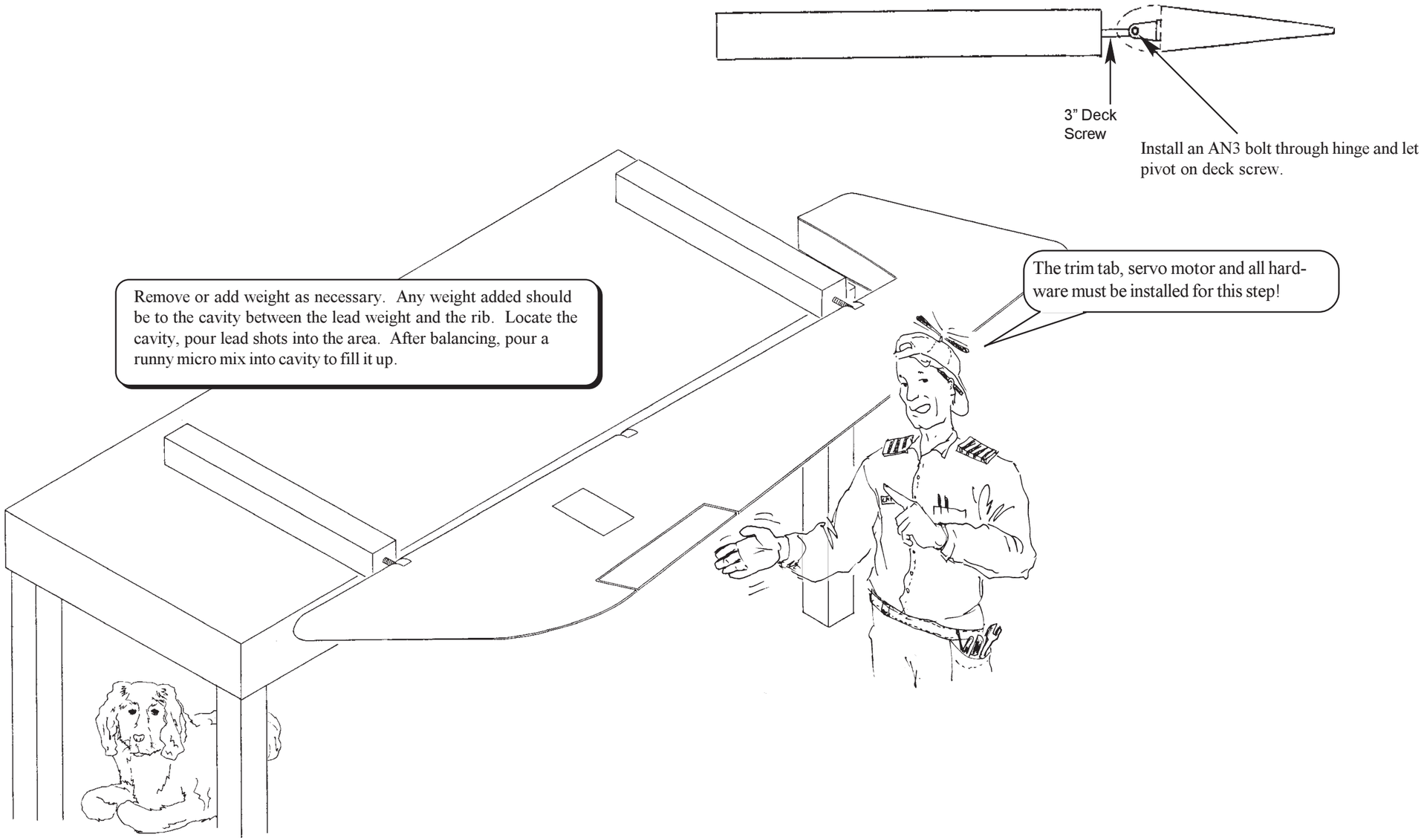


Fill with epoxy/micro as shown.

D. Adjusting the Rudder Counter Weights

Adjusting Rudder Counter Weights
Fig 17:D:1

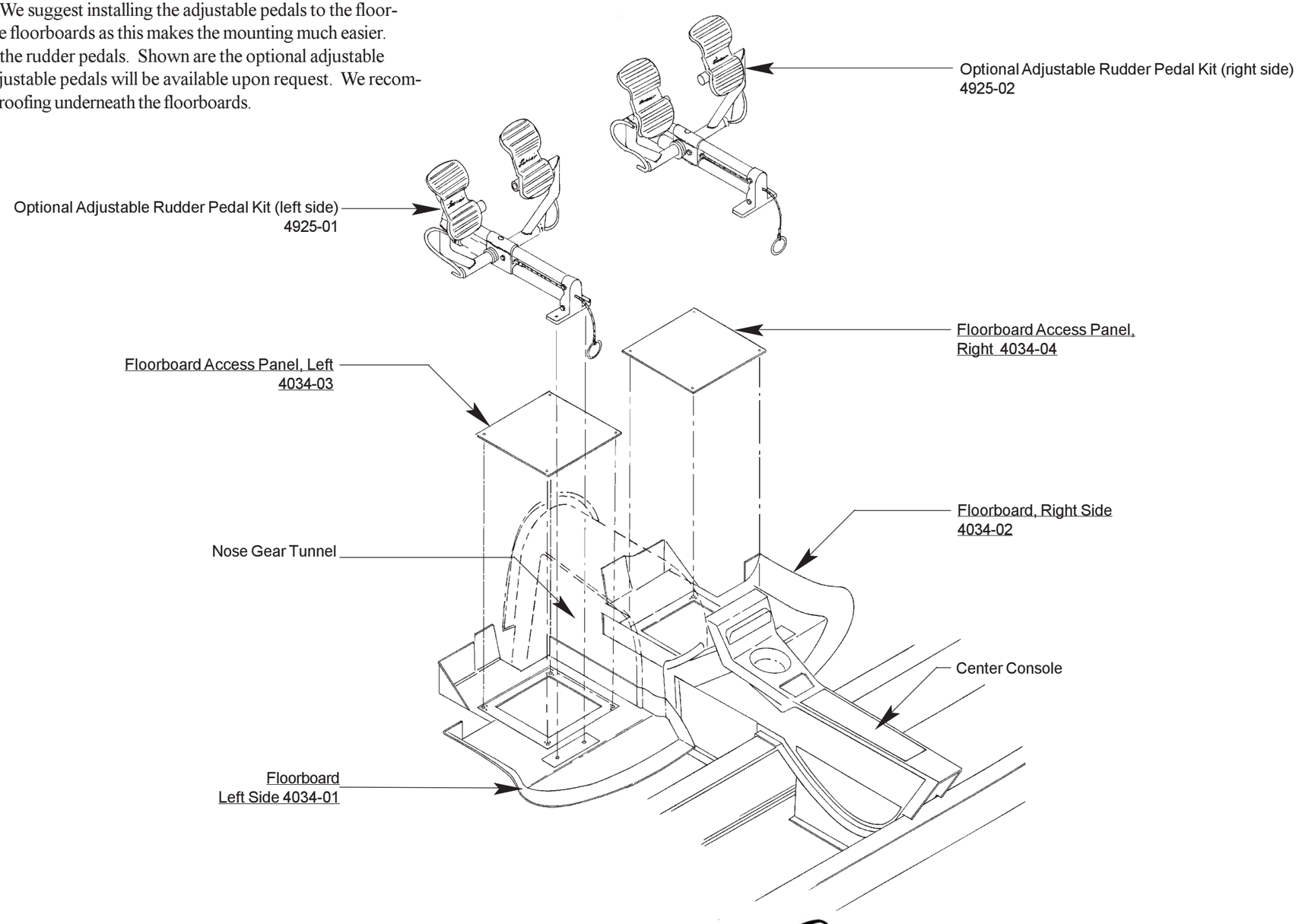
This step should be done after the body work and priming and just before paint. Provided you are 100% mass balanced prior to paint, the added weight of the paint is within tolerance.



E. Rudder Pedal Installation

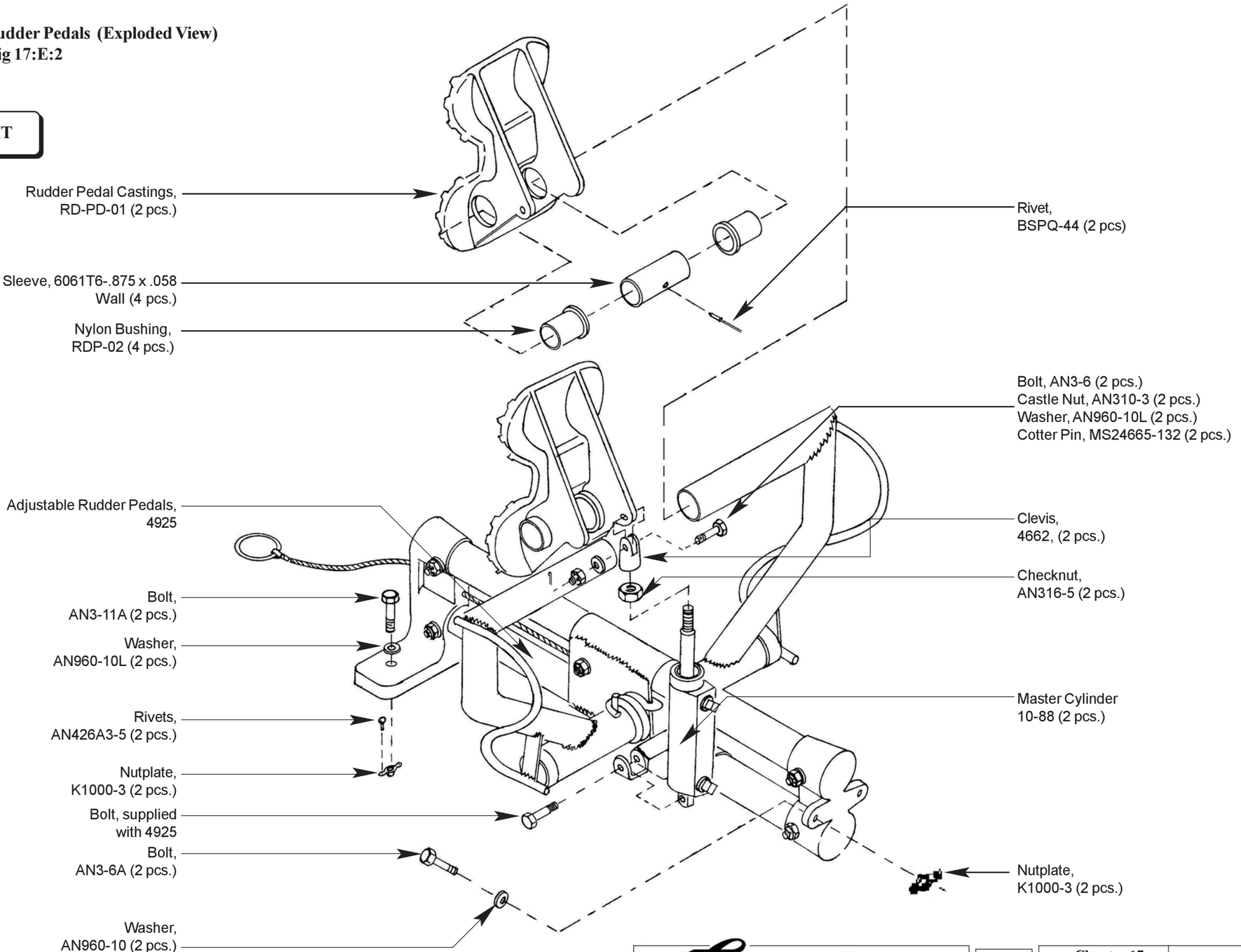
The floorboards install by the pilot's and co-pilot's feet. The rudder pedals mount to the floorboards. We suggest installing the adjustable pedals to the floorboards prior to bonding the floorboards as this makes the mounting much easier. There are two options for the rudder pedals. Shown are the optional adjustable rudder pedals. The nonadjustable pedals will be available upon request. We recommend installing the soundproofing underneath the floorboards.

General Overview
Fig 17:E:1

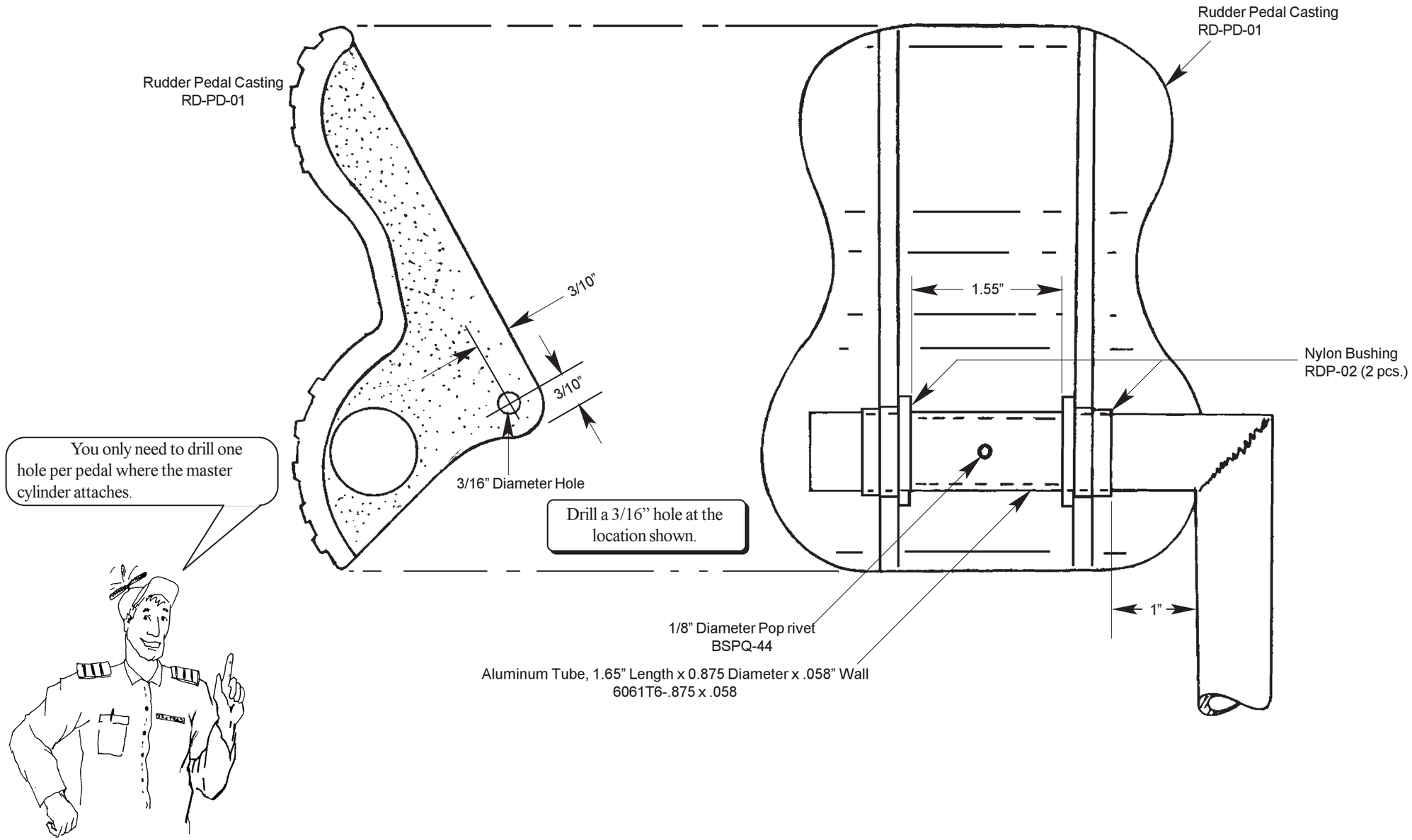


Optional Adjustable Rudder Pedals (Exploded View)
Fig 17:E:2

(*) Included with KIT



Installing The Rudder Pedal Casting
Fig 17:E:3



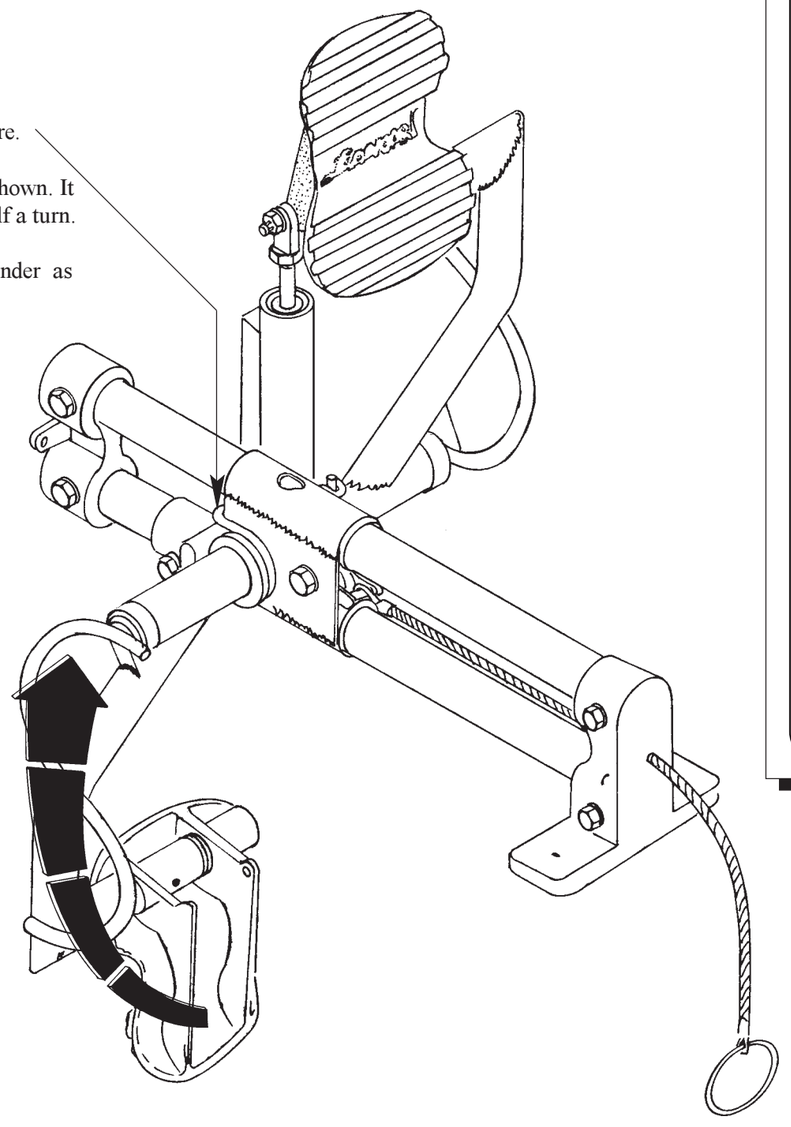
Installing Rudder Pedal Master Cylinder
Fig 17:E:4

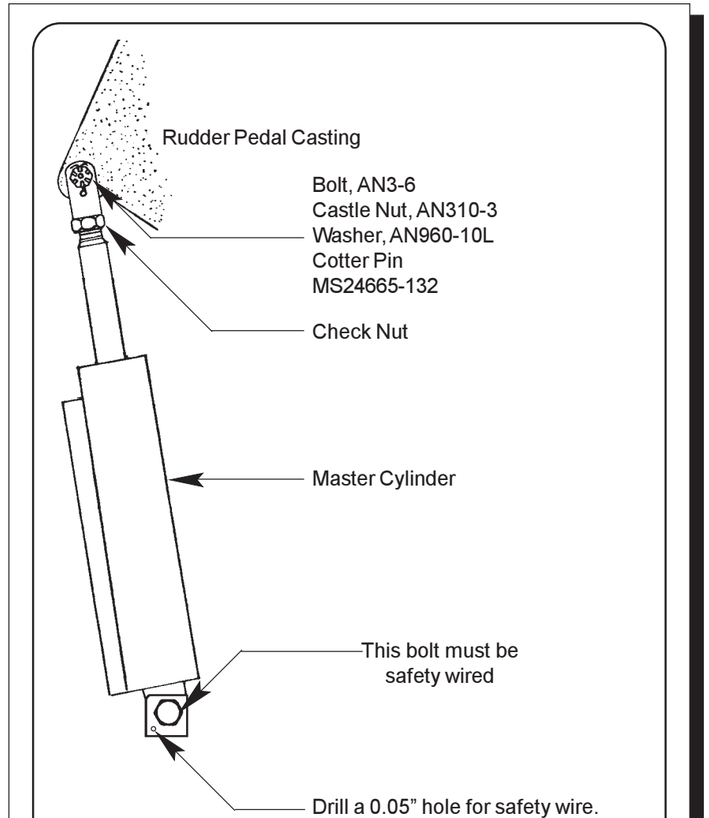
"Winding up the pedal:"

1. Attach the spring here.

2."Wind" the pedal as shown. It takes approximately half a turn.

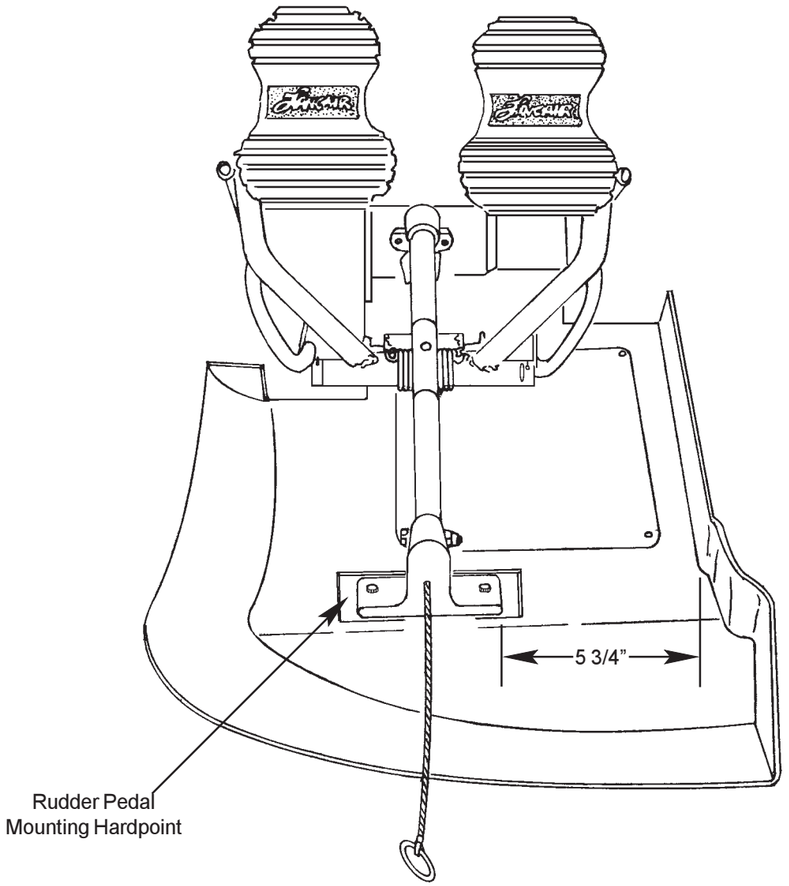
3. Install the master cylinder as shown.



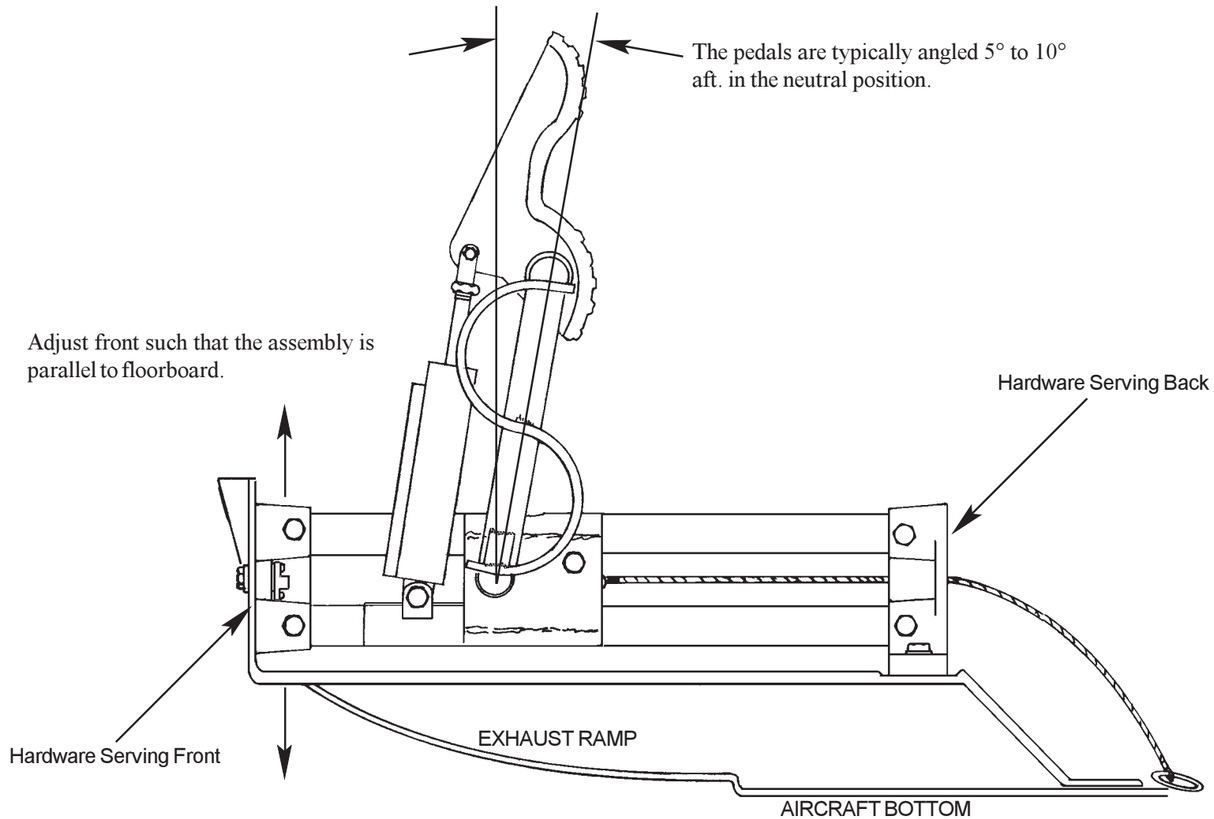


Mounting Rudder Pedals To Floorboard
Fig 17:E:5

TOP VIEW



SIDE VIEW



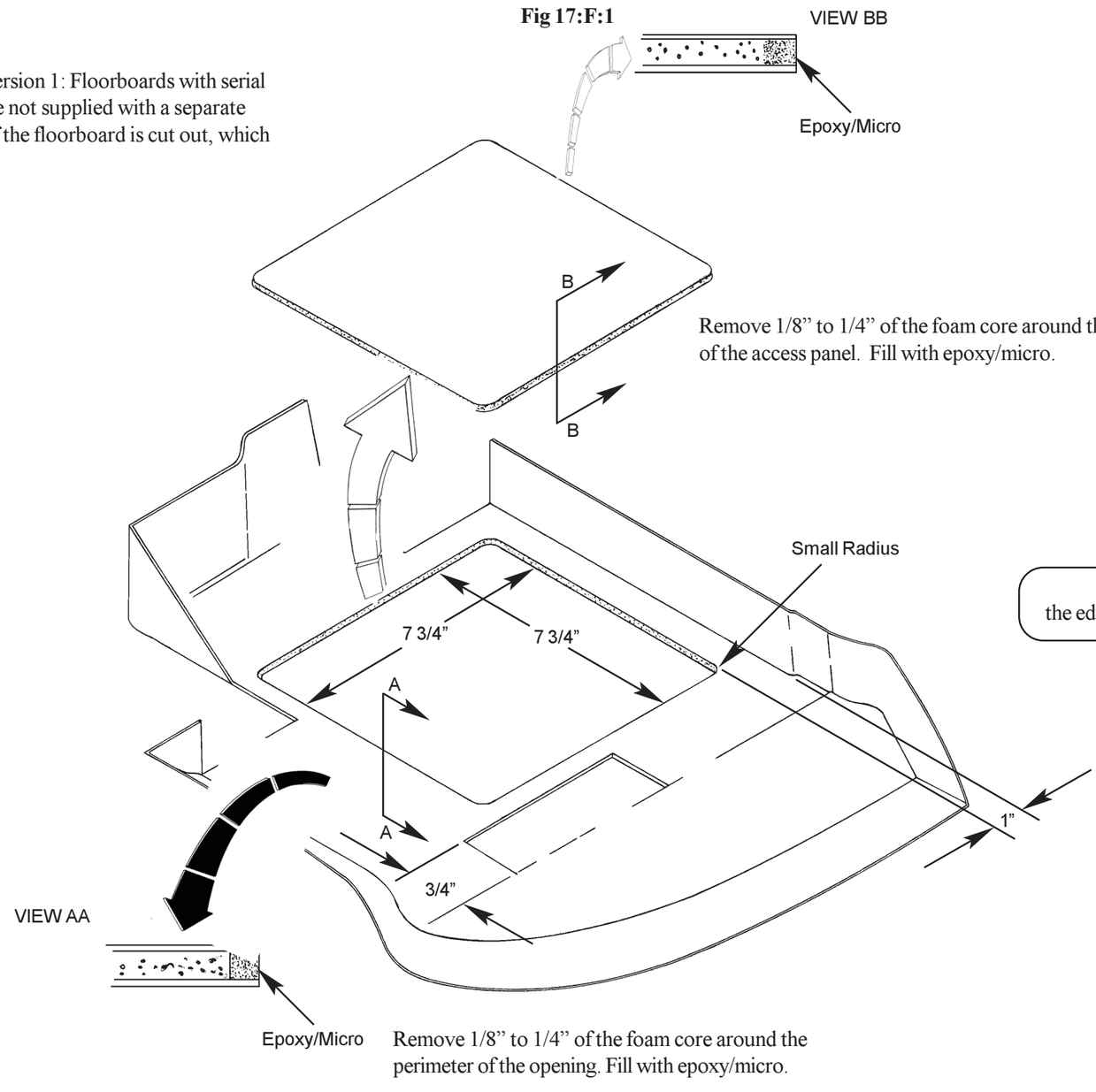
F. Floorboard Installation

Version 1

There are two different versions of floorboards. Version 1: Floorboards with serial number 2000-2021. The version 1 floorboards are not supplied with a separate floorboard access panel. A 7 3/4" x 7 3/4" piece of the floorboard is cut out, which becomes the floorboard access panel.

THIS PAGE APPLIES TO VERSION 1.

Floorboard Access Panels Version 1
Fig 17:F:1



Remove 1/8" to 1/4" of the foam core around the perimeter of the access panel. Fill with epoxy/micro.

Remove 1/8" to 1/4" of the foam core around the perimeter of the opening. Fill with epoxy/micro.

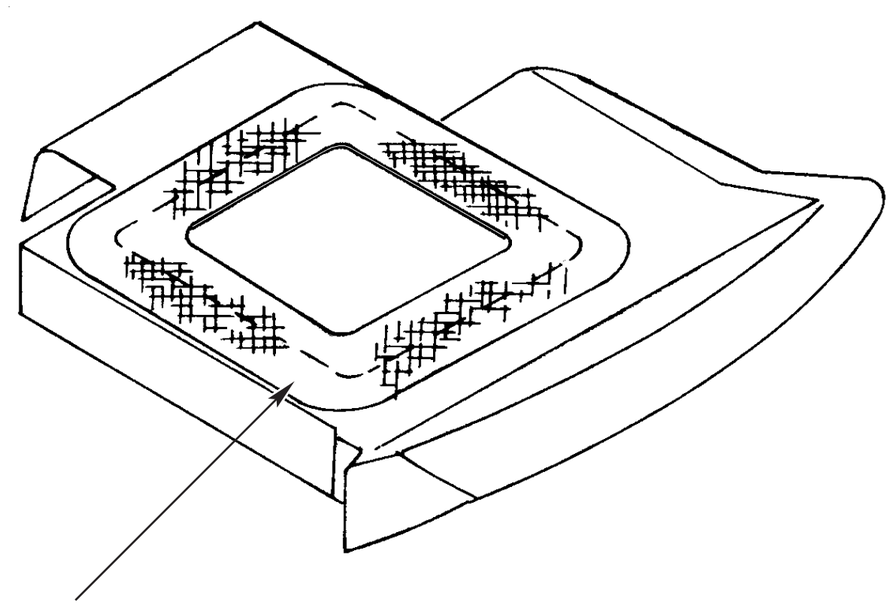
Floorboard Access Panels Version 1
Fig 17:F:2

To form the flange for Access Panel:

1. Release tape the lower surface of the access panel. Clean tape or duct tape works well.

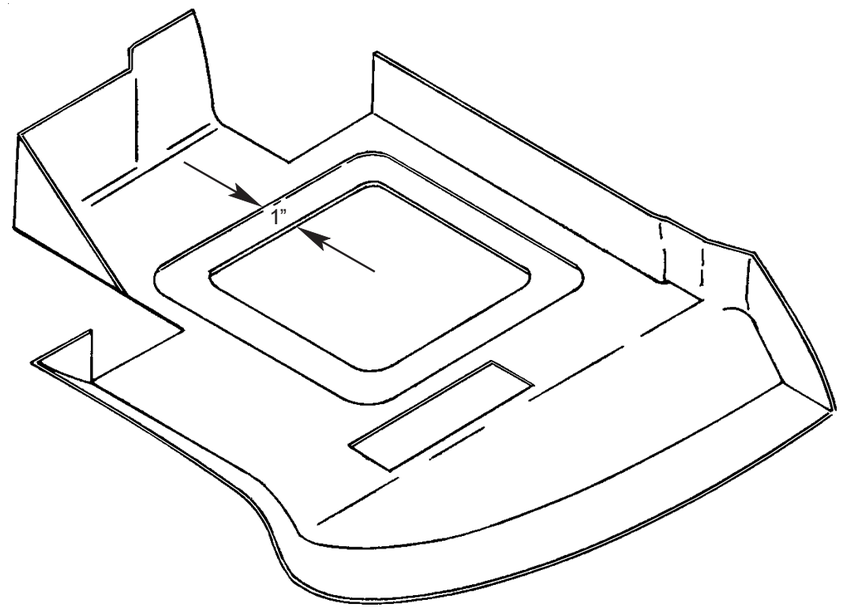
2. Hold the access panel in place by gluing pieces of tongue depressors across the upper surface between floorboard and the access.

3. Prepare the bonding surfaces



4. Apply 2” wide 6 BID as shown.

5. Trim the flange width to 1”.

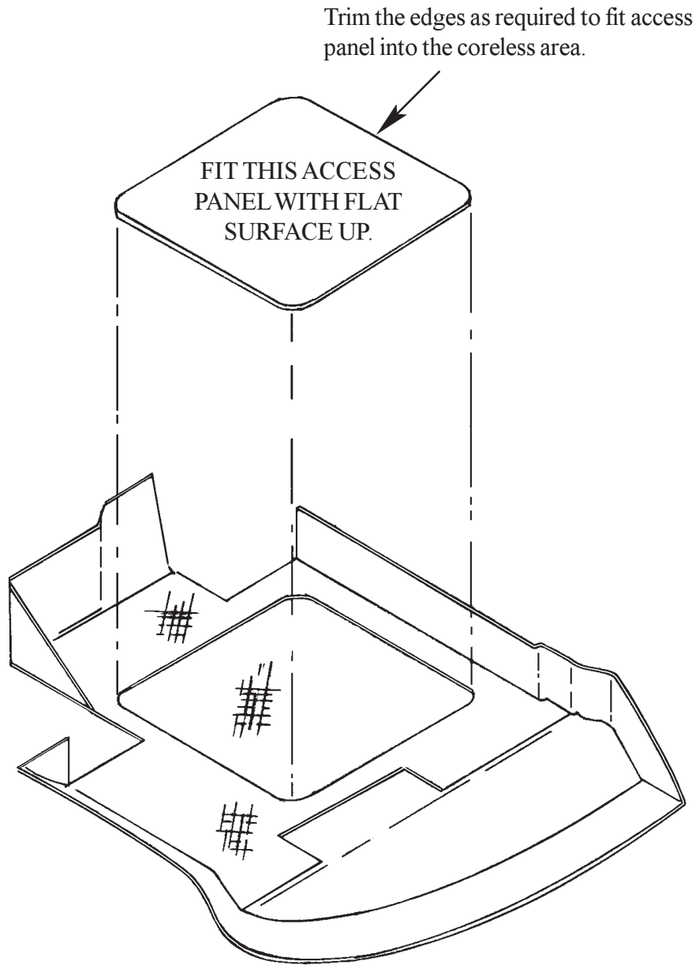


THIS PAGE APPLIES TO VERSION 1.

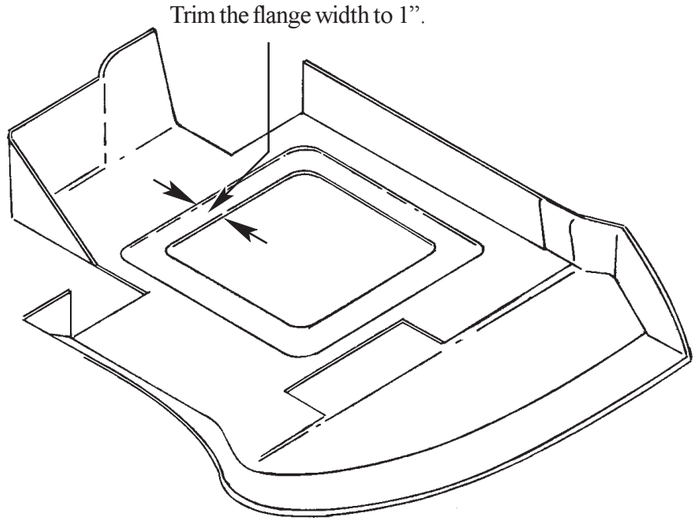
Version 2

Floorboards with serial numbers 2021 and above have separate access panels supplied. There is also a reinforced coreless area.

Fitting Floorboards Version 2
Fig 17:F:3



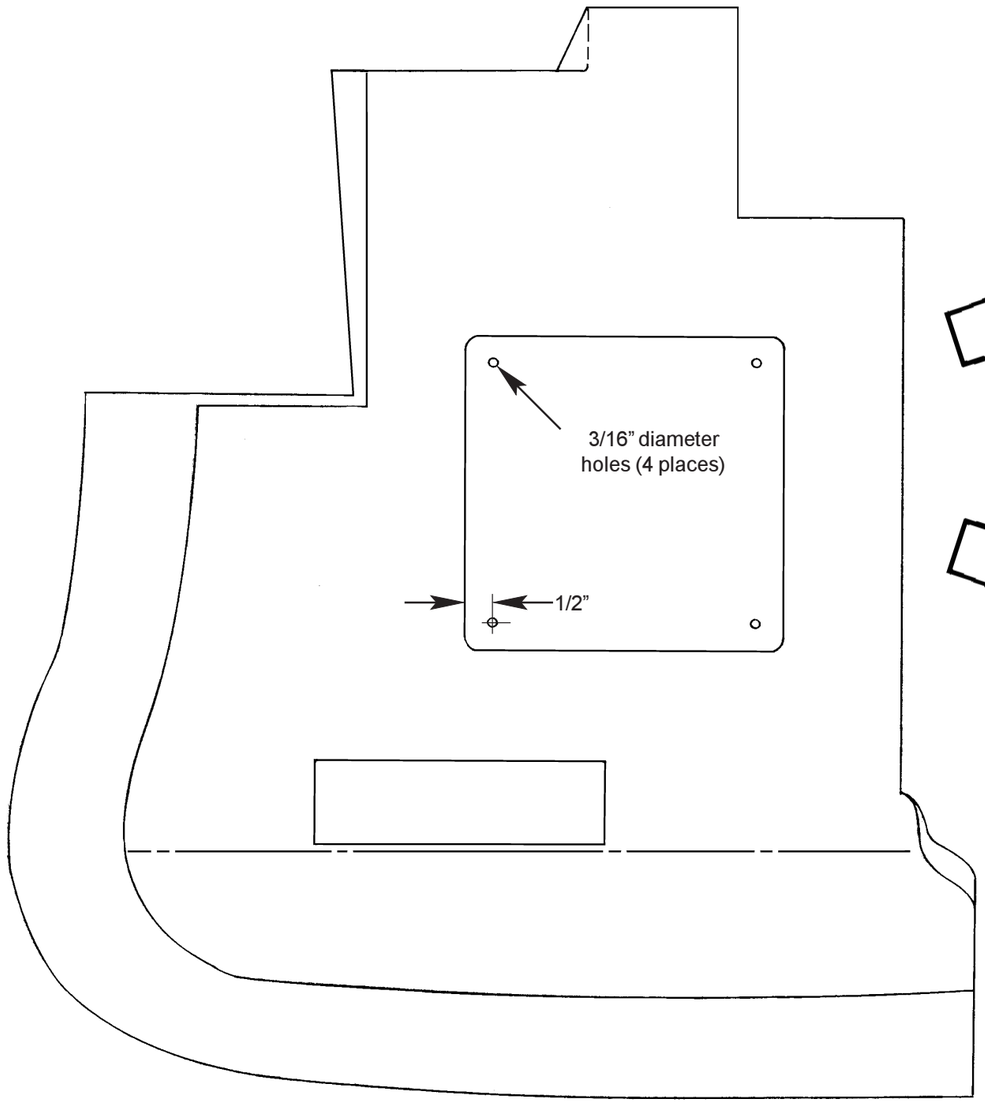
THIS PAGE APPLIES TO VERSION 2.



Securing Access Panels
Fig 17:F:4

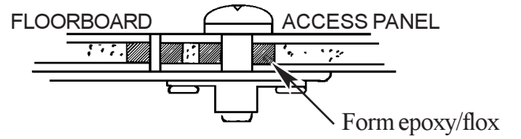
THIS PAGE APPLIES TO VERSION 1 & 2.

FLOORBOARD TOP VIEW



VERSION 1

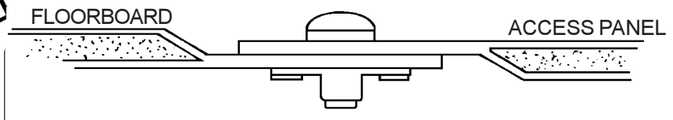
CROSS SECTION OF VERSION 1



Secure with:
- Screws, AN526-1032-R10
- Washers, AN960-10
- Nutplate, K1000-3
- Rivets, MSC-34

VERSION 2

CROSS SECTION OF VERSION 2



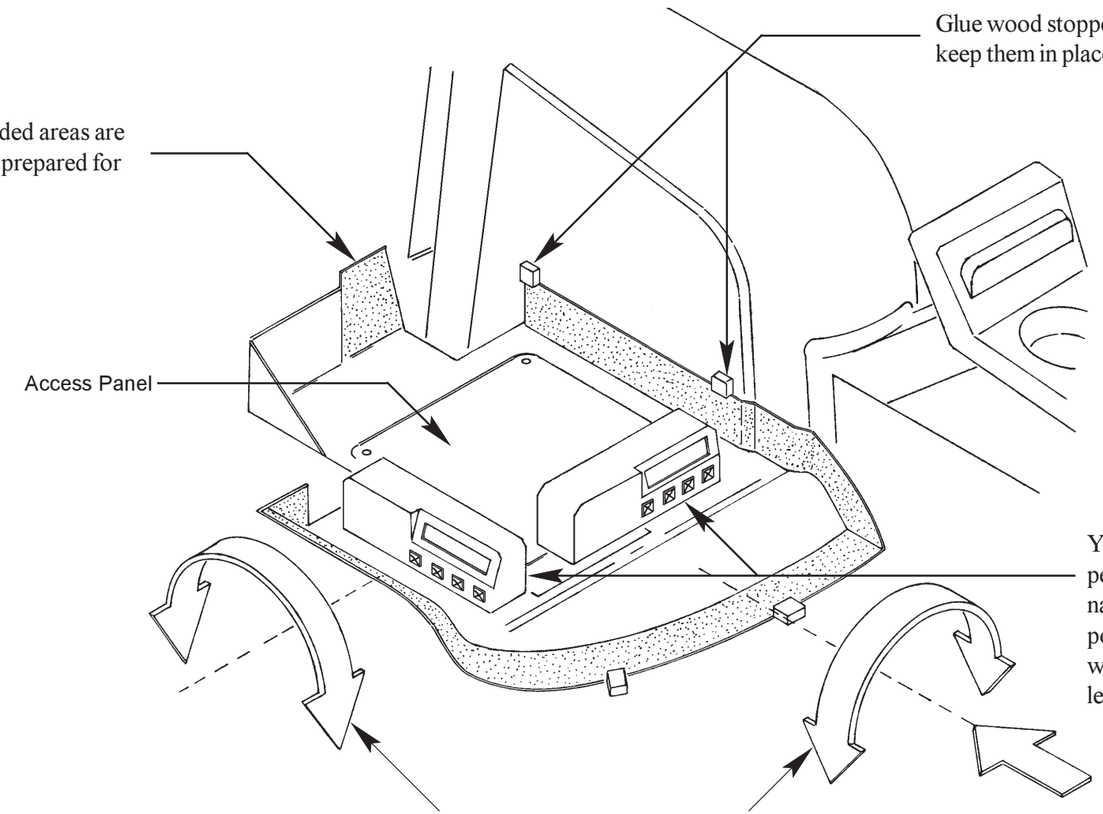
Secure with:
- Screws, AN526-1032-R8
- Washers, AN960-10
- Nutplate, K1000-3
- Rivets, MSC-34

Setting Rudder Floorboards in Place
Fig 17:F:5

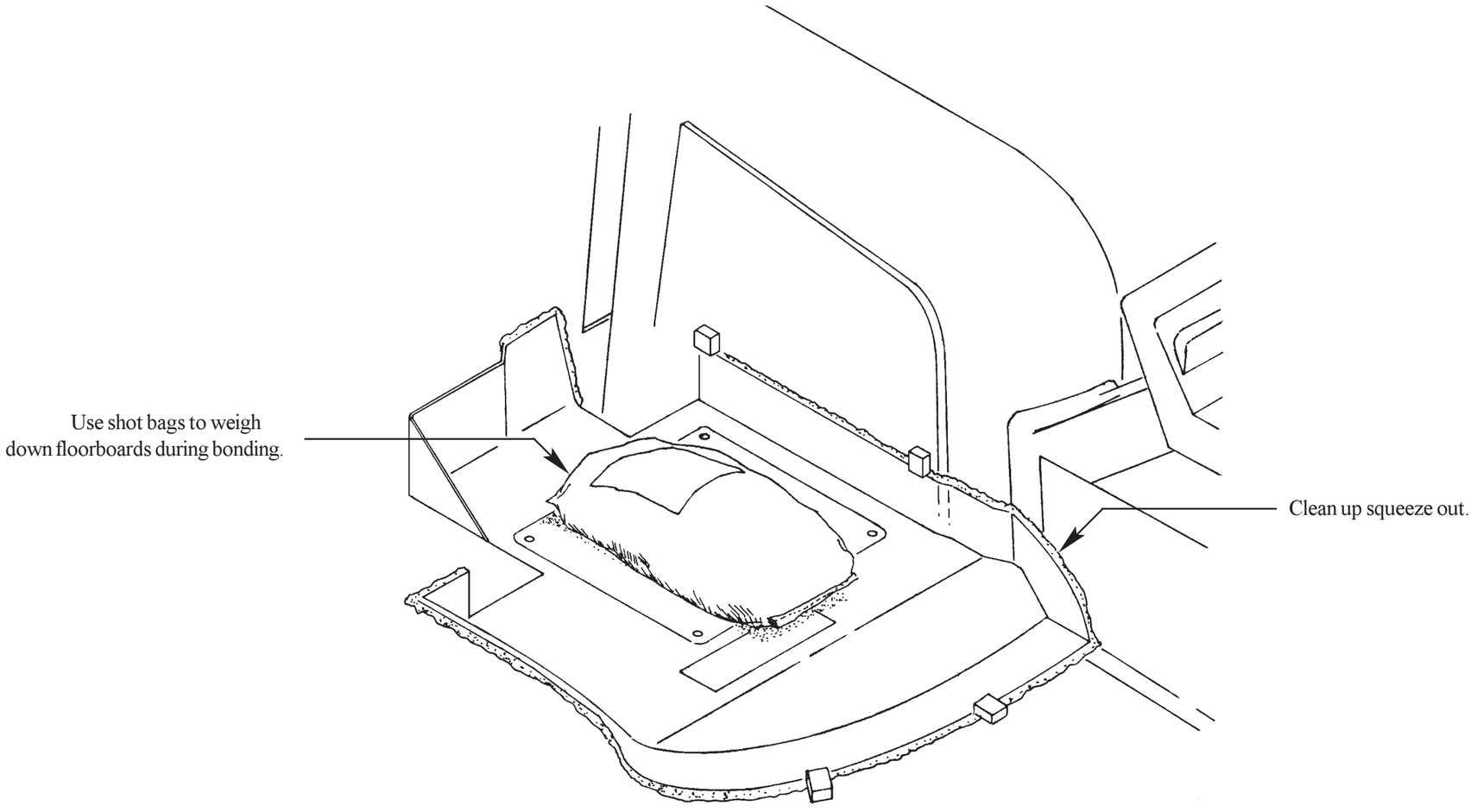
After installing the access panels and rudder pedals onto the floorboards you are now ready to bond the floorboards in the fuselage.

F 1. Remove the rudder pedals from the floorboards to ease floorboard installation.

F 2. Set the floorboards in place. They should fit snugly in place and shouldn't require much adjustments.



Bonding Rudder Floorboards
Fig 17:F:6



F 3. Bond the floorboards using Standard Bonding Procedures.

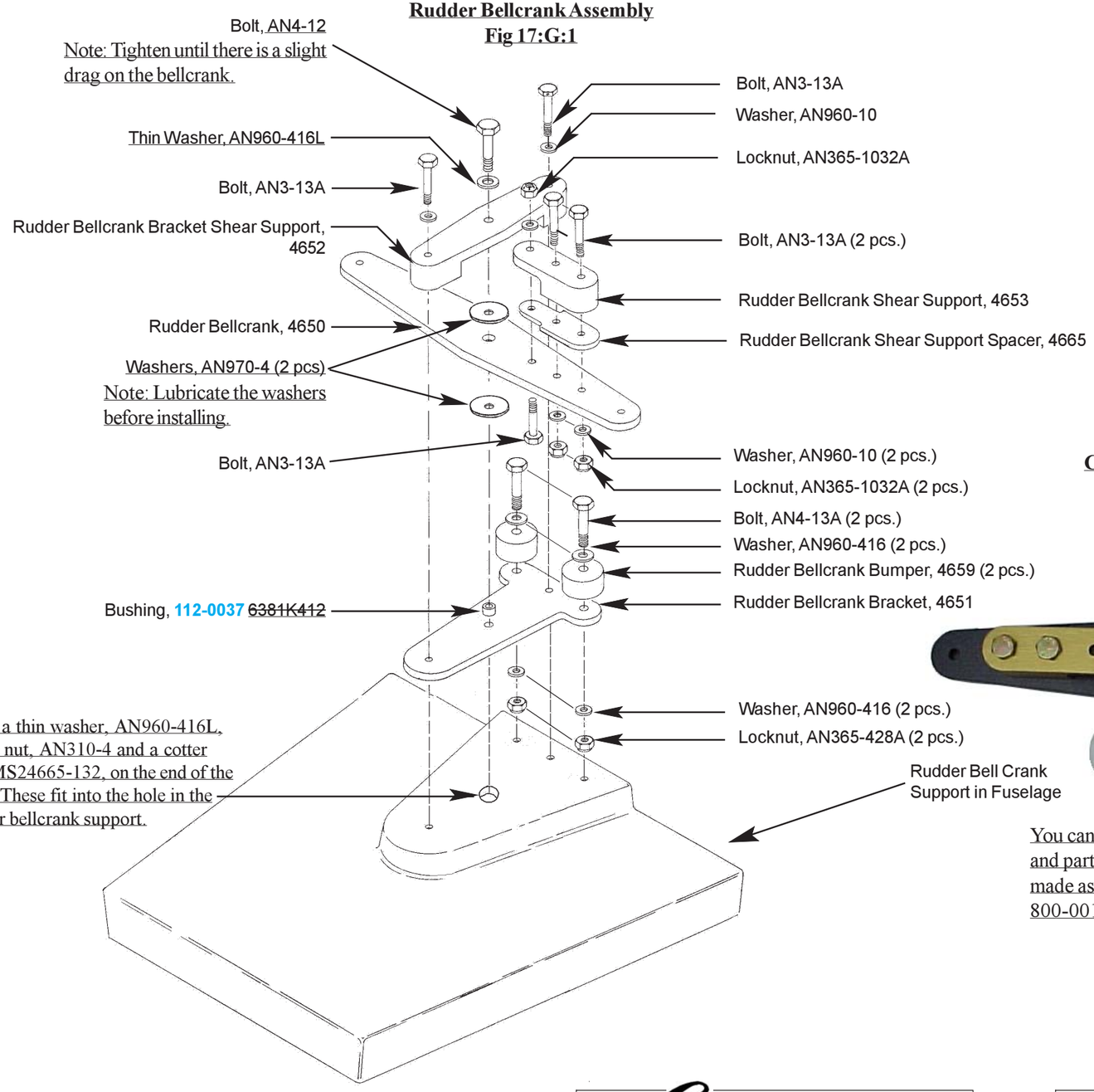
G. Rudder Bellcrank

Most of the rudder bellcrank assembly may be completed outside the aircraft, including the rudder pushrod. Note that one of the bolts going through the rudder bellcrank shear support points up. This is necessary for the bolt to clear the rudder bellcrank support in fuselage.

As always, double check all hardware lengths. There must be a minimum of one thread showing through the fastener.

Note: If your bellcrank has a couple of "bumps" on it, install such that the bumps face aft. The flat side should make contact with the bumpers.

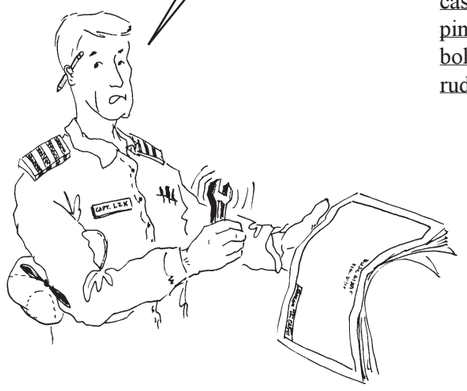
Rudder Bellcrank Assembly
Fig 17:G:1



Completed Rudder Bellcrank
Fig. 17:G:1a

You can assemble the bellcrank using the diagram and parts in figure 17:G:1 or you can request a pre-made assembly from KCI by ordering part number 800-0013.

Also study figure 17:H:1 prior to installation.

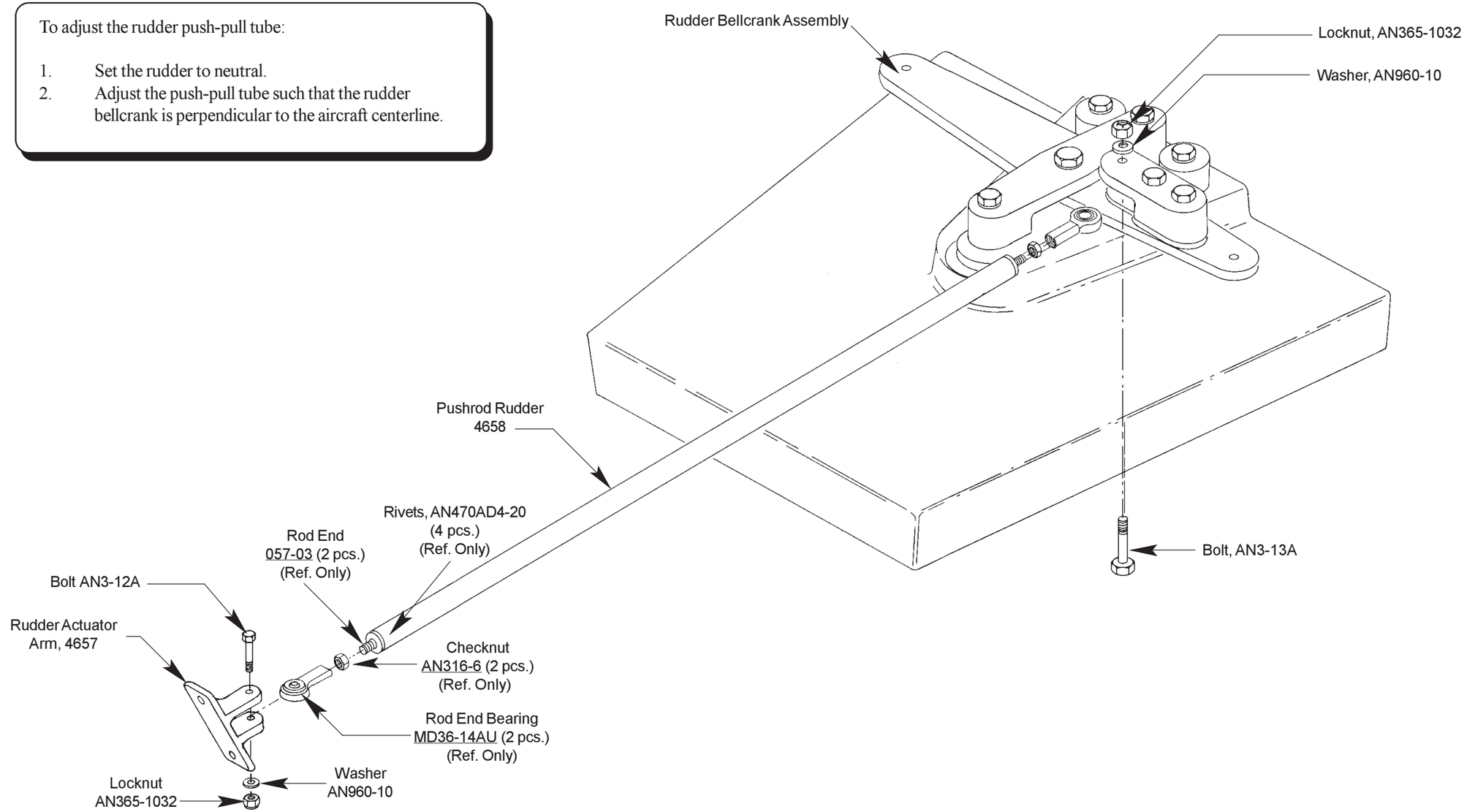


H. Rudder Pushrod

To adjust the rudder push-pull tube:

1. Set the rudder to neutral.
2. Adjust the push-pull tube such that the rudder bellcrank is perpendicular to the aircraft centerline.

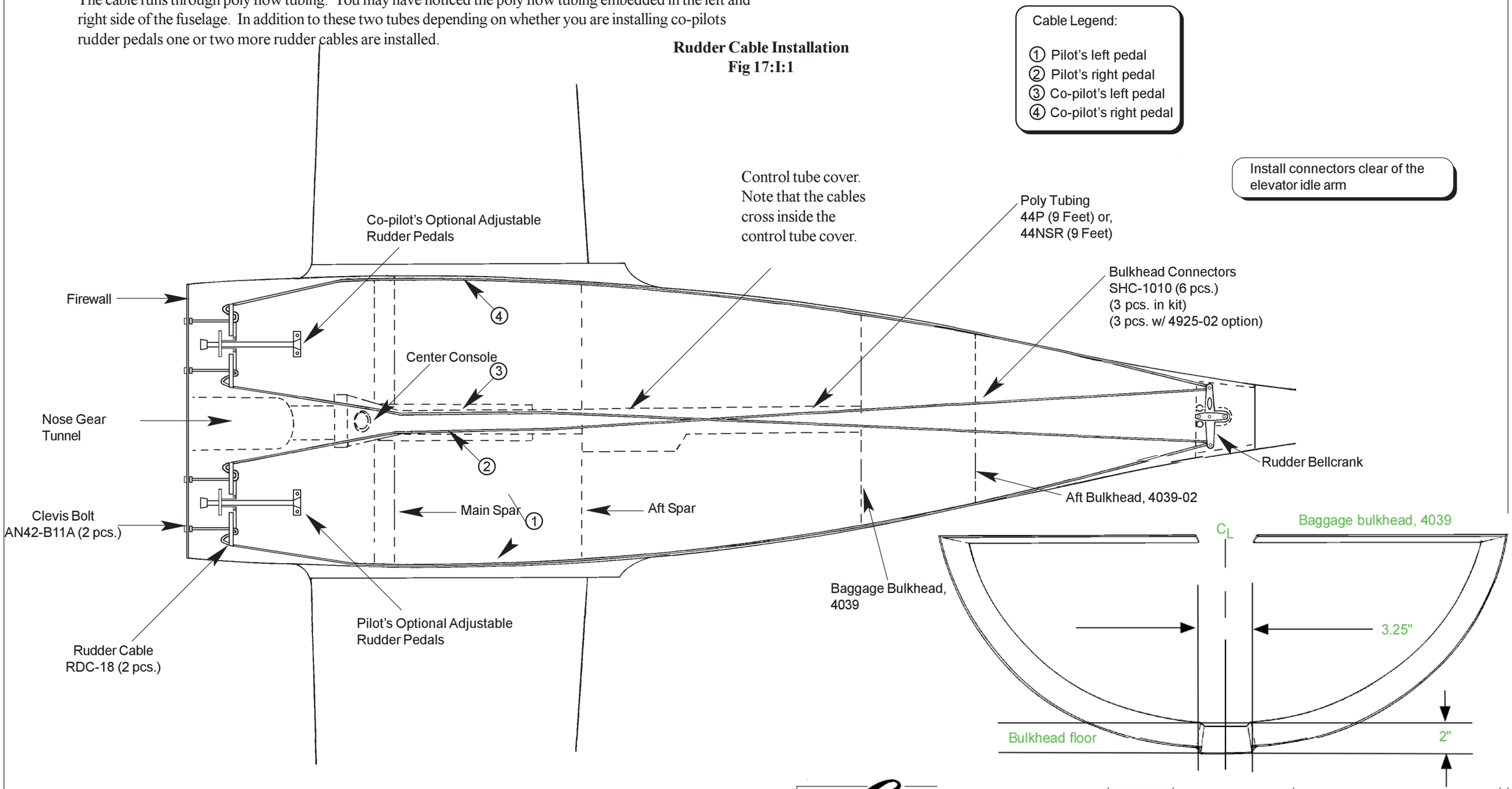
Rudder Pushrod Installation
Fig 17:H:1



I. Rudder Cable

The final link in the rudder controls is the cable that runs from the firewall to the rudder bellcrank. The cable runs through poly flow tubing. You may have noticed the poly flow tubing embedded in the left and right side of the fuselage. In addition to these two tubes depending on whether you are installing co-pilots rudder pedals one or two more rudder cables are installed.

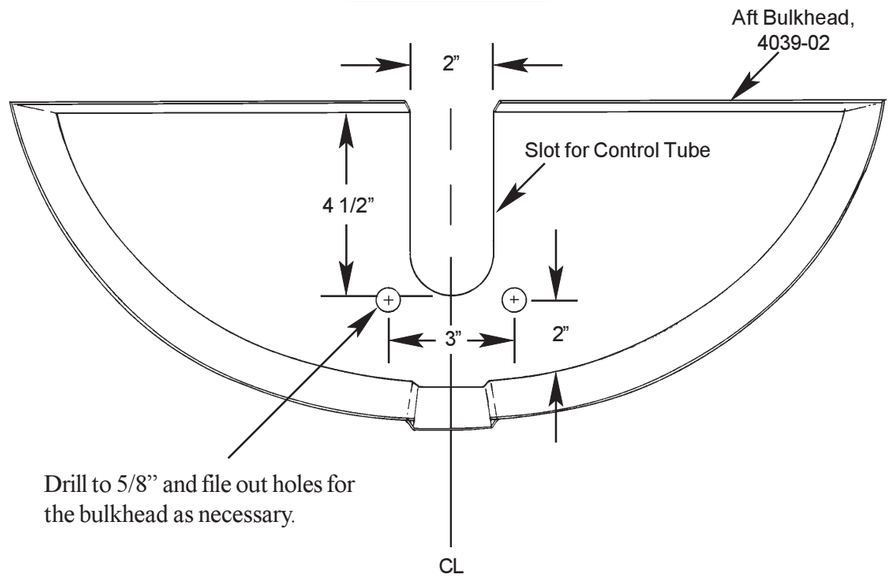
Rudder Cable Installation
Fig 17:I:1



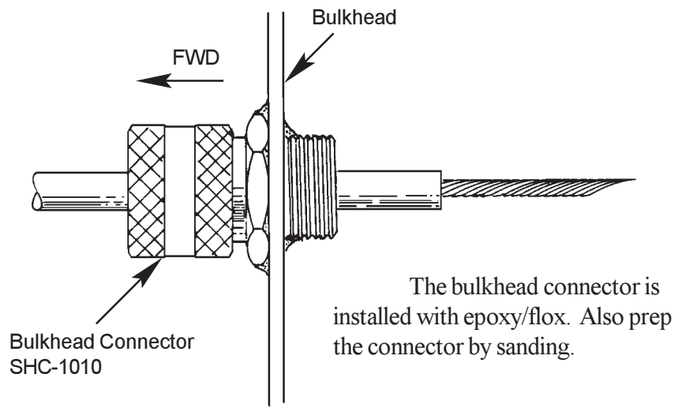
Aft Bulkhead Installation
Fig 17:I:2

Note: This bulkhead is optional and typically only installed if installing an Autopilot. 4039

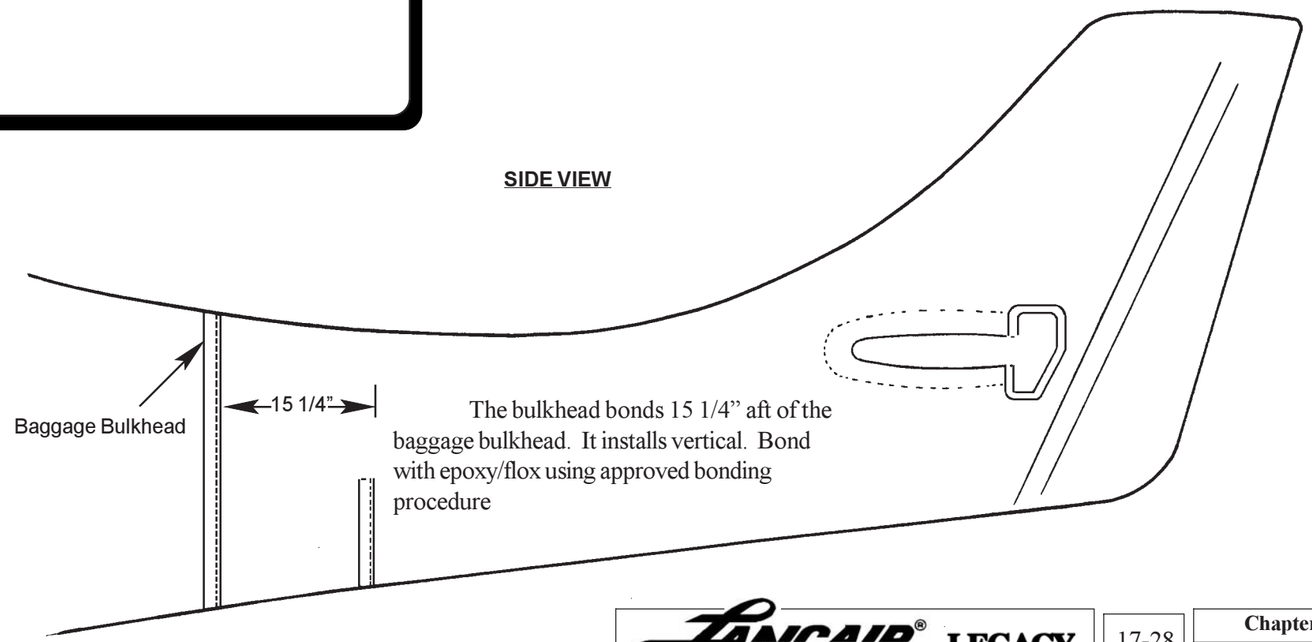
VIEW LOOKING AFT



BULKHEAD CONNECTOR INSTALLATION

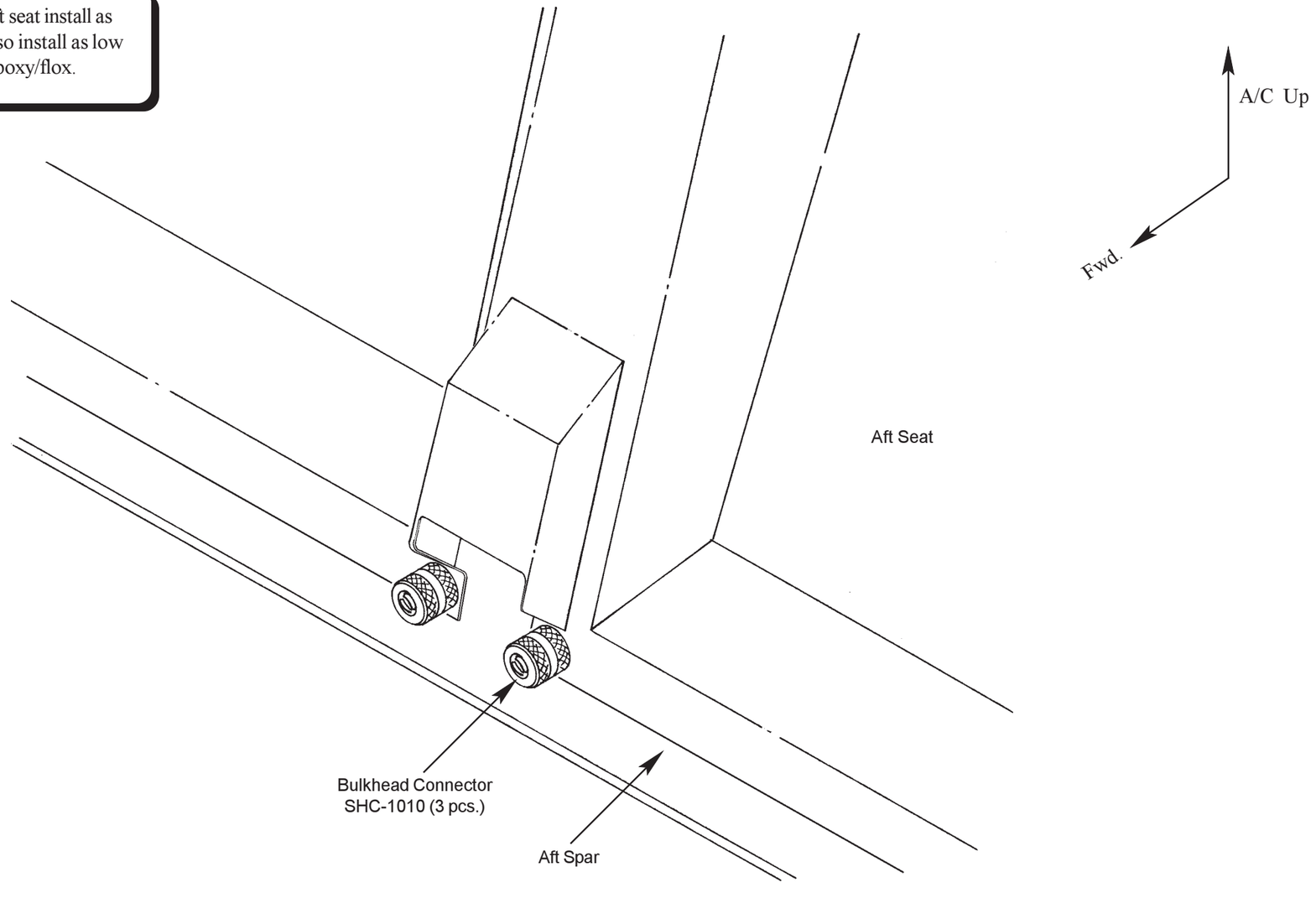


SIDE VIEW

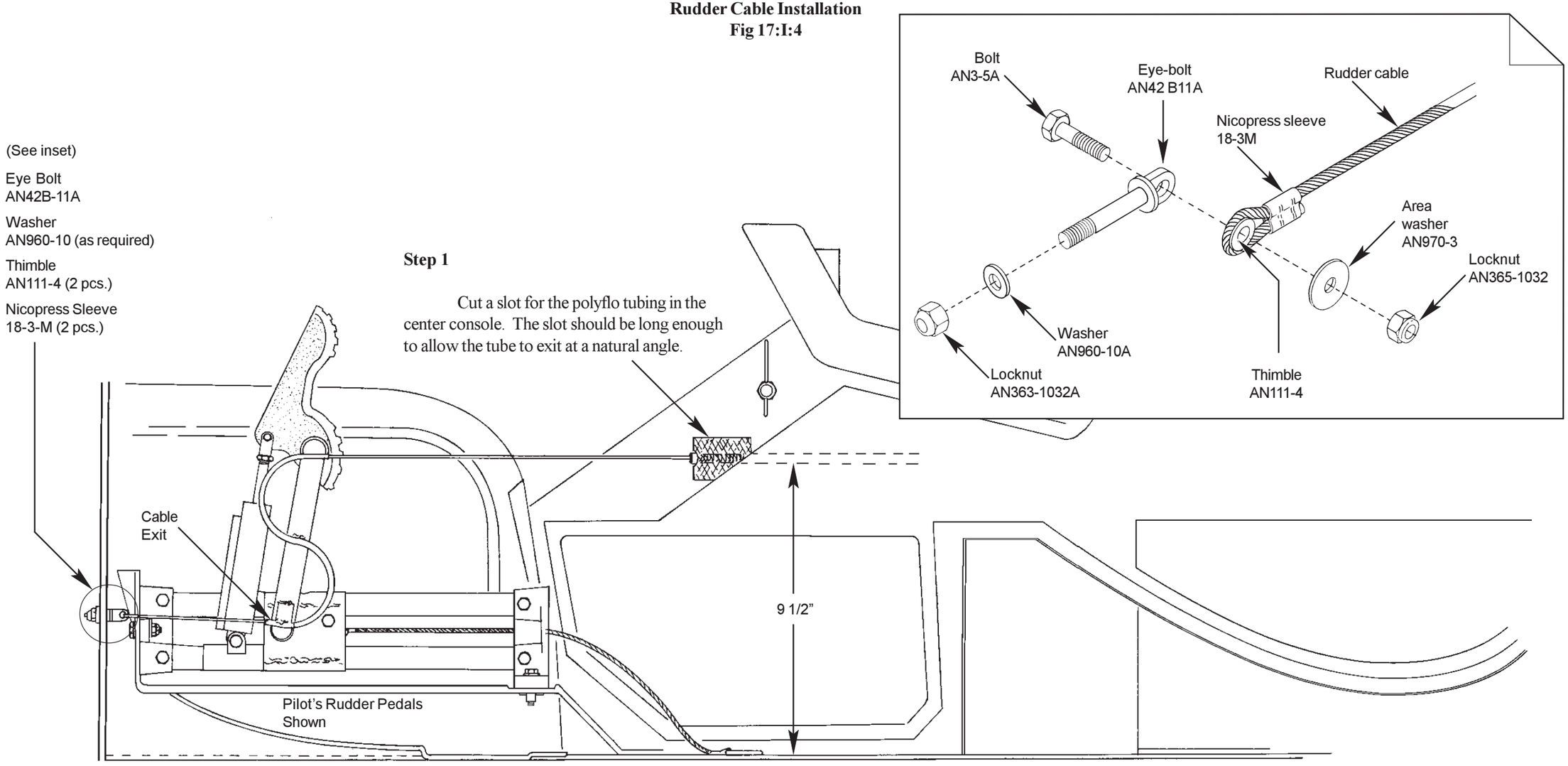


Bulkhead Connector Installation In Back Seat
Fig 17:I:3

The bulkhead connectors in the aft seat install as close as possible to the center console. Also install as low as possible. Install the connectors using epoxy/flox.



Rudder Cable Installation
Fig 17:I:4

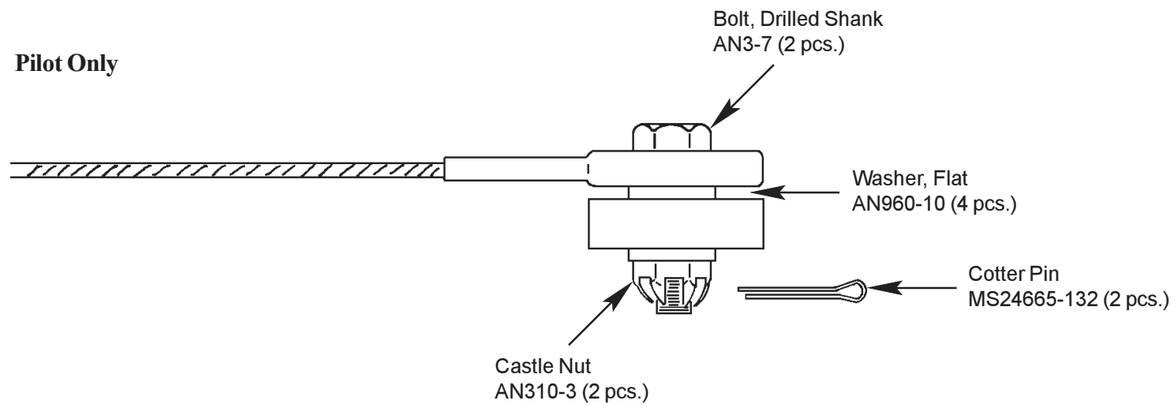


Step 2

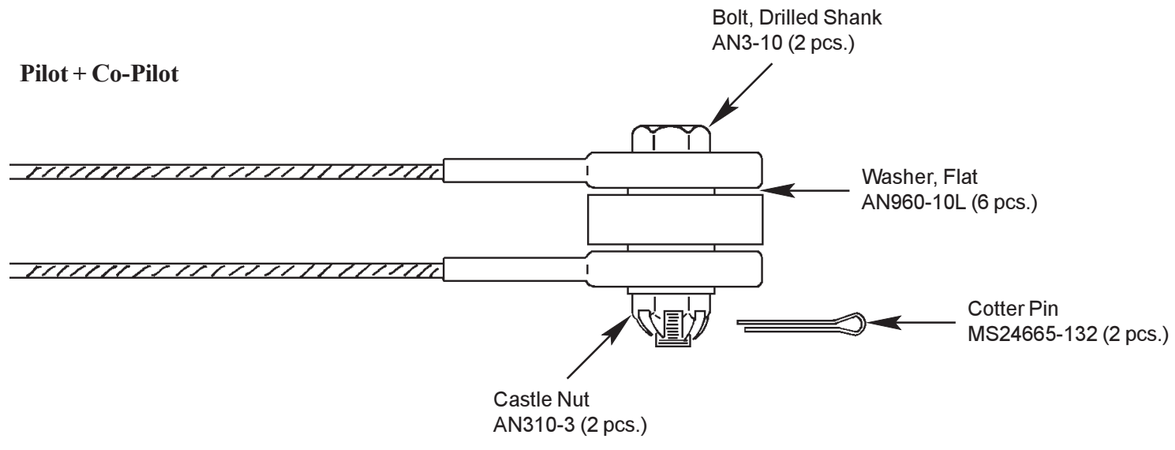
Prior to bonding the polyflo tubing, route the entire piece. Install into the bulkhead connectors. Make sure the lines are routed as straight as possible. The cables should align well with the rudder pedals.

Rudder Pedal Bellcrank Hardware
Fig 17:I:5

Pilot Only



Pilot + Co-Pilot



Step 3

Once you're satisfied with the routing of the cables, bond the exit end at the center console. First bond the end in place with epoxy/flox. (The tube must first be thoroughly sanded and prepped like any bond). Form a nice fillet and let cure. After cure, apply 4 BID extending the BID 1" above and below the tube.

Step 4

Clamp the two rudder pedals to each other such that they are both in the same position. They should be angled aft approximately 10°.

Step 5

Install the clevis bolts in the firewall. The bolts must be installed directly in front of the cable exit. Refer to Figure 17:I:4. Note that the outboard end will install in the engine mount reinforcement. On the inboard side the bolt installs in the cored area. Accurately mark the location of the bolt and de-core the firewall in this area. We suggest a coreless area of approximately one square inch. Reinforce the cored out area with a 4 BID extending onto the core by at least one inch.

Step 6

Install the clevis bolts with the majority of the washers on the aft side. This will allow you to tighten the cables later by removing washers.

Step 7

Fit and attach one cable using the nico press sleeve. Pull the cable snug as the length for the AN111 thimble is sized. Put some pressure on the rudder pedals to see how far they move when the slack is taken up. (Hopefully, not too much.)

If it seems the assembly refuses to install correctly, use a dremel with a good abrasive cutter blade to cut the nico press sleeve off and try it again.

WARNING: BE CAREFUL TO NOT EVEN NICK THE CABLE, IF THE OLD NICO PRESS SLEEVE IS BEING CUT OFF. A NICK IN THE CABLE COULD RESULT IN RUDDER, BRAKE AND GROUND STEERING FAILURE.

Put a small amount of lubrication on the lower tube of the pedal assembly where the holes for the locking pin can be seen. This is to allow the lock pin to easily slip into the detent under its spring load.

Adjusting the Pedal Position Aft

Simply pull the ring at the aft end of the assembly and the pedals will slide aft. Release the cable and apply forward pressure on both pedals, they will slide forward to the first available detent and lock there.

Adjusting the Pedal Position Forward

Hold a bit of pressure on both pedals and at the same time, pull the ring. While holding tension on the ring cord, push the pedals forward. Release and continue pushing. The pedals will lock into the next available forward position. (Thus it is best to release the ring cable tension when the pedals are nearly, but not quite, as far forward as one might like them. Then by pushing forward to the next detent, an appropriate length will be set.)