

# CHAPTER 17: CANOPY SYSTEMS

## 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 When such revisions are made, you should immediately replace all outdated pages with the revised pages.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 particular assembly step. However, time goes on and changes are made, so careful attention should be paid to the orientation arrows. That old cartoon of the guy agonizing over the plans for his canoe, built one end up, one end down, should not happen in real life. Especially to you.

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## 1. INTRODUCTION

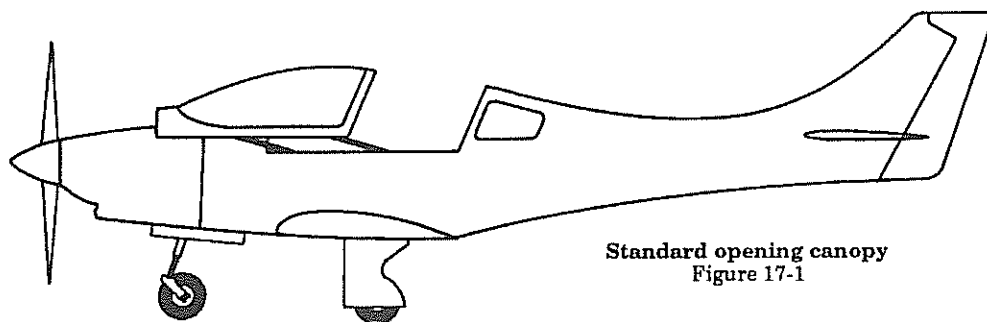
As previously discussed, the canopy frame installation must be initially fitted in conjunction with the forward deck and the top cowling. The cowling, being best fitted with the aid of the engine for placement, will most effectively locate the ideal forward deck line. The canopy frame will thus fit to that established line.

There are two installation methods to choose from at this time; the Standard Opening Canopy (figure 1) and the Forward hinge canopy (figure 2). **If you have chosen the fwd hinge style, then you may\* need to make modifications to the header tank before it is installed in chapter 11!** Refer to the specific instructions in section 5 of this chapter, the procedure for the fwd hinged canopy.

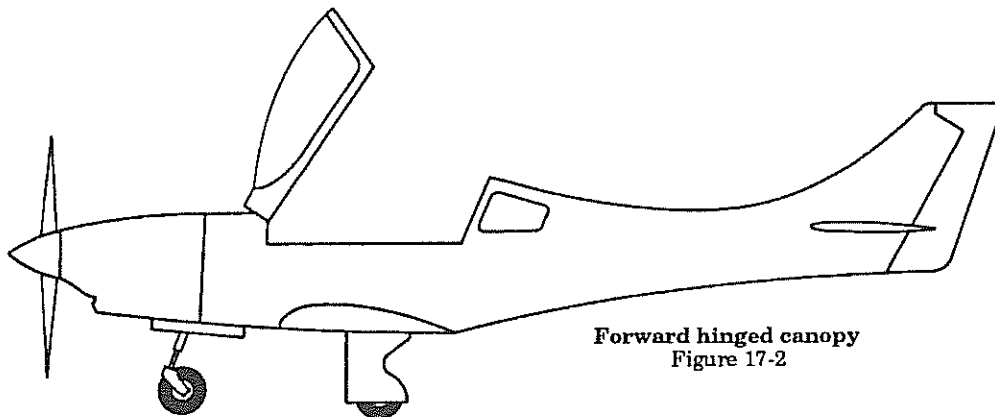
Both installations have their good points and trade-offs. The forward hinge method looks really sharp, but it will be a lot more work to install, whereas the standard method will be easier and cheaper to install.

You should review both methods before choosing, and then, after you have decided, it is again recommended that you re-read this entire chapter prior to performing the header tank installation and the canopy installation.

\*Kits shipped after 9-15-91 will have header tanks with the "pockets" already installed in them, so they can be used for either canopy opening system without need of modification.



Standard opening canopy  
Figure 17-1



Forward hinged canopy  
Figure 17-2

## 2. DRAWING LIST

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17-2	17-2	Forward hinge canopy
17-3	17-7	Canopy frame assembly
17-4	17-8	Tracing pattern for canopy braces
17-5	17-9	Canopy frame taped in position
17-6	17-10	Canopy frame hard points
17-7	17-11	Canopy pivot arc
17-8	17-12	Canopy frame brace
17-9	17-13	Canopy frame side rail channel
17-10	17-14	Latch installation, canopy frame side rail channel
17-11	17-16	Canopy to frame assembly
17-12	17-18	Canopy forward pivot weldment
17-13	17-19	Canopy fwd pivot, keeper / saddle
17-14	17-20	Fwd canopy swing mechanism
17-15	17-22	Aft canopy "H" pivot
17-16	17-27	Canopy to frame, cleco mounting
17-17	17-29	Canopy fairing
17-18	17-30	Canopy open stops
17-19	17-31	Canopy sealing
17-20	17-34	Modified header tank
17-21	17-35	Mold for header tank pocket
17-22	17-36	Forming pocket
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17-25	17-38	Pocket attachment
17-26	17-39	Locating strut bracket attach points on longeron
17-27	17-41	Marking and positioning mounting bracket
17-28	17-42	Fabricating strut bracket
17-29	17-43	Drilling holes in strut bracket and mounting plate
17-30	17-44	Installing nut plates on mounting plates
17-31	17-45	Removing/installing retainer clip in rod end
17-32	17-46	Locating strut bracket
17-33	17-48	Canopy frame assembly
17-34	17-49	Tracing pattern for canopy braces
17-35	17-50	Canopy frame taped in position
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17-37	17-55	Canopy stiffening
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17-55	17-88	Canopy locks
17-56	17-93	Canopy closure guide

### 3. EQUIPMENT REQUIRED - SPECIAL PARTS, TOOLS & SUPPLIES

#### A. Parts

- Pre-molded canopy frame
- Pre-molded plexiglass canopy
- Appropriate components for your choice of canopy - either swing arms or hinges and air pistons
- Key locks (optional)
- Solenoid locks (optional)
- "P" strip or equivalent sealing strip - about 18'.



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## B. Tools

- drill motor
- drill bits: 3/16"  
9/32"  
1/8"  
#12  
#19  
#30
- hammer
- hot glue gun or clamps
- tape measure
- rotary grinder (Dremel or equiv.)
- 1/4-20 tap & drill bit
- Clecoes (about 30)
- Cleco pliers
- Pencil



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### C. Materials & supplies

- L-320 Forward Hinge Canopy Kit (Optional)
- Uni-Directional carbon fiber (for fwd hinge canopy only)
- epoxy
- flox
- BID cloth
- micro
- sandpaper, assorted grit
- Duct tape or release tape
- MC or acetone for cleaning
- structural adhesive
- 1/4" and 1/2" white Clark foam sheets
- plastic tape (release tape)
- 1/4" phenolic material for hard points
- instant or hot glue
- Nails for making canopy frame brace
- 2" x 4" board, 16-17" long
- Inflatable "D" seal or equiv.
- 3/8" plywood or equiv.
- Some scrap wood for making a canopy frame brace / holding fixture
- Double-sided tape or equiv.
- Bondo or equivalent
- .090" aluminum for hard points
- plastic electrical tape (1/2" wide - get a couple of rolls)



#### 4. **PROCEDURE: Standard Opening Canopy**

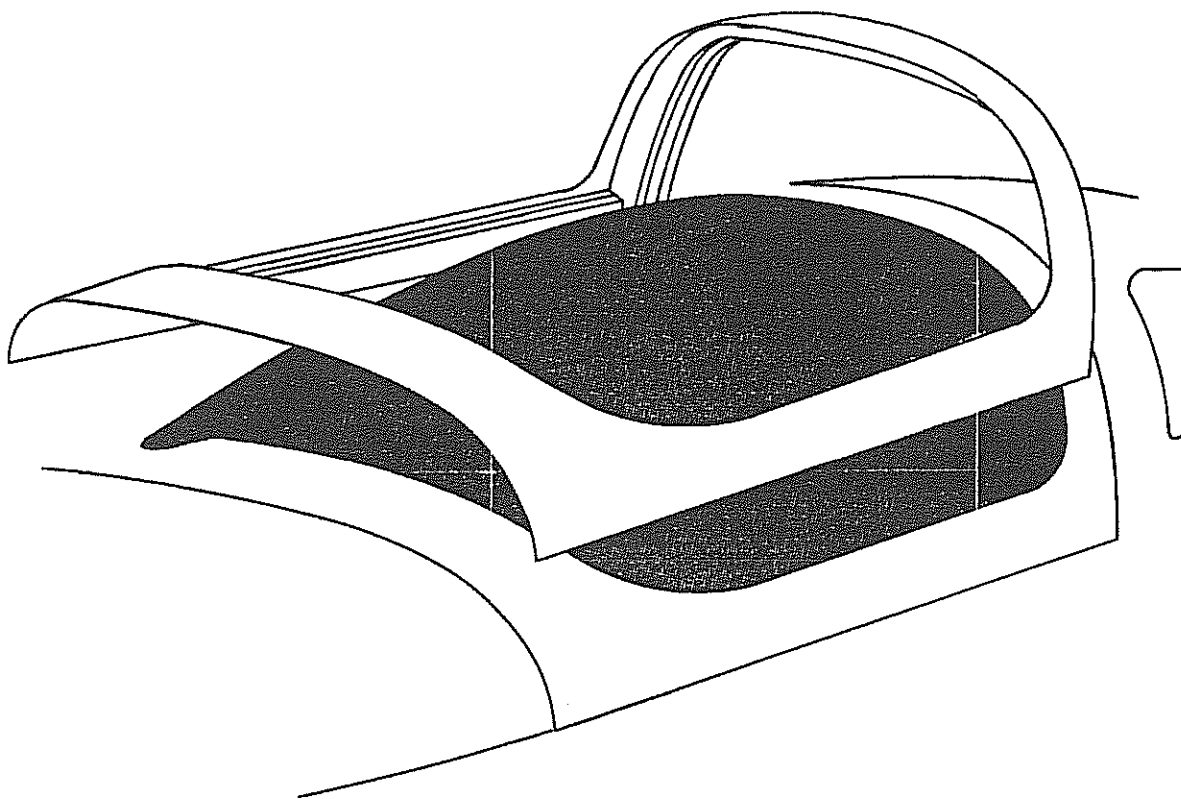
##### A. **Canopy frame**

1. Since you have already established the fwd deck location, cleco it in place as shown in figure 17-5.
2. In order to have the canopy frame maintain the proper shape, and still be able to work on it, a brace for it must be constructed. Get two pieces of plywood or equiv. and make a contour pattern of the fwd deck at the junction of the canopy frame and also a pattern of the rear roll over. These do not have to be accurate at all, just pencil them in by placing the piece of plywood on the longerons and by laying a pencil flat on the decks, trace off the contour line all the way down to the longerons. These pieces of wood should be about 6" wider than the fuselage at their relative positions so that they hang over the longerons by 3" per side. They will be used later to make a quick and simple jig to hold the canopy frame when you remove it from the fuselage. By making sure that the wood is level, it will be easy to sit the frame upside down later without it "walking around" when you're working on it. See figure 17-4. Set the wood aside.

#### **Canopy frame assembly**

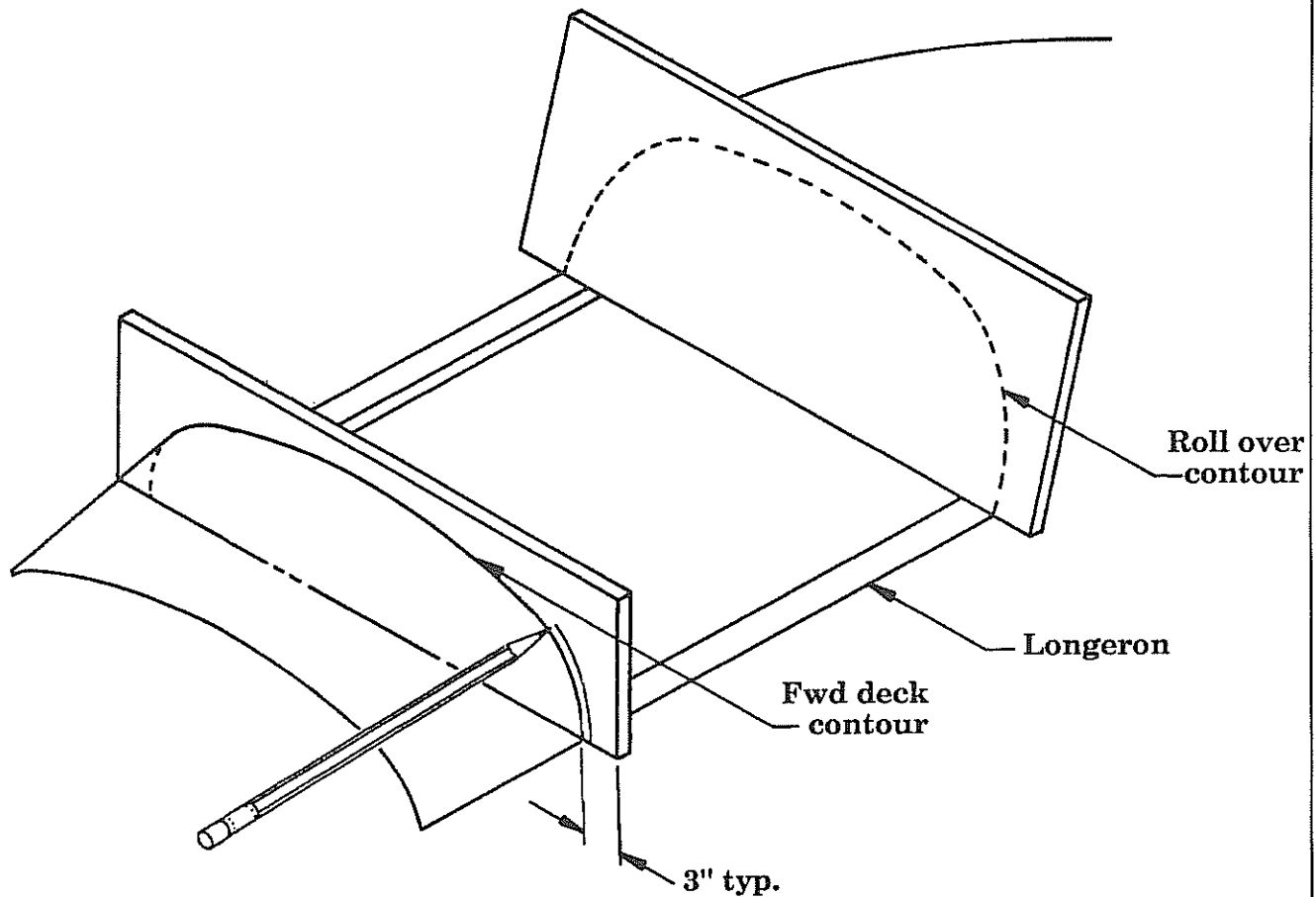
EXPLODED VIEW

Figure 17-3



## TRACING PATTERN for CANOPY BRACES

Figure 17-4



3. Lay the canopy frame over the airframe in relative position. Check for side rail alignment, the frame sides will eventually have approximately 1/8" - 3/16" clearance from the top of the longerons. This is to allow for a "P" strip seal or equiv.



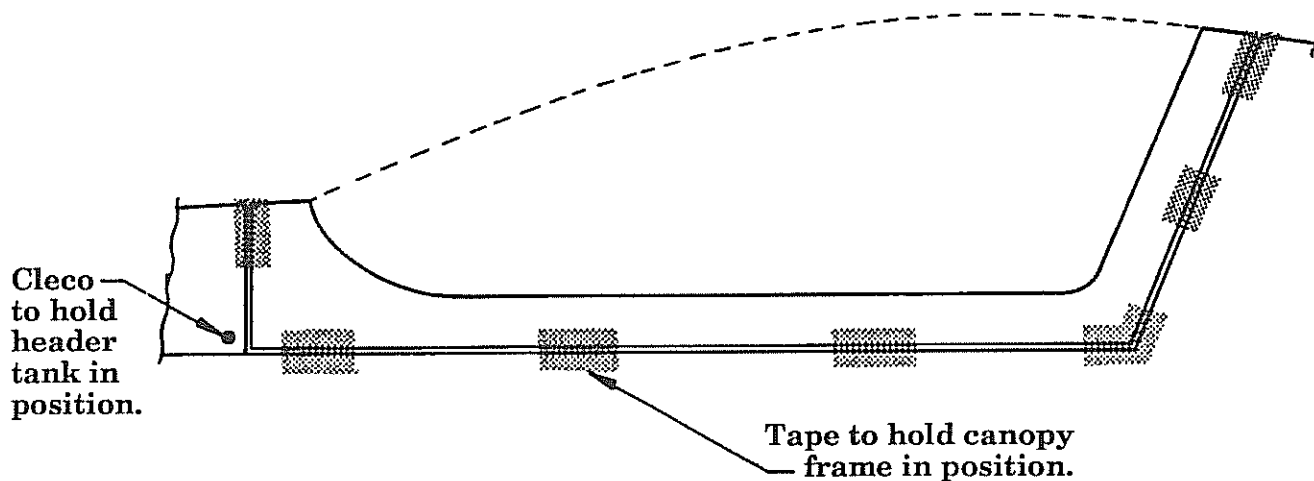
4. Locate the frame in a fwd/aft orientation that places it at a point which allows for complete coverage of both the fwd deck joggle and the aft roll over joggle. The frame has been factory trimmed to mate with these joggles. If at all possible, it is generally best to orientate the frame as far fwd as possible, this will provide additional instrument room since the distance from canopy to panel would be at its maximum potential. Trim and sand as necessary to establish an alignment with the L.E. of the fwd deck joggle and alignment with the T.E. of the aft roll over joggle.

**NOTE:** It is recommended that before you trim any of the material on the sides of the frame, first be sure that the frame is flushed up with the surfaces of the fwd deck and aft deck. The joggle may be initially too deep so use short pieces of mixing sticks to shim the frame up to a flush condition. Use dabs of hot or instant glue to hold these shims in temporary position as shown in figure 17-5.

**NOTE:** Do not trim the inside of the frame (where the canopy will install) until you have laid the canopy itself over and verified dimensions. You'll want to establish at least 5/8" overlap on all areas except for the front curved area where the overlap can be a little less. (The canopy will be bonded to the inside of the frame but you can verify dimensions by fitting it over the top initially.)

### Canopy frame taped in position

Figure 17-5

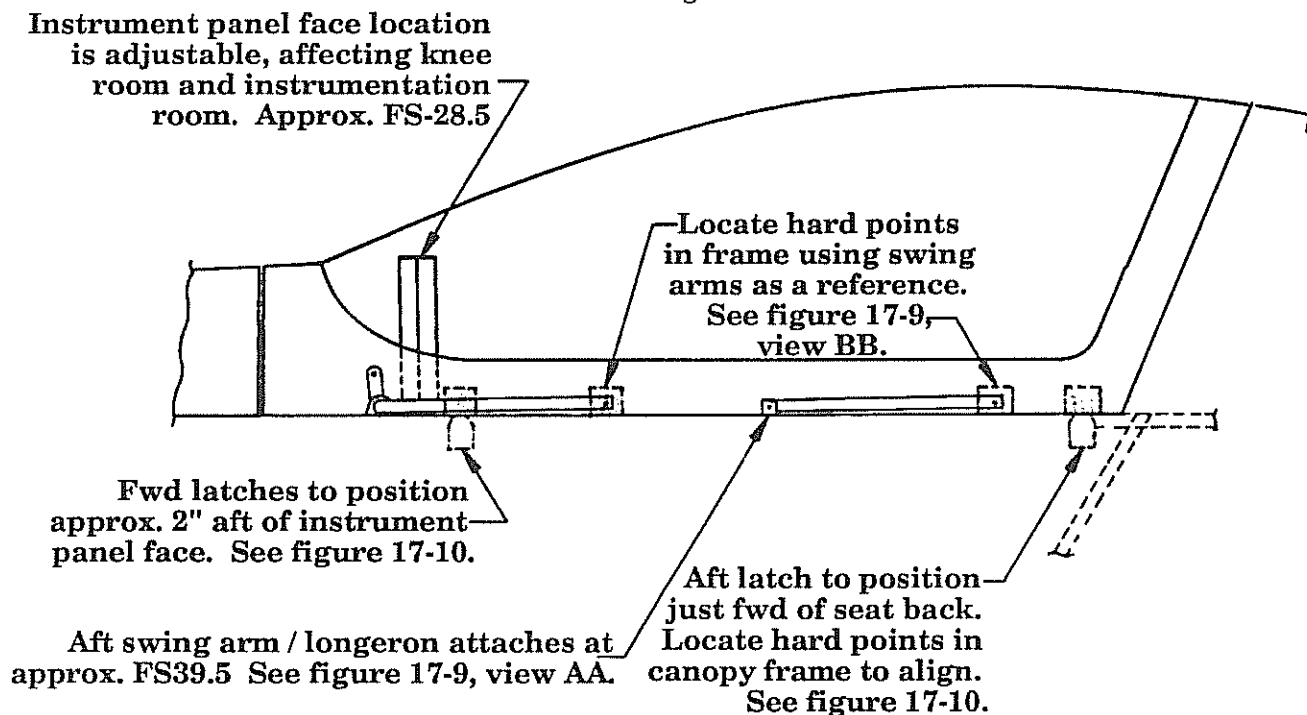


5. With the canopy frame fitted into the joggles you are ready to trim the lower edges as necessary to accurately match the frame side profile to the fuselage sides. By using mixing sticks and hot or instant glue, and cutting and sanding as necessary, position the canopy frame so that it is flush with the fuselage profile, with about 1/8" gap between the frame sides and the longerons, even fore & aft and on both sides. Either sand this to a smooth line now, or mark it well and sand it later after you install the bracing and remove the canopy frame for other steps.
6. Referring to figure 17-6, carefully lay out the hard point positions by marking their lines onto the fslg sides. Draw a line that crosses the longerons vertically and thus provides position marking reference on both the canopy frame (inside and outside) and the fslg. Label them as "fwd canopy swing, aft canopy swing, latch, etc. (This can become confusing later so some simple labeling now will eliminate some later head scratching.) Also mark the area that foam will need to be removed from to make clearance for the swing arms.

There will be eight hardpoints that must be installed for the swing arms; four on the inside of the outbd edge of the canopy frame, and four on the outbd side of the inbd edge. You will also need four hardpoints for the latches, two fore and two aft, on the outbd side of the inbd edge of the frame lip.

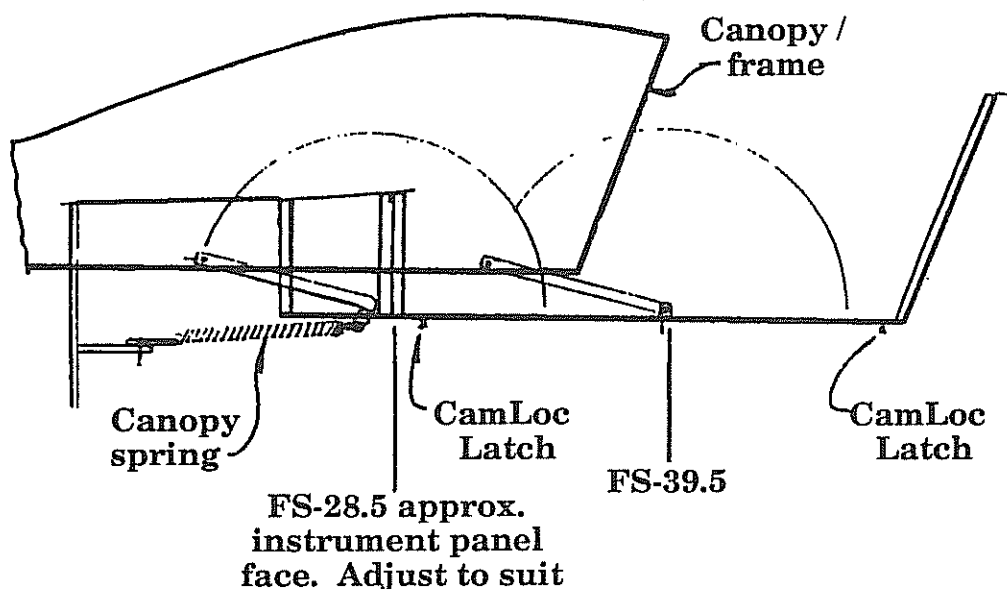
### CANOPY FRAME HARD POINTS

Figure 17-6



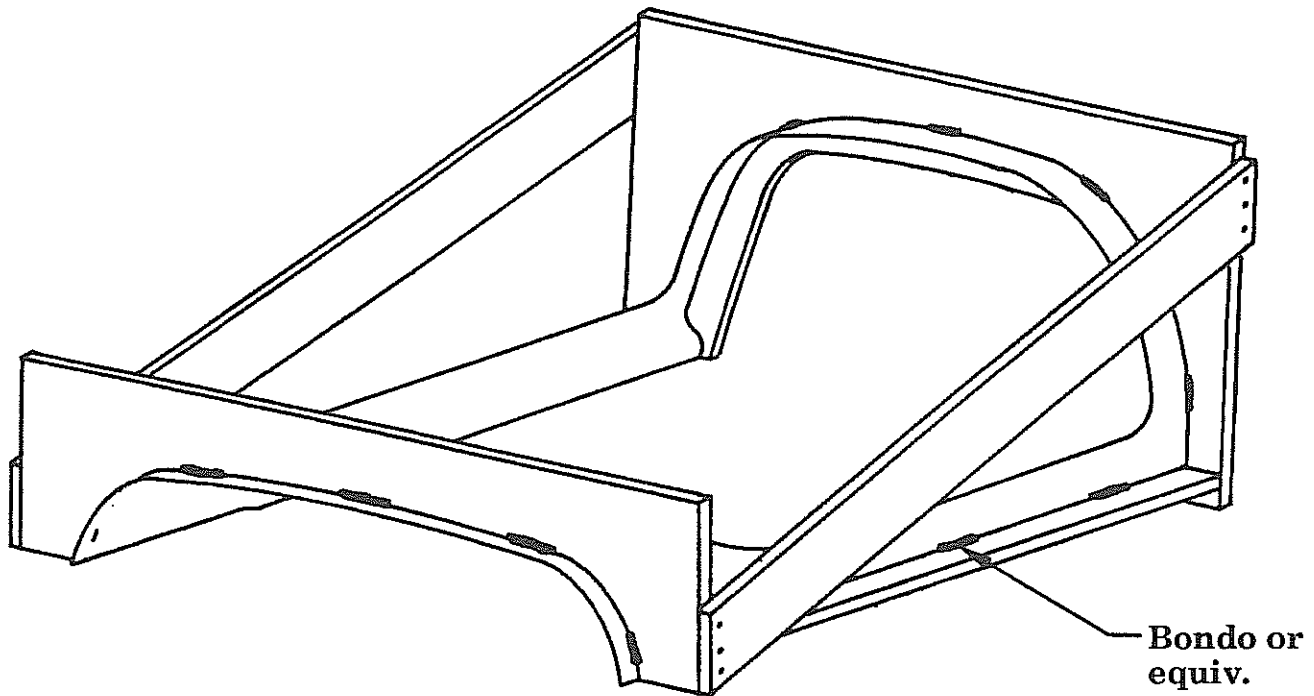
7. Referring to figure 17-7, mark off on the inside of the canopy frame the area that will have to be cleared of foam for the swing arms when they are in both the open and closed positions. Label these marks so you can recognize them later, you'll be pulling the frame off in a while to grind out the foam and you don't want to have to be putting this thing on and taking it off any more than you must.

**CANOPY PIVOT ARC**  
FIGURE 17-7



8. Now that the exterior of the canopy frame is the exact shape we want it to be, and we have all of the hard point locations marked off, we need to construct a brace to hold it in that position while we do some extensive modifying on the inside. Using a sabre or jig saw, cut out the plywood pieces you marked earlier, so that you have a silhouette that is slightly larger than the canopy frame itself. Don't bother trying to get it even close, Bondo will take care of that.
9. Sand the braces to remove any splinters that would get you later, and wipe the inside edge of the patterns with acetone or MC to clean them for the next step.
10. Referring to figure 17-8, mix up a big hot (lots of hardener) gob of Bondo, spread it along the forward part of the canopy frame from one side to the other, in spots about 2" long and a half inch deep. Squish the forward brace piece down into position, wiggling it a bit to get it down to the frame through the Bondo. Check that the top line of the board is level side to side (so it will be able to rest upside down) and true vertical (so it won't fold under when there is weight on it) and hold it for about 5 minutes while the Bondo cures enough to hold its position. Repeat this process for the aft brace.

Canopy frame brace  
Figure 17-8



11. Nail, screw or glue a couple of pieces of wood as shown in figure 17-8 between the two braces to make them a more rigid structure. Then use some more Bondo to put a couple of fore-aft braces down the sides of the frame, bedding the wood as you did in step 6, and then screw or nail it to the front and back braces. **BE SURE NOT TO DISTORT YOUR CANOPY FRAME WHEN YOU DO THIS** - When you are finished with the next steps, if you have distorted it here, the distortions will be permanent!

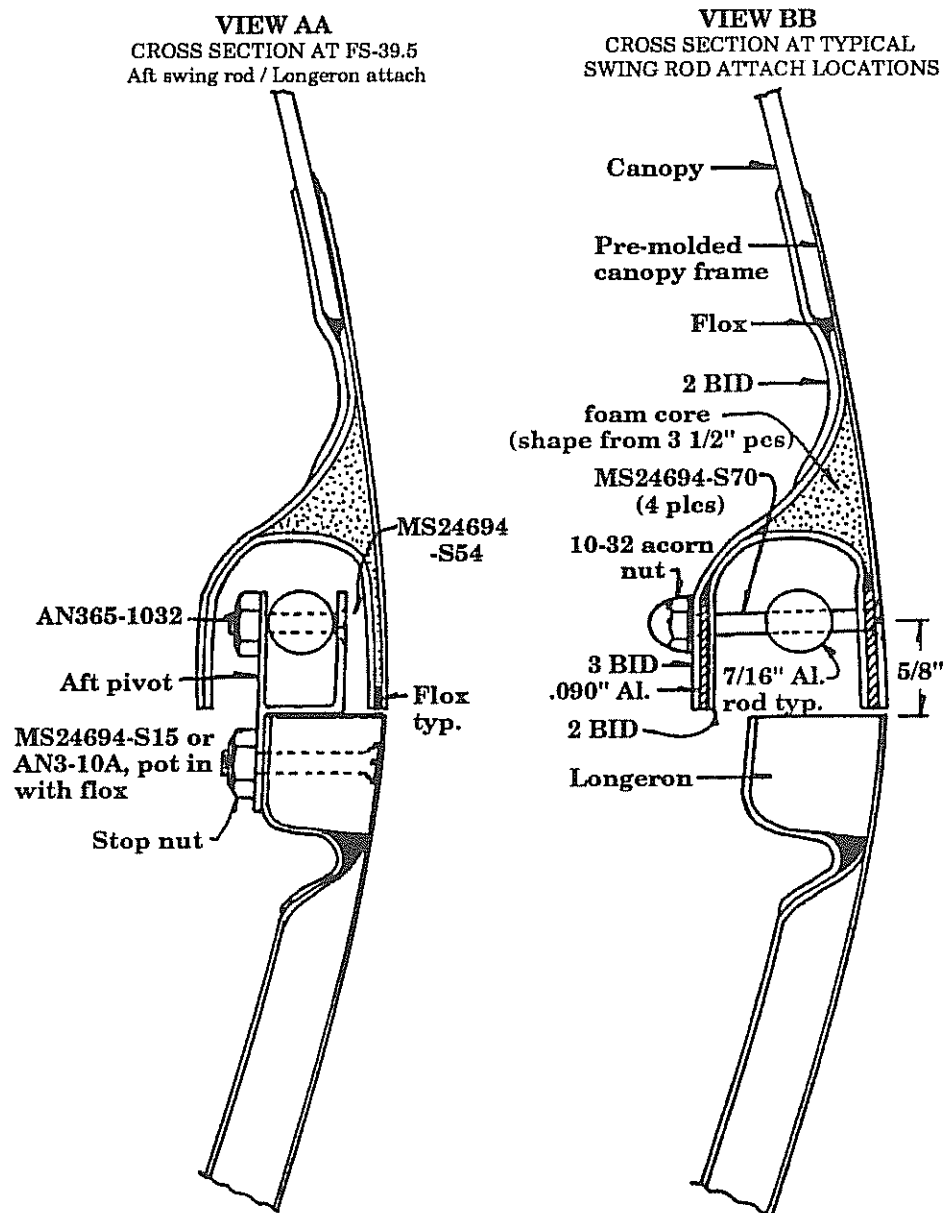
Later on, when you are finished with the frame, you can simply knock the boards off with a good smack of a hammer.

12. Cut 8 pieces of .090" aluminum that are 1-1/4" square. These will be potted into the side rails (inside and outside surfaces) at all four attach points where the canopy parallelogram arms connect. See figure 17-6.
13. Cut 4 pieces of .090" aluminum that are 2" long x 1-1/4" wide. These will be potted into the inner sides of the frame where the four latches will anchor, see figure 17-6.
14. Remove the canopy frame and bracing from the fslg and place it inverted on a bench or on the floor. Sand a smooth line onto the bottom of the rails to create a finished line for the side rails, if you didn't do this in step 5.

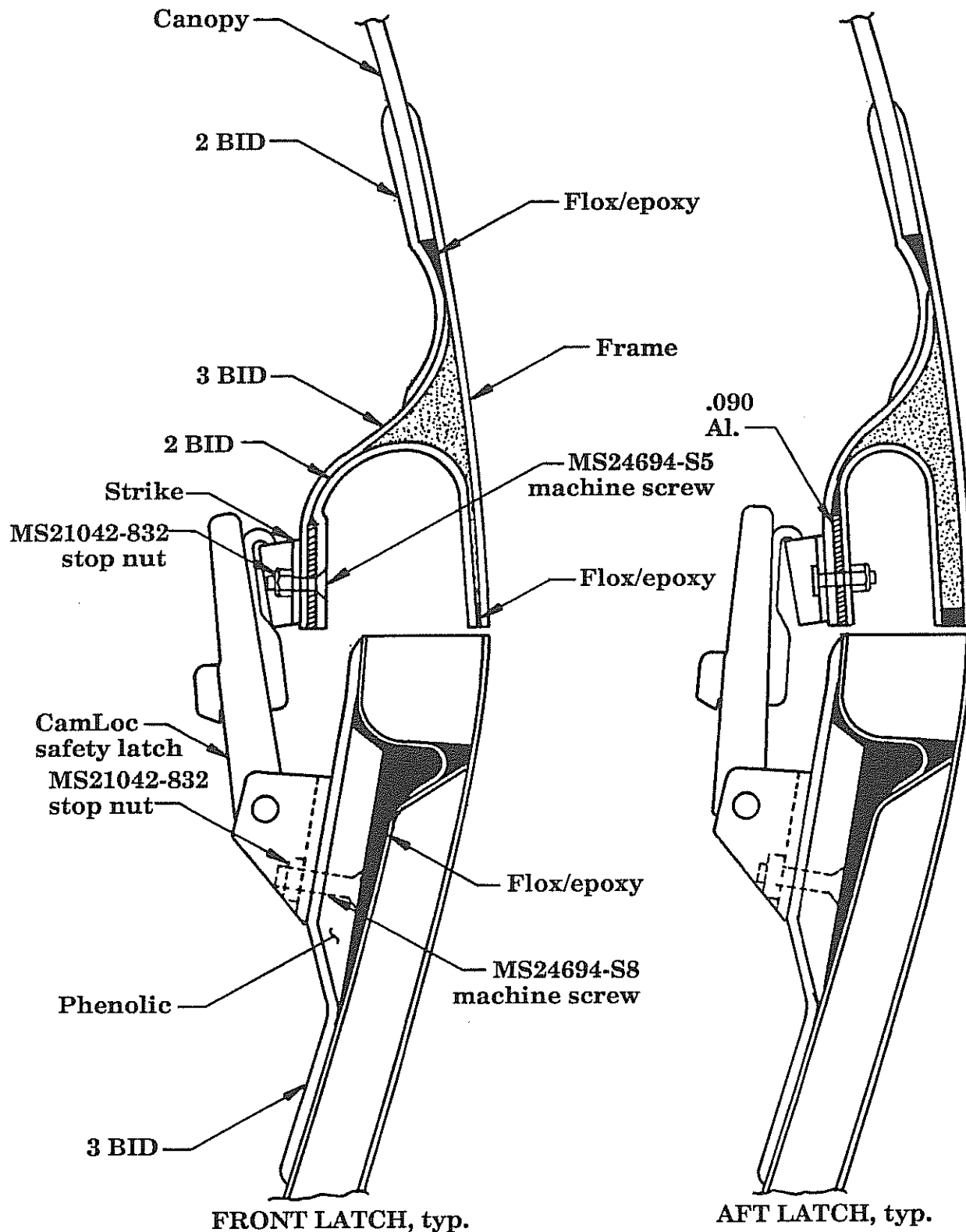
15. Using a drill with a router bit (or using a Dremel tool), remove the foam from the inside bottom of the side rails to form a channel. See figures 17-9 and 17-10. This channel should be made such that about 3/16" of foam remains along the outbd sides, the inbd sides can be carved out on a taper so that you will end up with a glass to glass edge. See cross sectional drawing, figure 17-10. (A fairly standard "ball" type router bit is available in most hardware stores, these are sometimes called "rotary rasps".)

### CANOPY FRAME SIDE RAIL CHANNEL CROSS SECTION VIEWS

Figure 17-9



**LATCH INSTALLATION**  
**CANOPY FRAME SIDE RAIL CHANNEL**  
**CROSS SECTION VIEW**  
 Figure 17-10



16. Once the channel is carved out fairly close to final size, go in by hand with a piece of 40 grit sand paper and give it a final sanding to smooth everything up.

**NOTE:** Clearances are fairly tight, particularly where the aluminum extrusion fits into the channel when the canopy is closed. Locate that area and establish proper clearances. Also the wide channel can terminate at an aft point that is approximately 1" aft of the rear swing arm attachment position however, the channel must continue aft to the point where the rear latches will be positioned. At that location, the channel can be narrower but room must be maintained to allow access for the latch "strike" mounting nuts. See figure 17-10.

**WARNING:** The four hard points that will attach the lock mechanisms will require the full elimination of foam against the inbd side of the channel where the aluminum inserts will mount. For structural integrity, all foam must be removed, thus the inner BID will attach directly to the aluminum inserts. See figure 17-10.

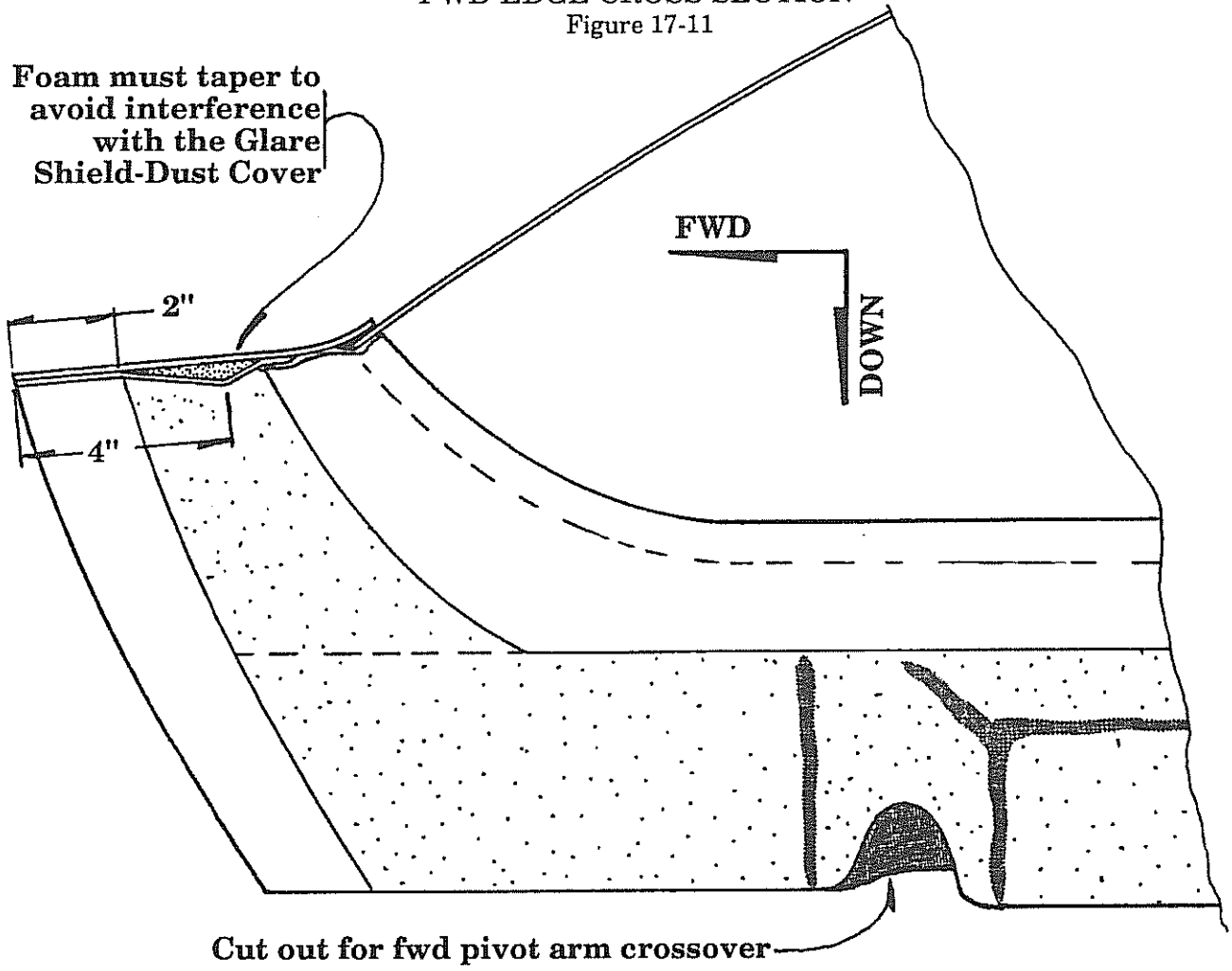
17. Remove the foam from the outbd section of the frame where the swing rod attach hardpoints will mount, sanding away all foam. Clean the area with MC or acetone. Rough up all surfaces of the four outbd aluminum hardpoints, clean them thoroughly with MC and, using epoxy/micro (or preferably, structural adhesive), bond them against the canopy frame. A small clamp should be used to hold them in place until cured. The squeeze-out of adhesive should be formed into a nice fillet, and any extra cleaned off before it hardens.
18. Locate and install the four inner hard points that will pick up the latches. Be sure to rough up the aluminum and clean it well for a good bond.
19. The fwd pivot weldment will exit the channel through a required cut in the channel walls adjacent to the instrument panel. See figure 17-11. Make this cut out now.
20. With the channel completed, it is a good idea to lay the canopy frame (with braces still attached) back onto the airframe and verify that the channel will clear all the rods that must lay inside when the canopy is closed. Adjust as required. Try to maintain as large of a lip on the outbd portion of the channel sides as possible. This will help provide a good surface upon which to place a seal strip later. With the checks made, place the frame back on the bench.
21. Apply a 2 BID lay up into the channel. Use a thin application of micro over the foam first to seal the foam pores. See figures 17-9 and 17-10.



# CANOPY to FRAME ASSEMBLY FWD EDGE CROSS SECTION

Figure 17-11

Foam must taper to  
avoid interference  
with the Glare  
Shield-Dust Cover



Cut out for fwd pivot arm crossover



## B. Canopy swing mechanism - canopy fwd pivot weldment

The standard mechanism that opens and closes the canopy is that of a parallelogram system. There is one fwd cross weldment that crosses the fslg in front of the instrument panel and two aft swing arms that attach the aft portion of the canopy to the longerons. This will produce a movement that rotates the canopy up and forward providing excellent access into the cockpit area from either side of the plane. This system is spring loaded so that it will operate with finger tip ease.

1. Position the fwd canopy pivot weldment across the longerons. The actual FS location is not critical. If you keep at least three inches fwd of the instrument panel, then you will have room to install circuit breakers, switches, etc. along the bottom and still clear this pivot weldment. (A suitable position for the weldment is approximately FS-23).
2. The weldment must not extend more than half way over the longerons on each side. This is to allow adequate room for the canopy frame to extend down past the weldment and seal against the outbd portion of the longerons. See figure 17-12.
3. Lay the weldment down on the longerons and square it with the center line of the fuselage. Note the angle that the 12" arms form when laid on the longerons. They should approximately parallel the widening nature of the longeron spacing as they move aft, i.e., when moving aft, as the cockpit gets wider, the canopy pivot weldment should be bent to approximately follow that widening span. This can be easily tailored by simply putting a little additional bend if needed at the existing bends in the weldment.
4. Now, to make things work a little better yet, place a counter bend in the top of each arm on that weldment such to help align the through holes as approximately parallel to each other, see figure 17-12. This will help later when drilling for the attachment bolt holes in the canopy frame.

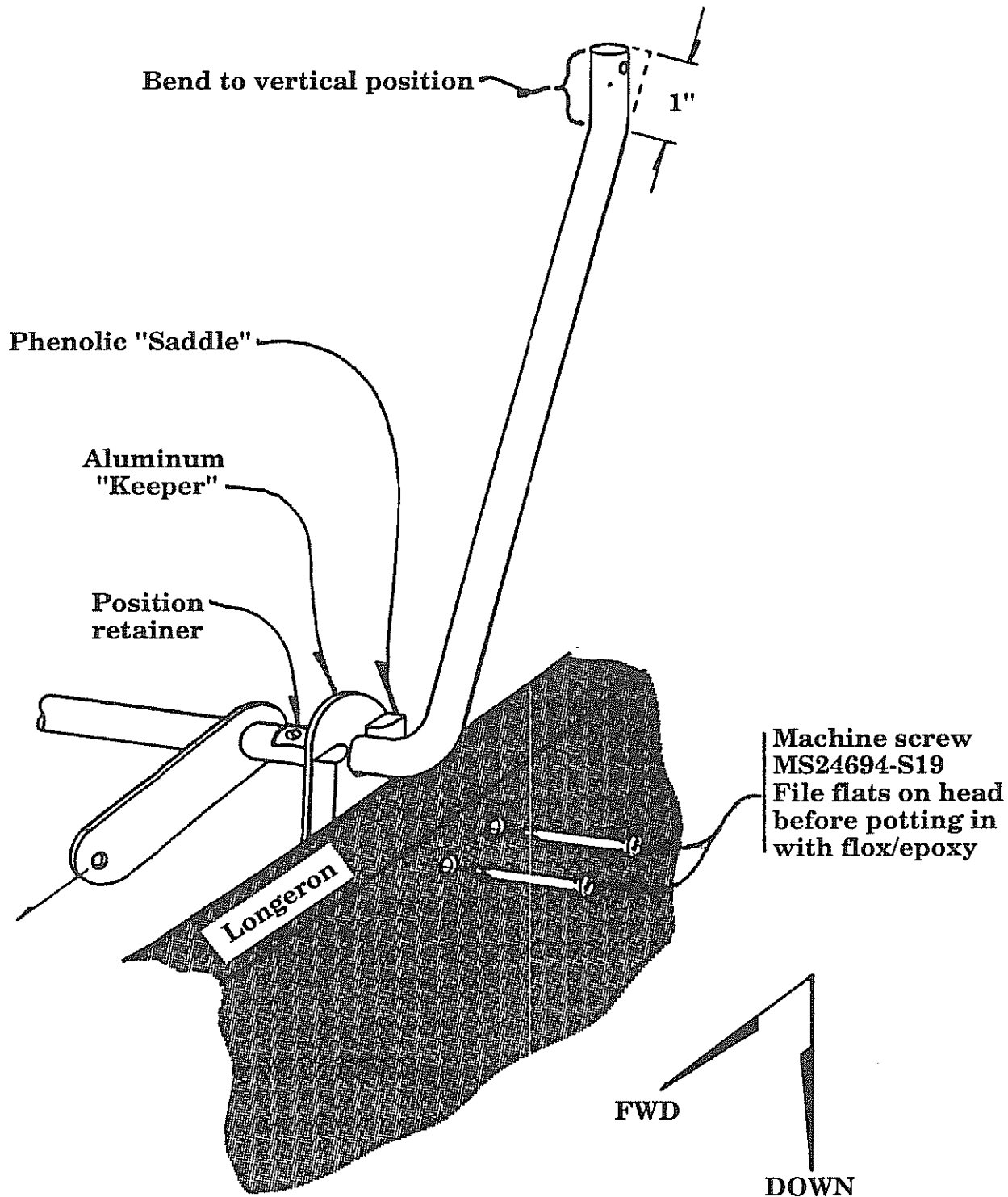
**NOTE:** This is not a critical fit and is not structural either. This system only functions to open and close the canopy and has no interaction with the completely separate safety latching mechanism for flight conditions.

5. Next cut the two phenolic saddles that will be used to mount the pivot weldment, see figure 17-13. These are cut from 1/4" phenolic. Drill a 7/16" hole to form the saddle then make two vertical saw cuts to complete the cut out shape. A little filing will be necessary to provide clearance for when the weldment is in the aft down position (canopy closed) and also when rotated fwd into the fwd down position (canopy open). See figure 17-12.



## CANOPY FORWARD PIVOT WELDMENT

Figure 17-12



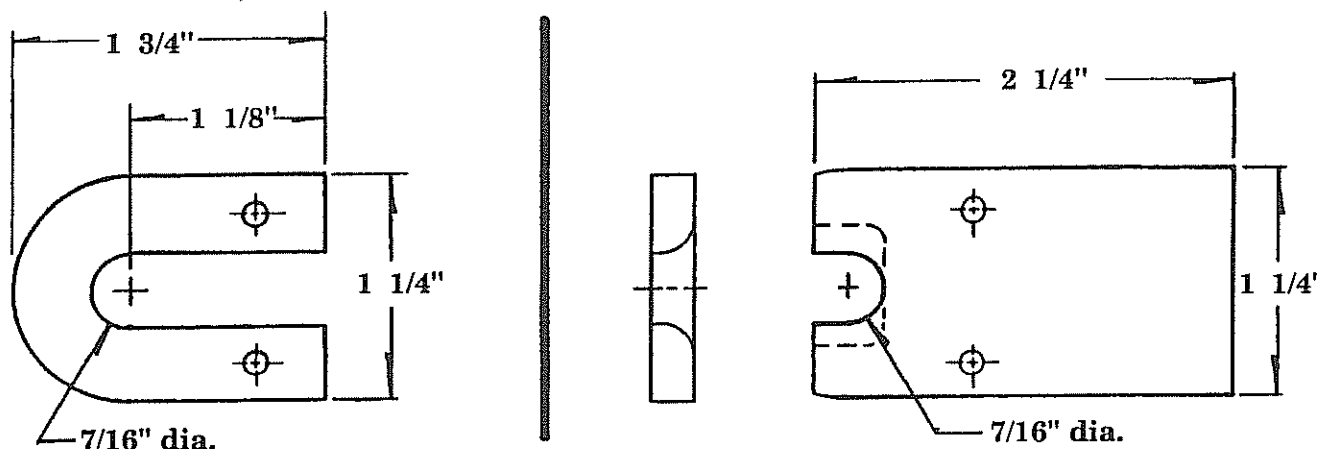
## CANOPY FWD PIVOT, KEEPER / SADDLE

(2) TWO EACH REQUIRED

FIGURE 17-13

KEEPER: Al., .090" thick

SADDLE: Phenolic, 1/4" thick

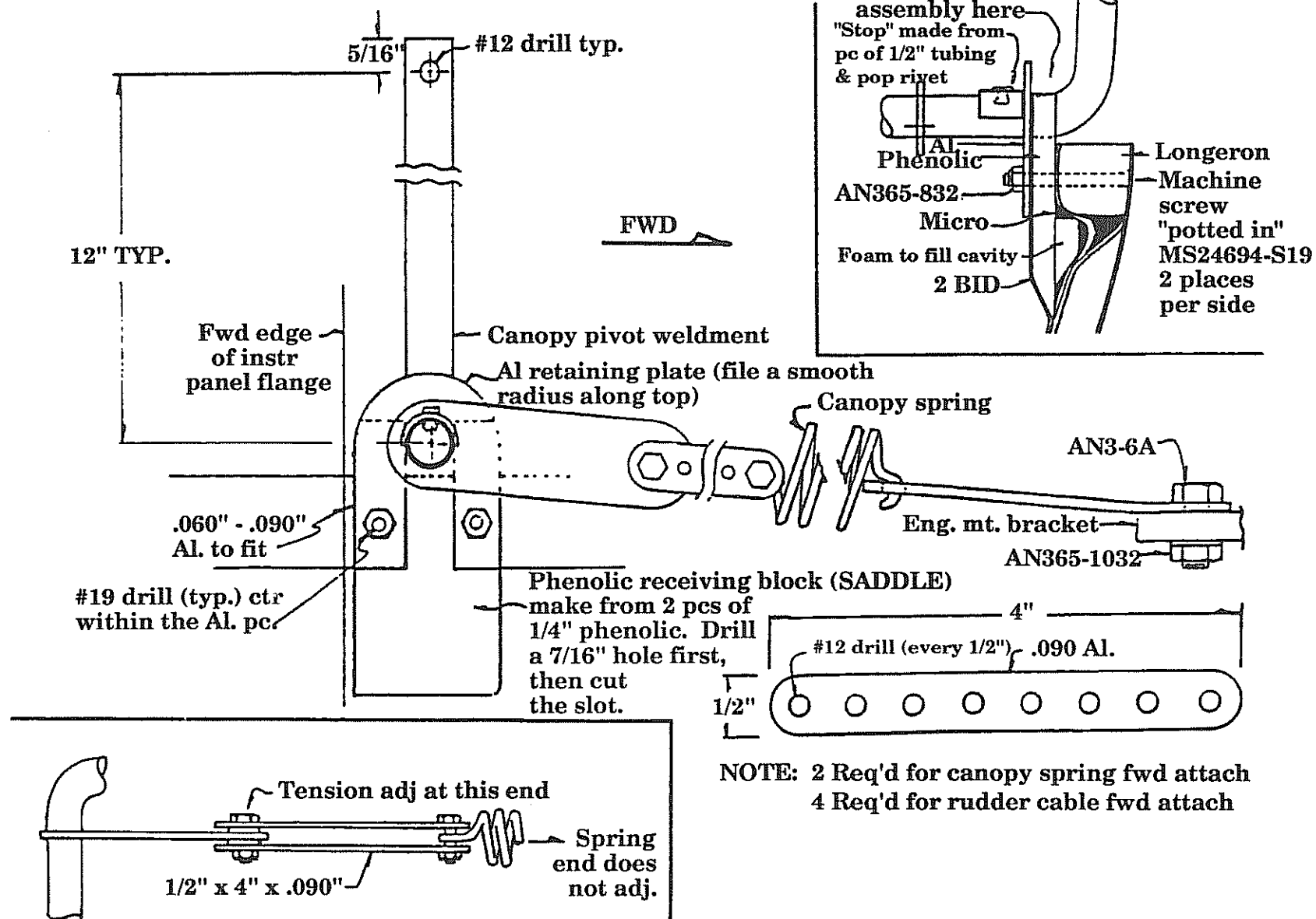


Clamp & drill (#19 bit) Saddle & keeper after Saddle is floxed in place.

6. Also make the two aluminum "keepers" that will secure the weldment down into the phenolic saddles, see figure 17-13 for dimensions.
7. Bond the phenolic saddles against the side of the longeron at the appropriate location. You will need to make a foam filler block per figure 17-14 to fill the void under the longeron. Use epoxy/micro to secure this in position. Clamp and allow to cure.
8. Next apply a 2 BID lay up over the phenolic saddles. This should contact about 1" onto the fslg all around. This 2 BID does not have to extend up and onto the longeron tops. Allow to cure.
9. After cure, position the weldment into the saddles and verify sufficient corner clearances to allow the weldment to rotate aft such that the ends of the arms are within 5/8" of the longeron tops. (The arms do not have to touch the longerons since they will be mounted higher.) Also swing the weldment fwd until an angle of approximately 25° is established. (The weldment arms must always clear the fwd deck when in the fwd position, this will generally become the basis of establishing the limit stops for the canopy which will be discussed later.)

# FWD CANOPY SWING MECHANISM

Figure 17-14



10. Slide the aluminum "keepers" down over the weldment that's in position in the phenolic saddles. The keepers should fit close but not tightly since the weldment will have to rotate under them. Check for a condition that does not allow more than about .015" clearance or looseness of the weldment in the vertical direction, i.e., you should not be able to wiggle the weldment up and down very much when held in position by the keepers.
11. Locate the two required bolt holes in the bottom of the keepers and drill them first into only the keepers. Use a #19 drill bit.
12. Using a small C-clamp, clamp one side of the keeper down to secure its position over the weldment thus allowing room to drill a hole through the other side. Drill the opposite hole through the entire assembly, all the way through the longeron and through to the outside of the fslg. Temporarily set a machine screw through this hole to secure positioning. Then release the clamp and drill the remaining hole.
13. Put in the machine screws from the outbd side. Use the standard approach of grinding "flats" on the side of the countersink head and then flux the screw into position. Allow it to penetrate into the longeron enough to add a little micro fill over it. This will require only about a .010" depression. Don't drill it too far. Allow the fluxed in screws to fully cure before tightening up on a nut. See figures 17-12 and 17-14.
14. From a short piece of 1/2" tubing, cut a section in half to form a "stop" for the side to side movement of the weldment. See figures 17-12 and 17-14. Set these in position with either a pop rivet or standard AN rivet, either will work well.
15. The tabs on the side of the weldment will attach to the big springs which can be adjusted to counter balance the weight of the canopy. See figure 17-14. These springs will be attached to the tabs with a simple "link" as shown in figure 17-14. Make one link set for each side.
16. The springs will be a tough pull. They will attach to a tab bolted to the lower engine mount brace arm on the top mount pads. See figure 17-14. They can be made adjustable by installing an adjuster arm similar to that described for the rudder cables. Always place the spring into the last hole and make adjustments by moving the attachment bolt.

**WARNING:** Be very careful when setting these springs. Avoid letting them snap free since they could recoil and hit you in the face!

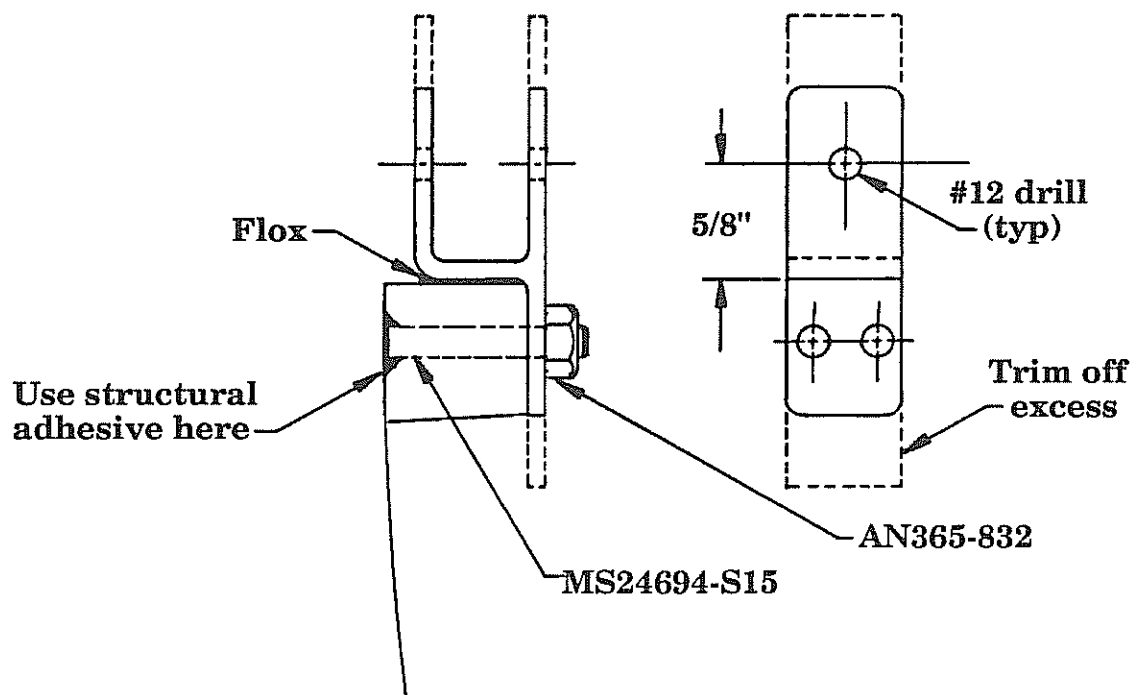


### C. Canopy frame aft swing arms

These are very simple rods that complete the parallelogram movement by supporting the back of the canopy frame. They attach to a fitting off the longeron and attach through the back of the canopy frame.

1. Select the "H" section aluminum extrusions and trim them down to resemble figure 17-15.
2. Locate the attach point on the longeron where these fittings will be installed and install using two machine screws. Locate the holes in the aluminum fitting first and use it as a guide in drilling through the longerons. You should also predrill the holes that will attach the swing rods. Pot the machine screws in from the exterior by creating "flats" on the sides of the countersink heads and pot them in with epoxy/flox.
3. Attach the swing rods per figure 17-7.

**AFT CANOPY "H" PIVOT  
RIGHT SIDE SHOWN  
FIGURE 17-15**



4. Carefully mark the locations of the canopy frame attachment holes that are on the ends of the aluminum pivot arms. These locations must be carefully marked onto the sides of the fslg and should represent a position for the rods when they are elevated approximately 1/16" above the top of the longerons. If you make two long reference lines on the side of the fslg to locate each hole, then finding their position once the canopy frame is laid onto the plane will be easy. (This is similar to the described method of locating the holes for the middle gear door brackets, refer back to page 6-18, step 9).
5. Place the canopy frame onto the fslg and locate the four attachment hole positions. Use a #12 drill bit and drill through the outer side only of the side rail.
6. Once you've drilled through the first (outer) wall of the side rail, reach in and slip the aluminum rod onto the drill bit to verify alignment. Then drill the rest of the way through the inner side rail of the canopy frame.
7. With all four hole sets drilled, you can slip the long machine screws in and the canopy frame can be rotated up. It will seem quite wiggly and clumsy - don't worry though. After the canopy is bonded into position, additional stiffeners are laid up and once the springs are set, it will work nice and smooth.



#### D. Canopy latch mechanism

The in flight latch mechanism is a very straight forward installation using CamLoc® safety latches. These latches will pull over center for a positive lock with an additional safety catch to prevent accidental opening. These are each load rated at more than 4 times the required strength.

1. First locate the positions of the hard points in the inner side rails where the latches will be positioned. Put a pencil mark on the glass to easily depict their location.
2. Position and mount the "strike" for the latches by drilling the two #19 holes through the strike as a guide and thus through the inbd side rails of the canopy frame. The strikes should be positioned even with the bottom of the side rail. See figure 17-10.
3. Next position the latch onto the strike and mark a reference position onto the sides of the fslg to show the location needed for the latch build up attachment block. See figure 17-10. Note the distance inbd from the fslg sides required for the latch when it is properly hooked on the strike. This will require the latch to be positioned off of the inner surface of the fslg skin.
4. Form a phenolic block that shims the latch out to the required position and orientation. Cut a smaller phenolic piece to fill the cavity under the longeron. This does not have to be a real snug fit, simply use epoxy / flox to pot this in and fill any little voids. See figure 17-10.
5. Drill and install the two machine screws that will pot in from the back side of the phenolic to secure the latch onto the face block. Use the MS24694-S8 screws and pot them into the phenolic in the usual manner.

**WARNING:** When potting the machine screws into the phenolic block for the latches, do not remove any more of the phenolic than is absolutely required to lock the heads into the piece. Remember to file flats on the screw heads to prevent the screw from slipping. You may also use 1/2" phenolic if the installation of the latch requires additional shim distance.

**NOTE:** When setting the proper vertical alignment of the latches, check to verify that the internal latch adjustment is set to a mid range. The hook on the latch can be screwed up or down to fine tune the amount of pull produced when the latch is closed. This should be in the middle of its adjustment range to provide final adjusting room on both directions.

6. Now bond the phenolic onto the fslg using epoxy/flox. Clamp in position and allow to cure.



7. Wrap the machine screw studs with a piece of tape to keep the upcoming resin off of the threads. Now sand to smooth the edges of the phenolic, apply a flox fillet where necessary and add a 4 BID lay up over these four attach points. Contact at least 2" all around on the fslg sides. As always, be sure to clean and sand the bonding areas first. Make a good effort to keep the area of the phenolic (now with the 4 BID over it) smooth and flat so a good base is established for the latch to tighten up onto. Allow to cure then remove the tape and clean up the BID around the studs so that the latch will again seat solidly against the phenolic/BID base attachment.
8. Secure the latches with the two small (MS21042-832) all steel lock nuts. These are required since the available space is limited. Also mount the "strikes" using MS24694 machine screws. It is generally best (for clearance reasons) to insert them from the inside of the channel (for the fwd strikes) and attach the all steel lock nuts onto the outside. This will require a little hand operation of the counter sink. If there is room, you can of course run the screws in from the outbd side and place the nuts on the inside.
9. To attach the aft "strikes", since there is nothing else there, you can run the screws in from the inbd side and set the all metal lock nuts on the inside of the channel.



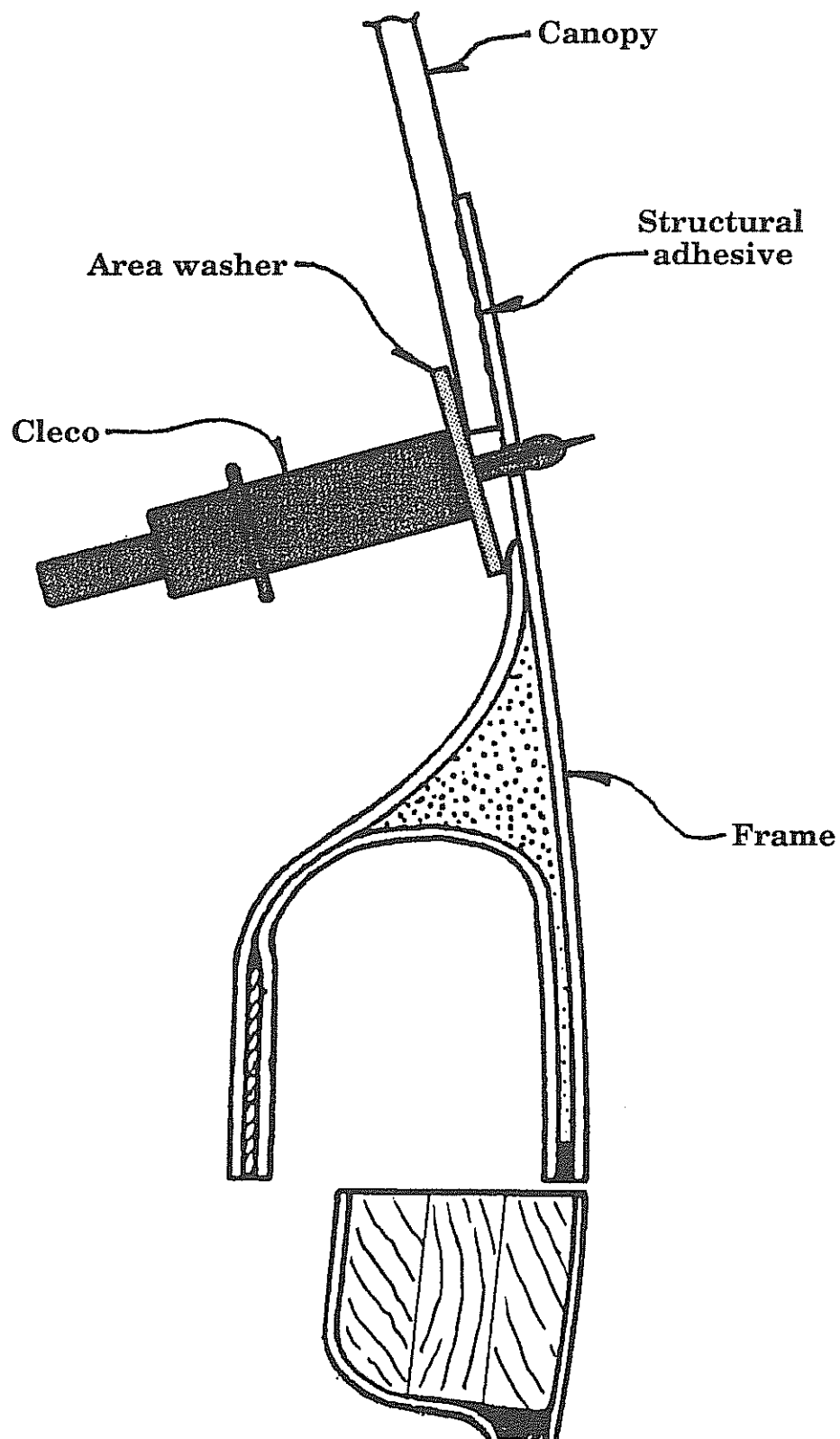
## E. Canopy plexiglass installation

NOTE: DO NOT REMOVE THE PROTECTIVE COATING FROM THE CANOPY UNTIL INSTRUCTED TO DO SO!

1. With the canopy frame upside down on the bench, STILL IN ITS BRACE, lay the canopy into it. Adjust it from left to right and fwd to aft until a good fit is established. Note the areas of overlap. You should have about 5/8" minimum around all sides with less around the front curvature.
2. Trim the canopy frame and sand the edges smooth. This will NOT be a finished paint line but it will determine that line to some degree. The actual finished paint line will be inside of the trim line by approximately 1/4".
3. Prior to bonding the canopy into the frame, sand a gradual bevel onto the outside of the cutout, this will help the transition during "finishing" later.
4. Also sand and smooth the inside frame surface where the plexiglass will be attached.
5. Now place the canopy back into the frame (inverted) and run a felt tip marker around the outside of it to indicate on the plexiglass wrapping exactly where it will register back into the frame for bonding purposes. Transfer this line onto the inner side of the canopy protective coating as well.
6. Trim the canopy if necessary. Consult the recommended directions for canopy cutting produced by Airplane Plastics, which has been reproduced in this chapter in section 7, "Plexiglass Hints For Perfect Canopies".
7. Using a #30 bit, drill holes through the frame about every 6" around the entire perimeter of the canopy, directly adjacent to the edge of the plexiglass. These will be used for clecoes which will serve as temporary clamps to hold the canopy in position during cure. Refer to figure 17-16.
8. Remove the canopy and peel back the protective coating, on the outside of the canopy, to a point beyond the felt marker line. Come back with plastic electrical tape (1/2" wide works best since it bends around contour lines easier) and remask the exposed canopy such that the tape line is just inside (by 1/8") the actual canopy frame line. Refer to figure 17-17. You'll be able to see the reference line marked on the inner protective coating. Make sure there are no other exposed areas of the canopy showing. All little peeled spots on the protective coating (inside or outside) must be covered with a piece of tape.
9. Sand the exposed surface of the canopy with 50-80 grit sand paper.



CANOPY TO FRAME, CLECO MOUNTING  
FWD EDGE  
Figure 17-16



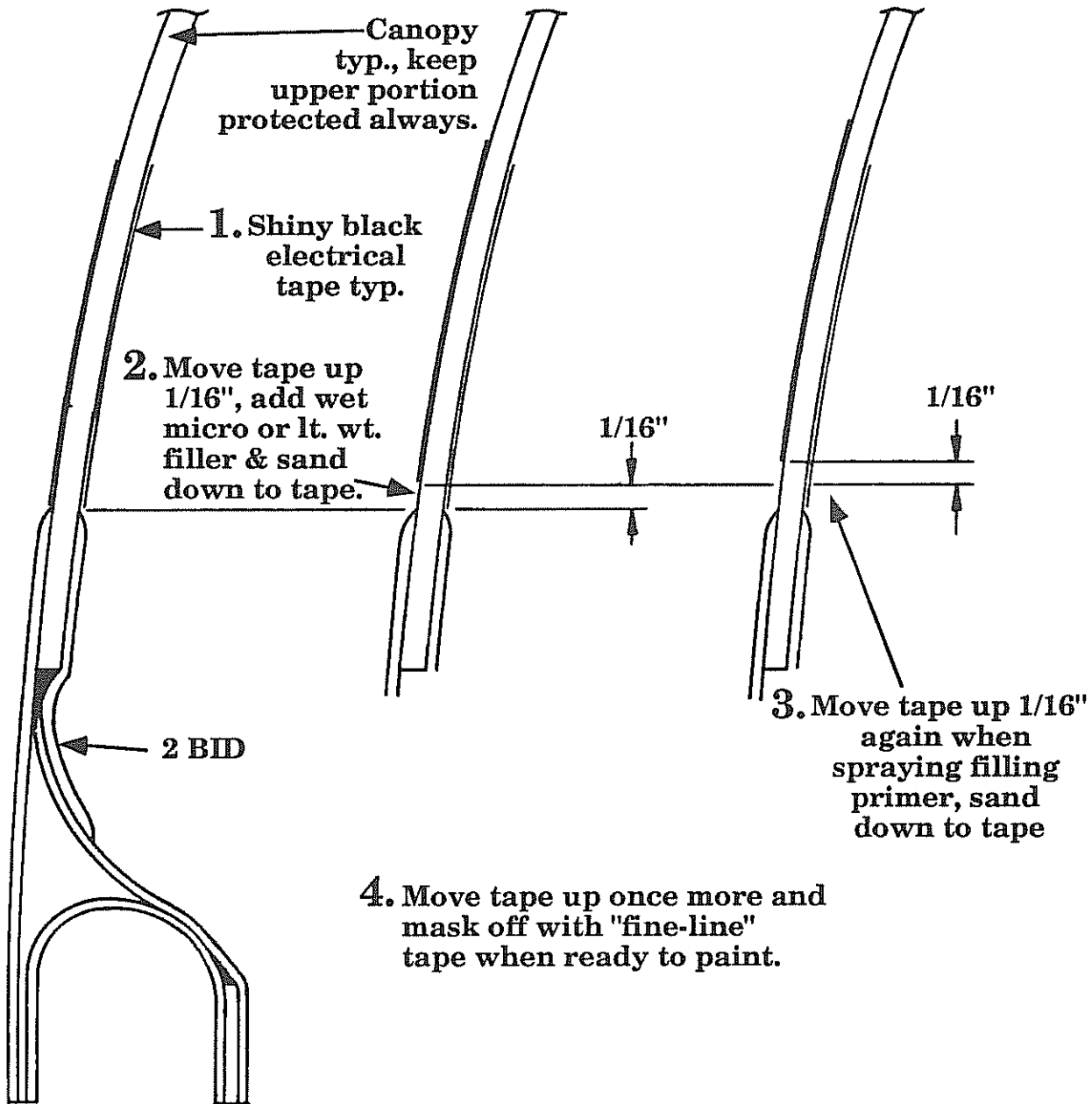
10. Mix up a batch of structural adhesive (with 5-10% flox added to thicken it up a bit) and spread a film on both the canopy and the frame.
11. With a little help from a friend, carefully place the canopy into position and set all the clecoes from the inside. It may be helpful to place an area washer over the cleco to attain a little more surface area on it while clamping however, it usually works quite well without these washers. If the clecoes have any tendency to slip off, then use the washers. As you set the clecoes, press down firmly on the canopy to squeeze out excess adhesive. Wipe this away as you proceed. You will generally be able to witness the bond area integrity by seeing the contact through the hazy (sanded) plexiglass. It turns darker when it has good adhesive contact. If you find that added pressure is needed in certain areas, just drill for a couple more clecoes.
12. When all the clecoes are set, carefully lift the unit off the bench and place it back onto the fslg to cure in the actual position. This is just a final safety measure to insure that you are not locking in any kind of twist in the canopy frame during this bonding process. With the canopy/frame positioned onto the fslg, wipe off any excess adhesive that squeezed out along the outside. Allow to cure at least 24 hours at room temperature.
13. Next, remove the canopy/frame and invert it back onto the bench top. Remove all the clecoes and clean away the protective coating from the inside. Peel it back about an inch and retape with plastic electrical tape to within 1/8" of the bond line. This bond line should be the same as on the other surface.

**At this time you may carefully beat the brace off of the canopy!**

14. Sand with 50-80 grit and clean. The fwd area of the canopy will form a ridge where the glass extends down away from the frame. Sand the edge of the canopy slightly and fill the remaining area to form a micro fillet so the BID tapes will install properly. This will also help to stiffen the front end. See figure 17-11.
15. Add 2 BID all around the interior perimeter of the canopy. Overlap at least 1" onto the frame. On the side rails, extend the BID tape down 1" past the point where the channel begins to roll out. This is to add additional stiffening to that area. See figure 17-17.



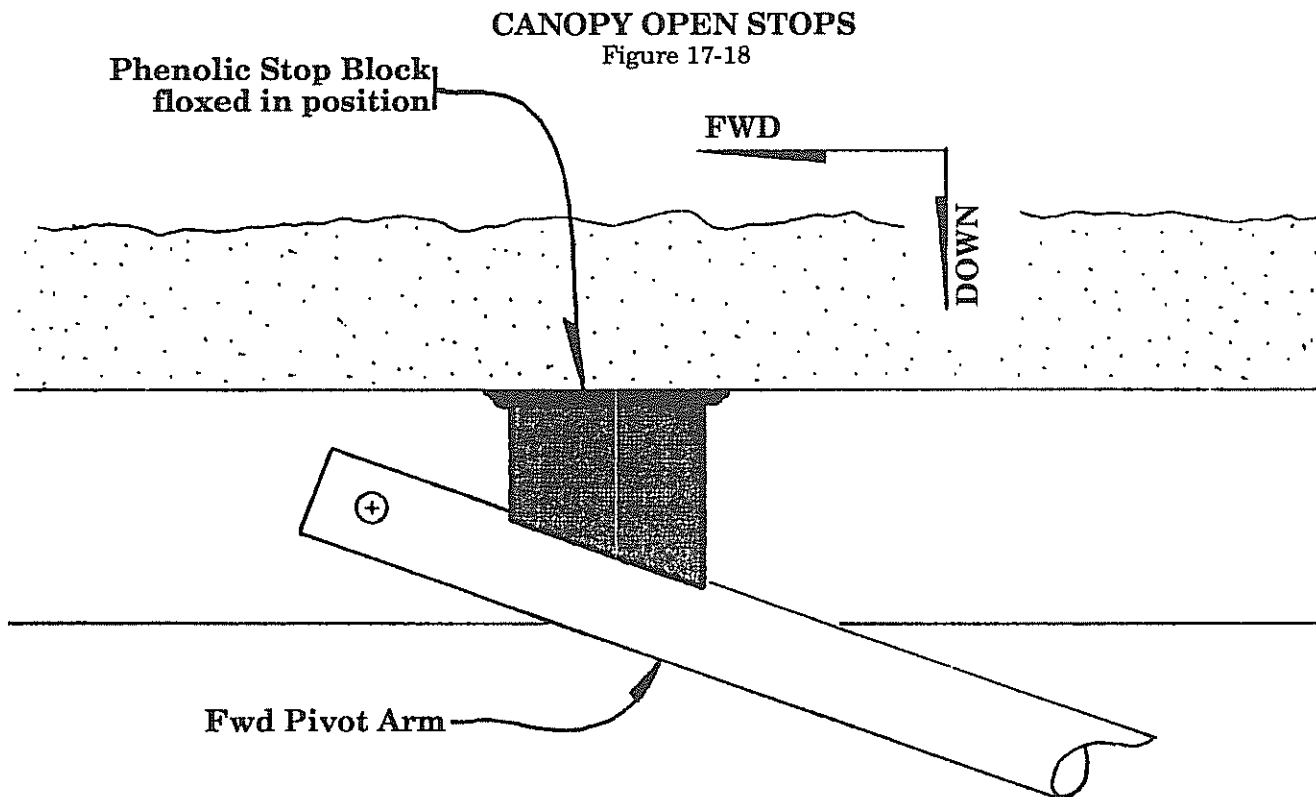
## Canopy fairing Figure 17-17



#### F. Canopy open stops

1. The canopy must have stops that prevent it from rotating fwd (open) too far. These should be established at the front pivot weldment.
2. Make two phenolic shims that can be bonded (epoxy/flox) into the channel just aft of the point where the pivot weldment bolts into the canopy frame. See figure 17-18.
3. To establish this stop, open the canopy and support it so that it is as open as possible without contacting the fwd deck. There should be at least 1/2" clearance preferably so that even with a bouncing action, it will not hit the fwd deck (and scuff your paint).
4. Grind some small shims that can be bonded into the inside top of the canopy frame channel so as to contact the pivot weldment arms and prevent any further fwd rotation. See figure 17-18. They do not have to be very closely carved to shape since the epoxy/flox will fill any little voids. Wrap the aluminum arms in plastic tape then insert the carved shims with a generous amount of epoxy/flox added. Lower the canopy down onto the shims and allow to cure. You may need to clamp a retainer type brace temporarily to prevent the shim from slowly being wedged back out of position. Sand it smooth later, no BID are required.

The edge of the canopy frame channel at the aft swing rod locations can also be adjusted so as to create a stop as well.

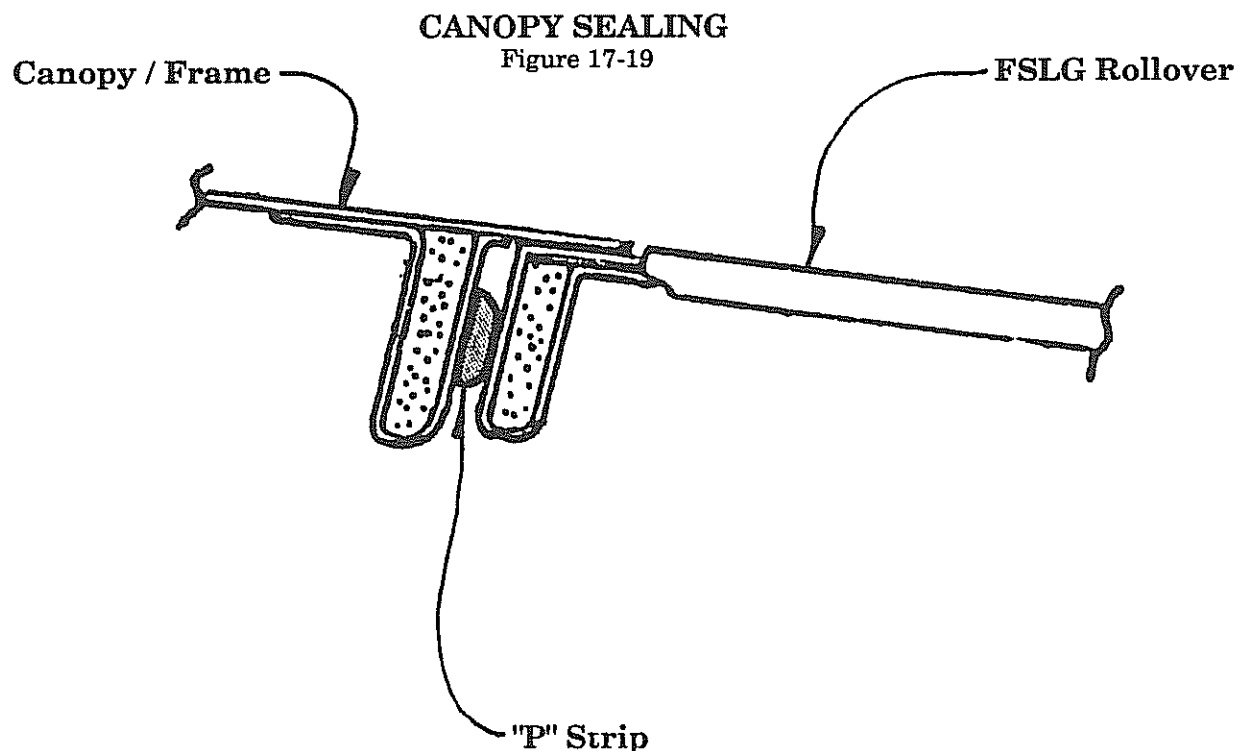


## G. Canopy sealing

There are several commercially available rubber seals. The common "P" strip, while working quite well along the front and sides, does not last too long. It is however, pretty cheap, so it can be easily and quickly replaced without too much time or cost. The silicone rubber seals are the best.

1. The aft deck line is generally the toughest to achieve a good seal against. This is because it's a low pressure area up there and difficult to seal. The best means of sealing is to seal against the two faces of the roll - overs, not along the aft joggle as you might think of as being best.
2. The roll overs should be about 1/4" apart, so a relatively large seal strip can be nicely fitted along either of these faces such to seal well on the other face. See figure 17-19.
3. The fwd edge of the canopy frame will seal down onto the dust cover or it can seal directly onto the fwd deck joggle. This will depend on clearances and how you choose to fit the instrument panel dust cover which also sits on that same joggle.

At this time, refer to info beginning on page 17-69, "Canopy sealing", choose a method shown or devise your own and install it at this time, then continue through that section, installing your canopy locks and aft windows. From here thru page 17-68 apply only to the fwd hinge canopy system.



## 5. PROCEDURE: FORWARD HINGE CANOPY

This section is to provide the information necessary to mount your Lancair 320 canopy as shown in figure 17-2. The normal mounting method is shown in figure 17-1. This installation may require alterations to the header tank (chapter 11, "Fuel System"), but any of the three header tank mounting configurations (permanent, hinged or screw mount) can still be used (Note - we do not recommend permanent installation of the header tank, since it severely limits future access to rudder pedals and engine mount bolts, and expansion of your instrumentation cluster!). If your kit was shipped after 9/15/91, you should receive a header tank as shown in figure 17-20, which is already modified for the forward hinge canopy type installation. If you have one of the older tanks, it will have to be modified per the instructions included here. This section will detail the modification of the header tank and installation of the Forward Hinge Canopy. Read these instructions through entirely at least once before proceeding with these modifications.



17-32

Chapter 17

REV.

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CANOPY SYSTEMS





**A. Equipment, parts and tools required:**

**Parts:** Forward Hinge Canopy Kit  
Blueprint "Q"

**Tools:** 3/8" wrenches (2)  
3/16", 9/32" and 1/8" drill bits  
Drill motor  
Hammer  
Hot glue gun or clamps  
Tape measure  
Router  
1/4-20 Tap & drill bit

**Materials:** L-320 Forward Hinge Canopy Kit  
Uni-Directional Carbon Fiber, 5" wide x 80' (ft.) long  
Epoxy/Flox mix  
Material for BID lay ups  
Bondo  
Sandpaper, #40 Grit  
White foam sheets, 1/4" & 1/2"  
Structural adhesive  
Plastic tape  
Epoxy/micro mix  
Nails  
2x4" board, 16-17" long  
Hot glue (or clamps)  
Inflatable "D" seal or equiv.  
3/8" plywood or equiv.  
Some scrap wood for making a canopy frame holding fixture  
Thin plastic, like supermarket grocery bags  
Double-sided tape or equiv.

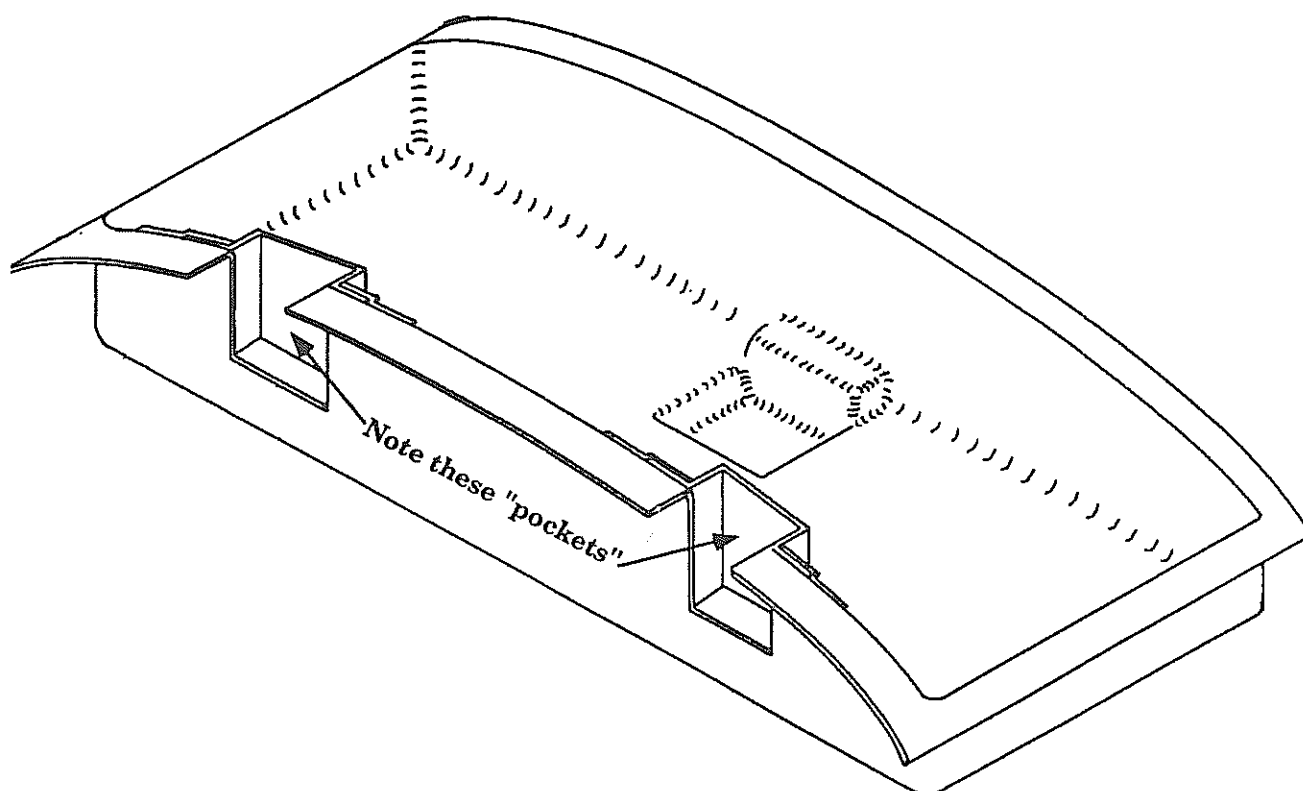


## B. Modifying header tank

Chapter 11 calls for attaching the header tank to the fwd deck. Before doing this, we need to install pockets in the header tank to accept the hardware for the canopy hinges. If your kit shipped after 9/15/91, it should already have a modified header tank. Refer to drawing 17-20.

### Modified header tank

Figure 17-20

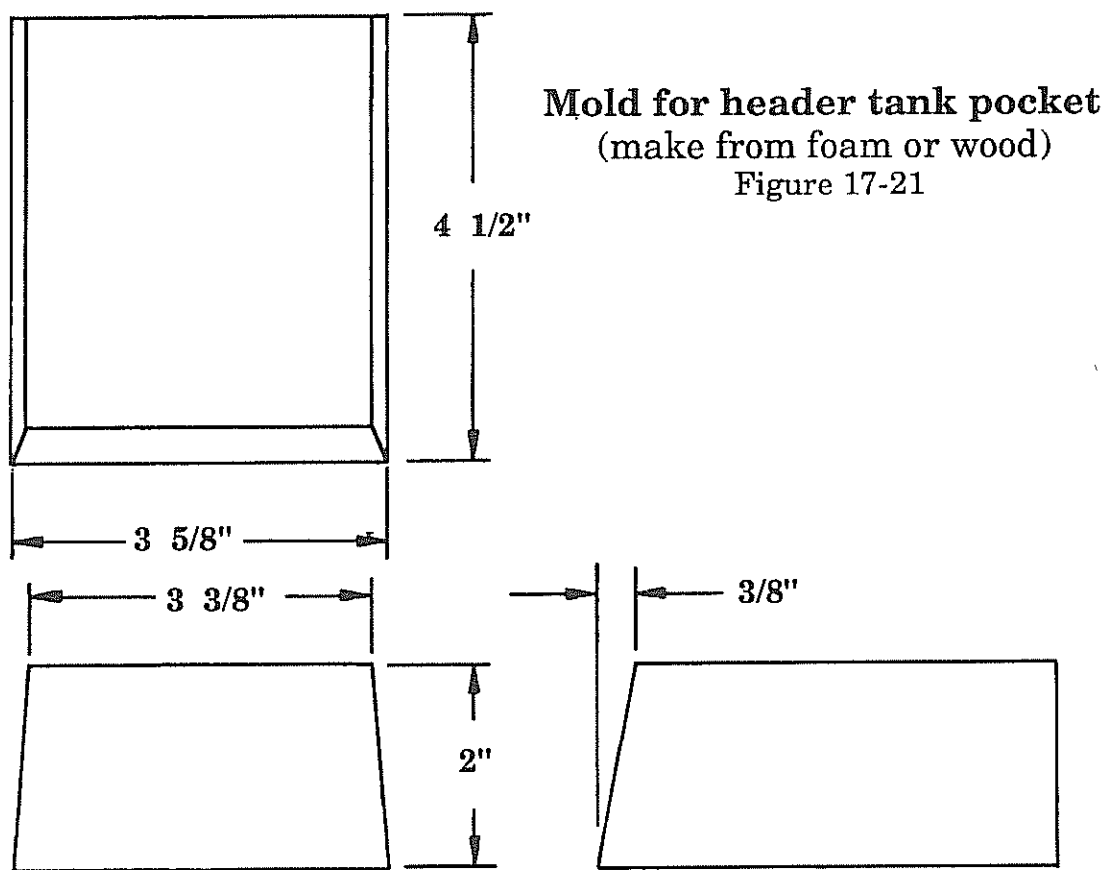


If your tank has these pockets already installed, proceed to chapter 11, page 7 and begin the forward deck alignment there. When you are back to this point in assembly, you can skip from here to top of page 17-39, as all of the intervening steps have been performed for you already.

**If your tank does not have these pockets, begin with step 1., below.**

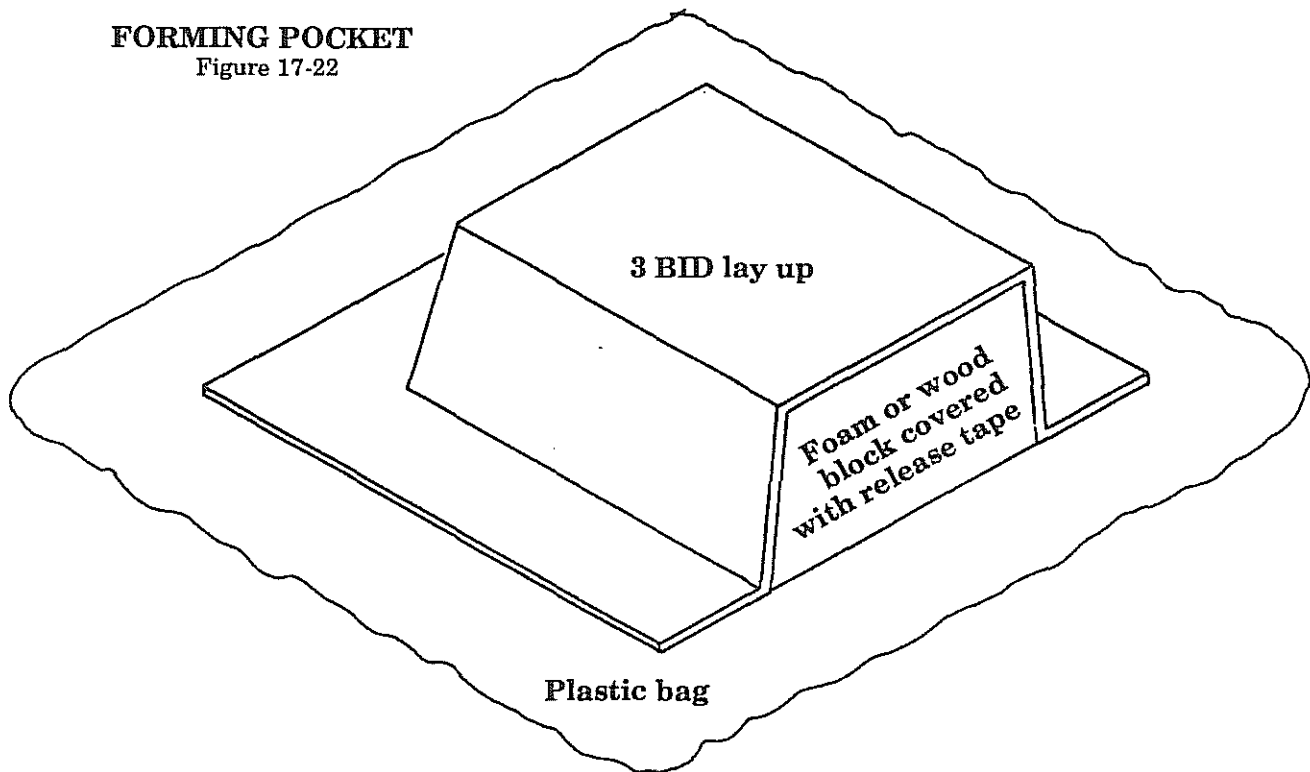
1. **Put tape or caps over the ends of the fuel tank fittings so that nothing from the following steps can get into them and form an obstruction.**
2. Place the header tank in position on the forward deck, with the forward deck mounted in it's cradle.

3. Mark areas of header tank to be cut out for pockets (refer to blueprint "Q", L-320 FWD HINGE CANOPY, for locations).
4. Mark outline of header tank on fwd deck, and mark where pockets will be.
5. Cut out pocket areas.
6. Make foam blocks (or pcs of 2x4 wood) per figure 17-21, contouring to fwd deck shape.
7. Cover blocks with plastic release tape.
8. On a flat sheet of plastic bag, make 3 BID lay ups over the blocks and forming the flanges, as shown in figure 17-22.



## FORMING POCKET

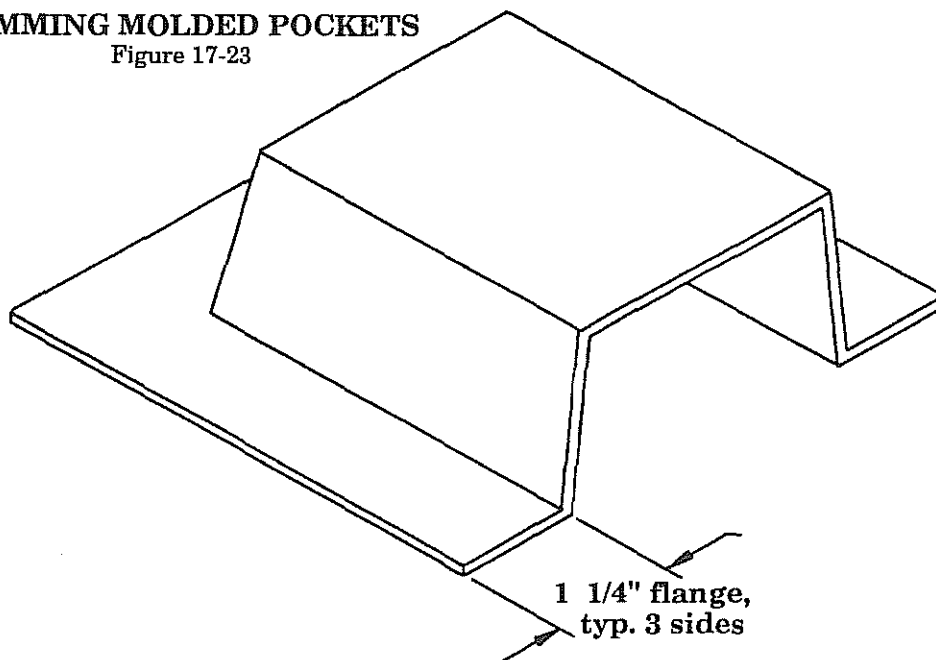
Figure 17-22



9. When dry, remove from plastic sheet, pry out taped blocks and trim molded pockets per figure 17-23.

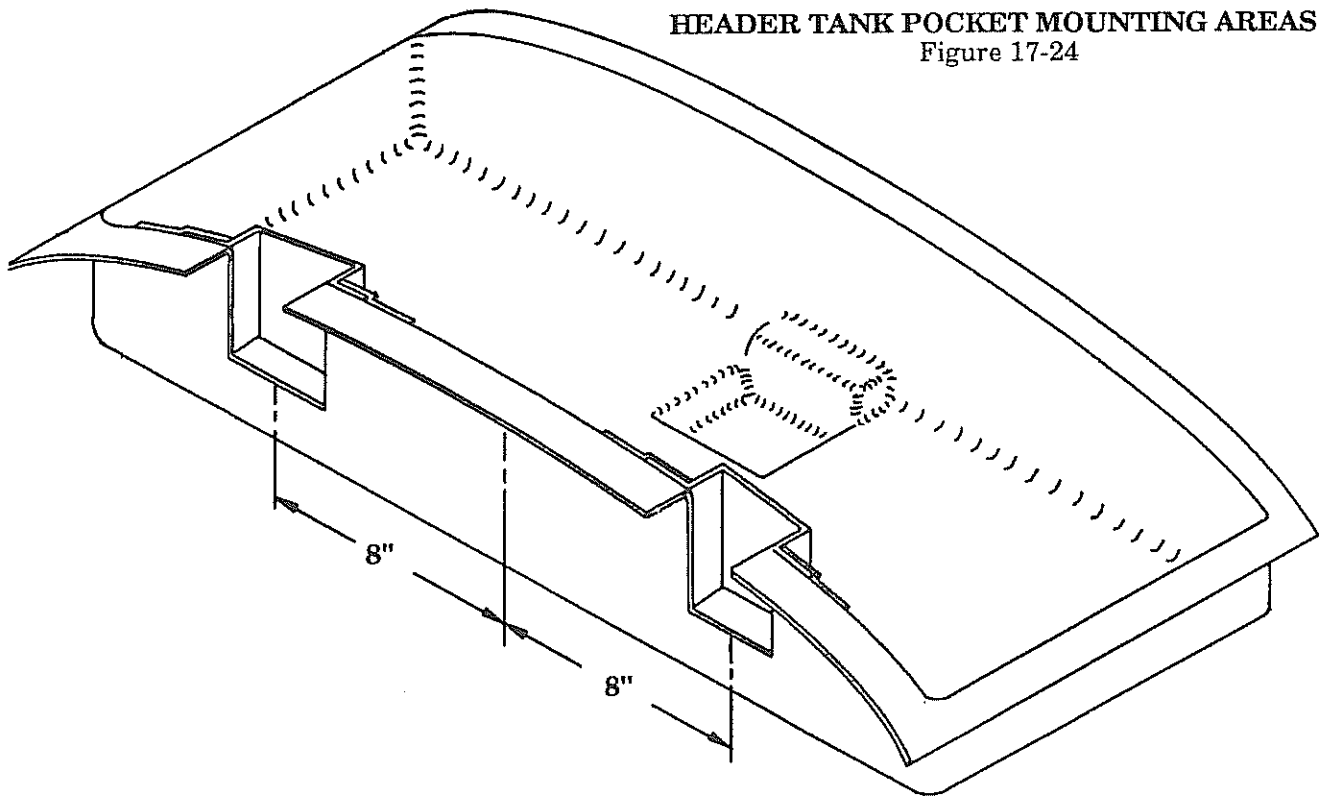
## TRIMMING MOLDED POCKETS

Figure 17-23

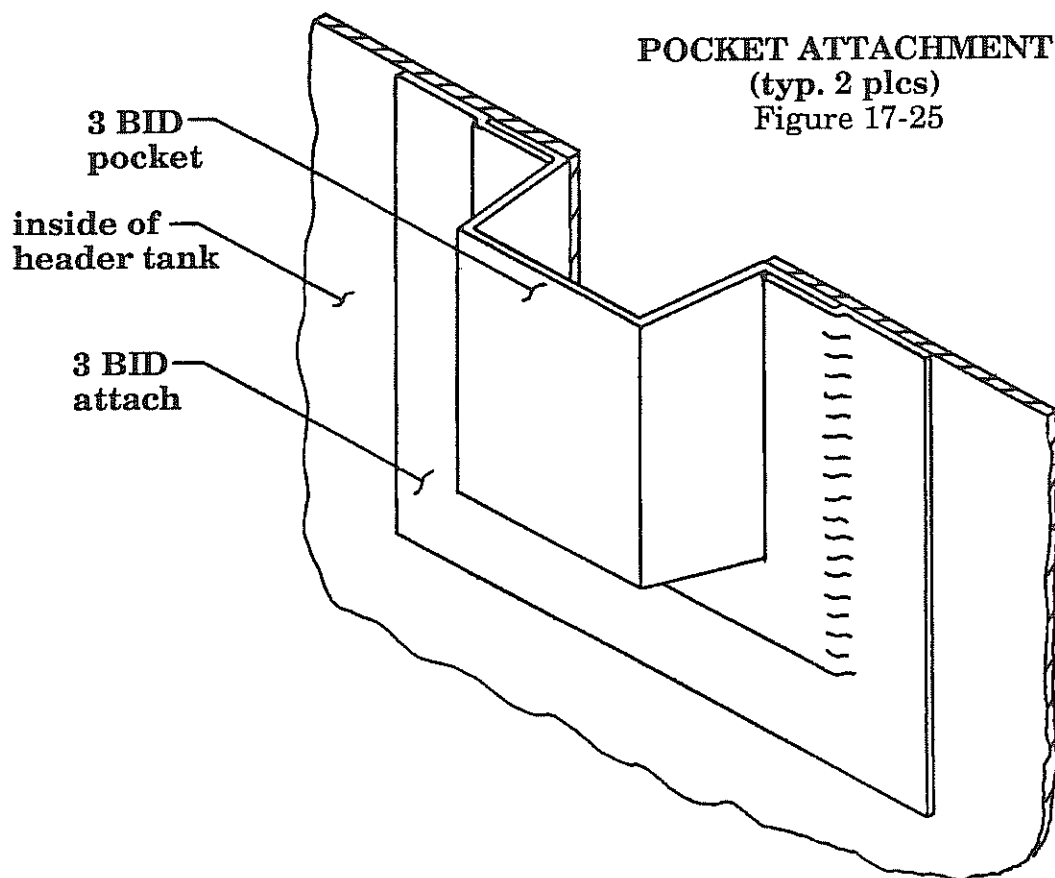


## HEADER TANK POCKET MOUNTING AREAS

Figure 17-24



10. Position pockets on inside of header tank and mark positions, see figure 17-24.
11. Using #40 grit paper, 'scuff' the inside of the header tank where pockets will go. Clean surfaces of pockets and header tank with acetone or MC.
12. Using structural adhesive, bond the pockets to the inside of the header tank and clamp in place, wiping off any excess adhesive before it hardens, and leaving a bit to act as a fillet for the BID to be applied later. Let cure before proceeding.
13. Lay up a 3 BID attachment strip around pockets as shown in figure 17-25.



14. Remove the tape or caps from the header tank fittings and proceed with the section in the manual for attaching the header tank to fwd deck (chapter 11). When you attach the header to the fwd deck, you will, at that time, attach the top of the pockets to the fwd deck. **AT THAT TIME, LAY IN THE 8 BID STIFFENER SHOWN ON DWG "Q".**

***NOTE: IF YOUR HEADER TANK HAS GEL-COAT ON IT, IT MUST BE REMOVED FROM ANY AREAS THAT ARE TO BE BONDED.***

You can now return to page 11-7, and perform the steps in the manual until you get back to this chapter. At that point, you can proceed to page 17-39 and begin at the top of the page.

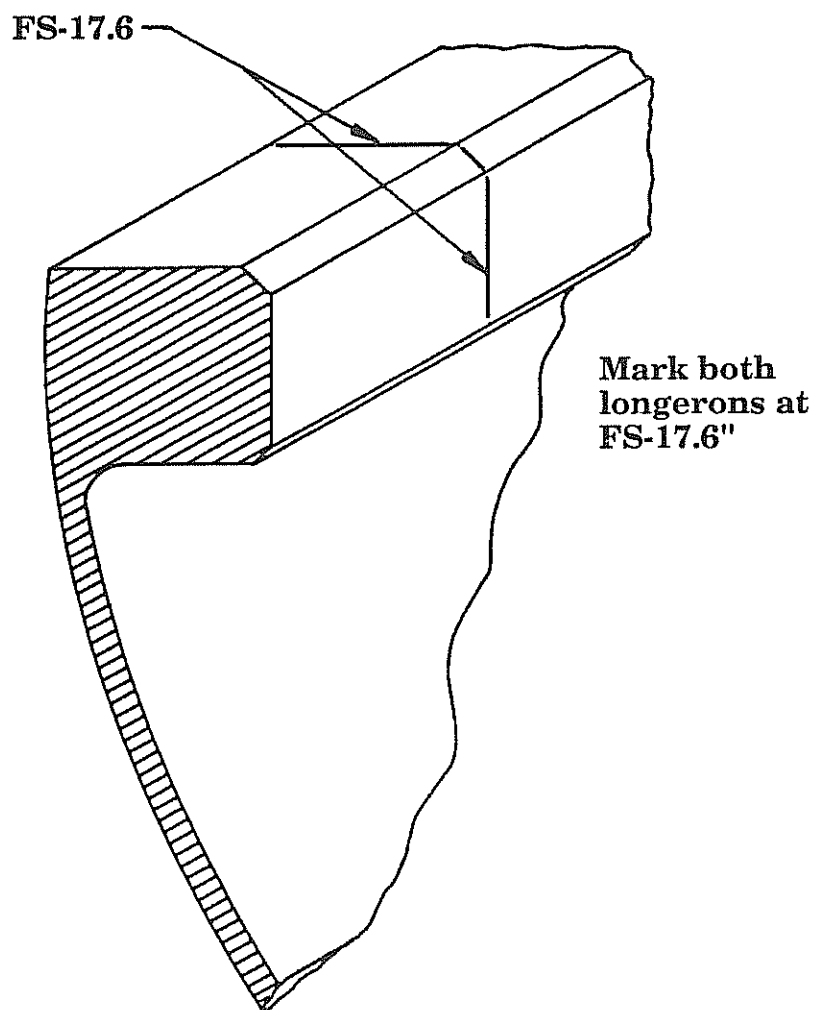
As previously discussed, the canopy frame installation must be initially fitted in conjunction with the forward deck and the top cowling. The cowling, being best fitted with the aid of the engine for placement, will most effectively locate the ideal forward deck line. The canopy frame will fit to that established line.

**C. Fuselage preparation**

1. Referring to figure 17-26 and to the blueprint "Q" for "L-320 FWD HINGE CANOPY", measure aft to FS-17.6, and put a mark on the top and inboard sides of both longerons as shown below.

**LOCATING STRUT BRACKET ATTACH POINTS ON LONGERON**

Figure 17-26



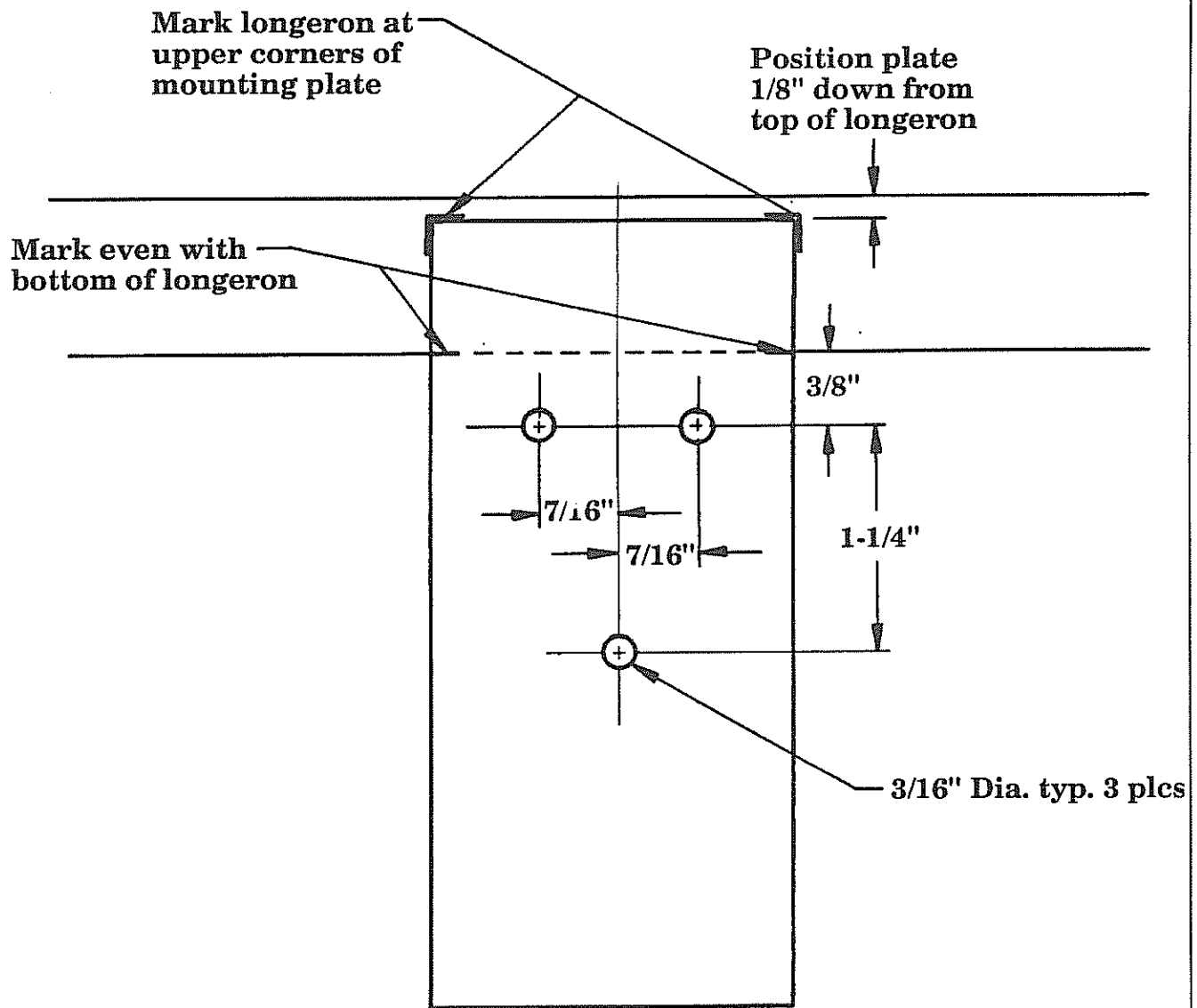
2. You need to make a mounting plate to support the strut brackets that will be mounted at the FS 17.6 position on each side of the aircraft. On your bench, lay out a piece of plastic and, using a marking pen, draw a square that is 2" wide and 8" long, making the lines dark enough to be seen through the lay up that follows.
3. Lay up 5 BID on the plastic, about 9" by 3", overlapping the pattern you have drawn. Don't worry about making the edges neat. When the mounting plate layup is still in the green cure stage, trim the edges to the pattern you have drawn. Allow to fully cure on a nice flat surface.
4. After the part is fully cured, cut it in half such that you now have 2 mounting plates, each about 2" x 4" in size.
5. Remove the plastic from the mounting plates. If you used the sandwich method, be sure you remove the plastic from *both* sides of the parts.
6. Draw a line down the center of both mounting plates, in the lengthwise direction. Mark one part "L" for left, the other "R" for right.
7. Doing first one side then the other, place each mounting plate against it's respective longeron at the FS 17.6 point and line up the center line on the mounting plate with the line you drew on the longeron. Slide the plate down until the top of the plate is 1/8" below the top edge of the longeron. Mark the plate as shown in figure 17-27 at the bottom point of the longeron. Remove the mounting plate and draw a line across it, as shown in figure 17-27, that is 3/8" below the marks denoting the bottom of the longeron.
8. Again refer to the mounting plate shown in figure 17-27. Measure out 7/16" from the center line, in each direction, on the line you just made, and mark as shown for two holes to be drilled later. Make a mark for a third hole, on the center line, 1-1/4" down from the other two. Don't drill the holes yet.
9. Using the 1" x 1-1/2" aluminum angle provided in the kit, make two strut brackets as shown in blueprint "Q" (they are mirror images of each other).



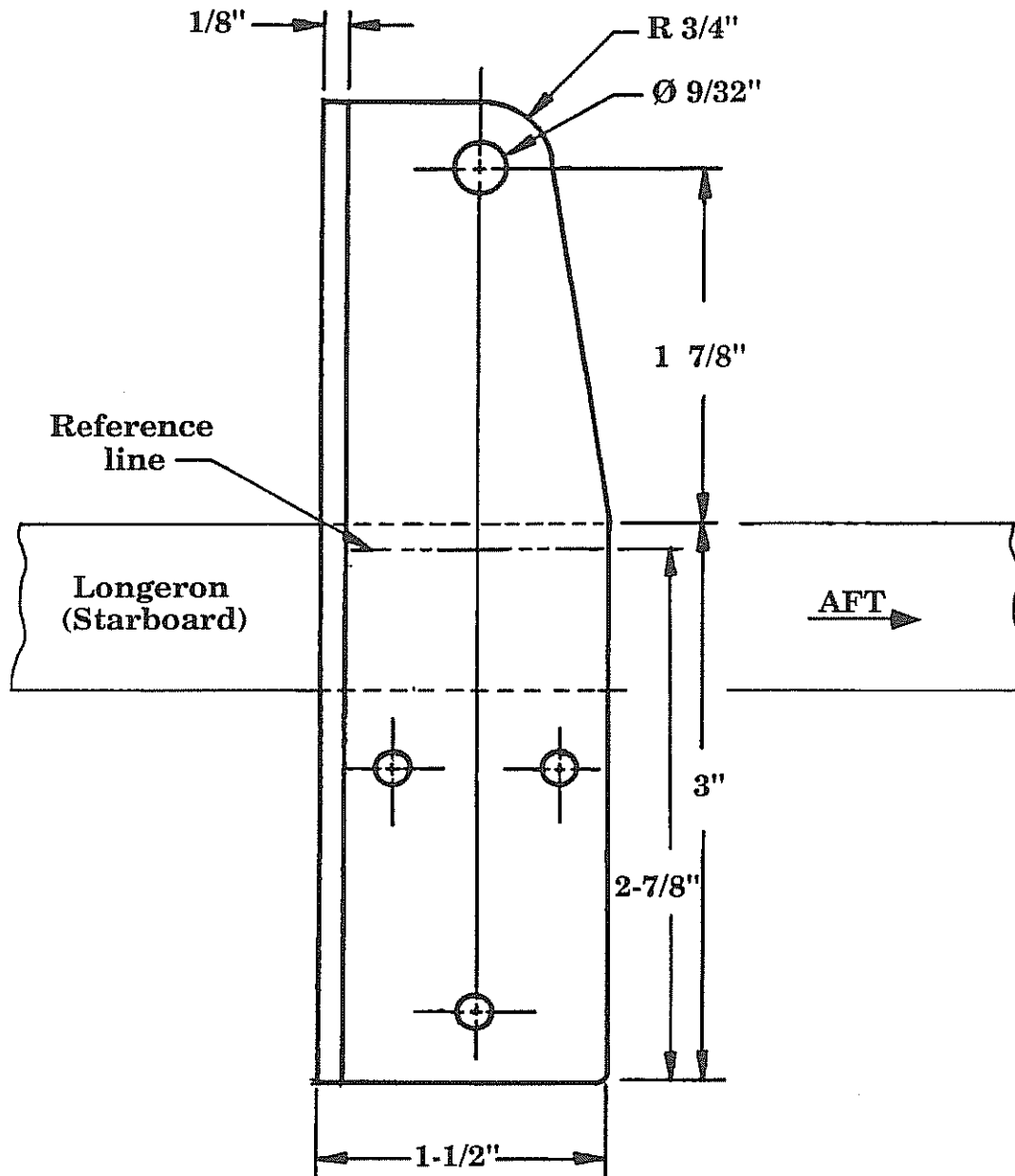


## Marking and positioning mounting bracket

Figure 17-27



**Fabricating strut bracket**  
(STARBOARD SIDE SHOWN)  
Figure 17-28

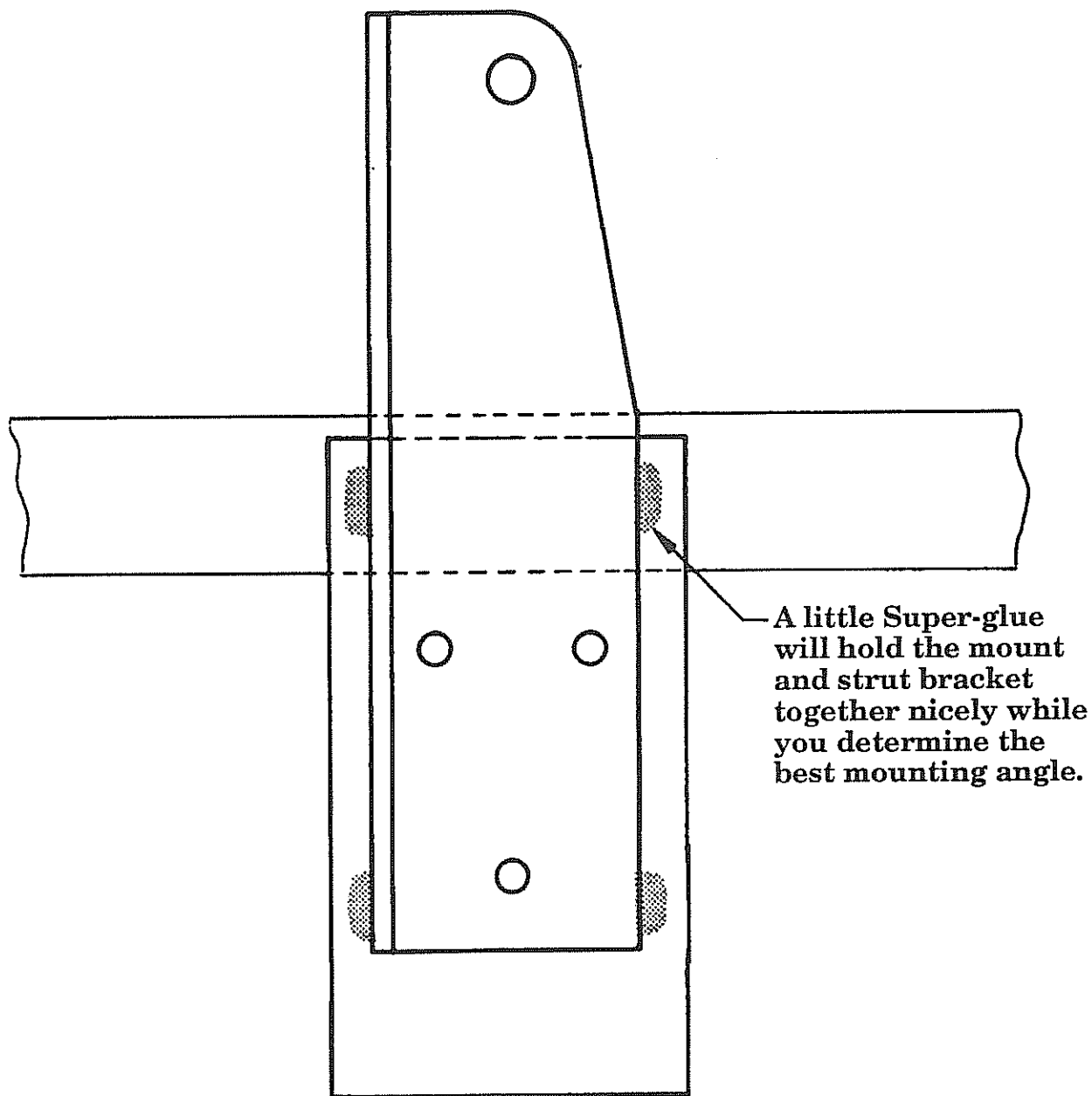


10. Mark a line up the center of the strut bracket as shown in figure 17-28. This line is in the center of the face, and disregards the web. Drill the 9/32" diameter hole 4-7/8" up from the bottom on this line as shown in blueprint "Q".

11. Measure up from the bottom edge of the bracket  $2\frac{7}{8}$ " as shown in figure 17-28 and mark a line across the bracket.
12. Place the top edge of the mounting plate flush with the line  $2\frac{7}{8}$ " up the strut bracket, and temporarily glue the parts together with four *small* dabs of instant or hot glue (see figure 17-29).

### Drilling holes in strut bracket and mounting plate

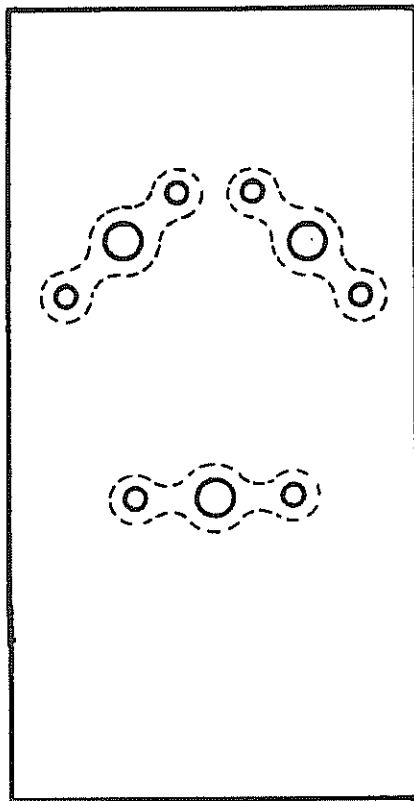
Figure 17-29



13. Using a 3/16" drill bit, drill through the marks on the mounting plate and through the strut bracket for the three mounting screws.
14. Carefully separate the strut bracket from the mounting plate. Using AN3-3A screws to hold them in place, install 3 K1000-3 nutplates to the back of each mounting plate, using AN426-A3 rivets, as shown in figure 17-30.

### Installing nutplates on mounting plate

Figure 17-30

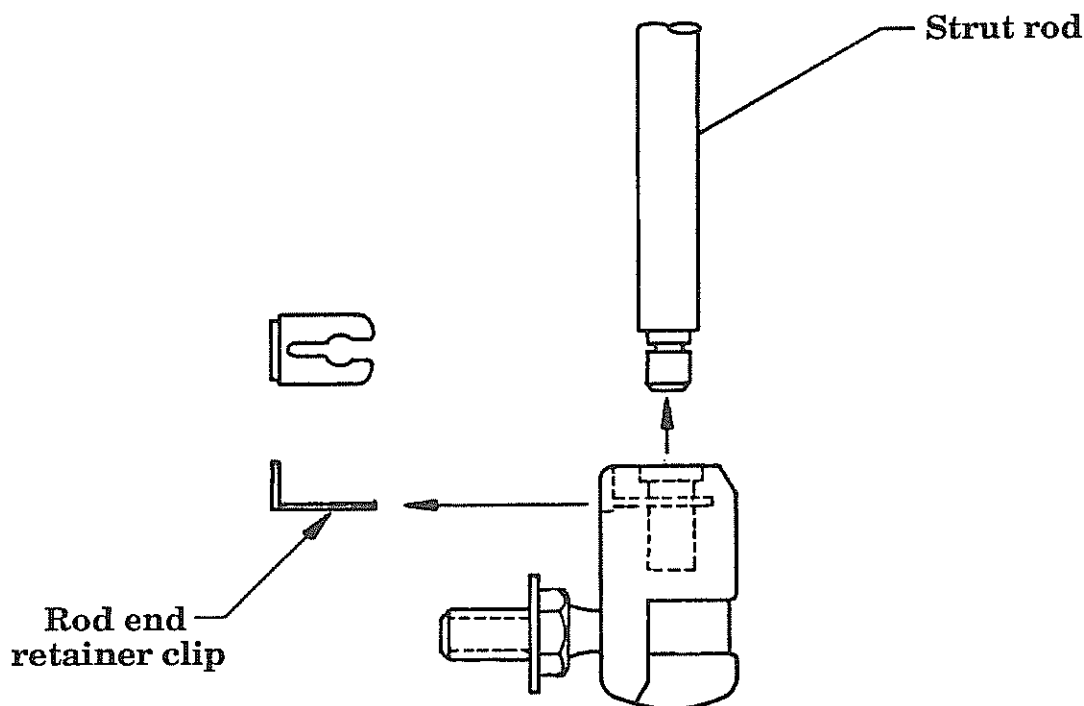


15. To simulate the 5 BID attach that will hold the mounting plate to the side of the fuselage, place 2 layers of duct tape on the outboard side of the strut bracket (the side that will go against the mounting plate).
16. Attach the strut bracket to the mounting plate using three (3) AN3-3A screws.
17. In order for the gas strut to have proper clearance, the bracket will have to be mounted at an angle, slanting inboard at the top. The strut mounting point will require about 1" of clearance between the bracket and the inside of the fuselage. To be sure that you have the proper clearance for the rod end, remove the rod end from the rod as shown in figure 17-31.

**Be careful** when removing the retainer clip from the rod - it can fly out and strike you in the eye, or get lost under the workbench or out in the grass or wherever it is those things end up that are never seen again. Keep your finger over it so it doesn't get away.

### Removing/installing retainer clip in rod end

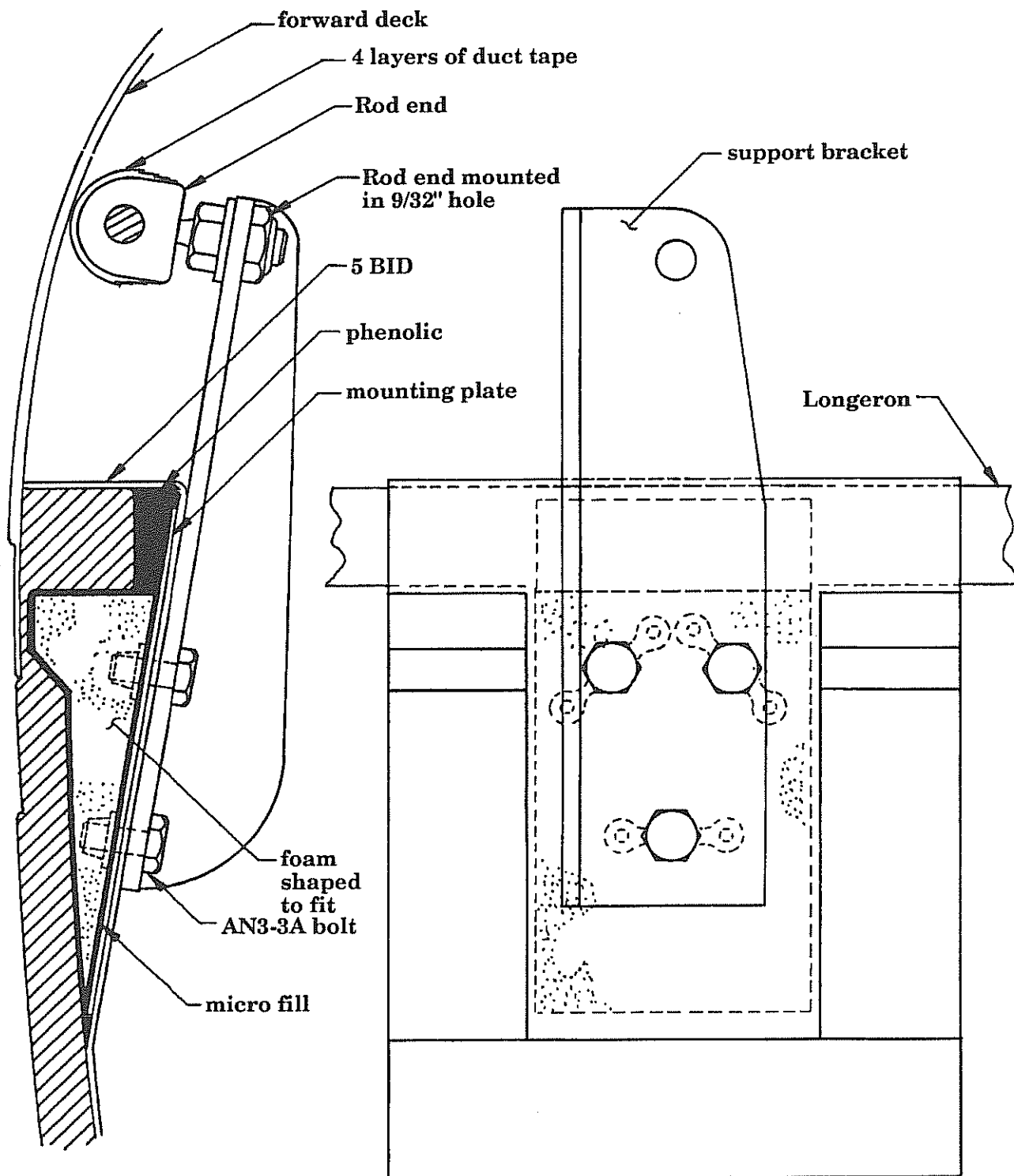
Figure 17-31



18. Bolt the rod end into the 9/32" hole in the support bracket so that the rod end is on the outboard side of the bracket. To insure proper clearance when you are measuring, wrap four layers of duct tape around the rod end. The end can now rest against the fwd deck, and you know you will have the necessary clearance.
19. Refer to figure 17-32. Place the mounting plate in position on the longeron so that the 9/32" hole center is 1-7/8" above the top of the longeron, and the duct tape on the rod end is just touching the inside of the forward deck. The mounting plate will not touch the longeron, but be held away from it by the bottom resting against the fuselage inner surface. A spacer must now be made for the longeron that will stand the bracket this distance away, and a foam block must be shaped to fill the gap between the mount and the fuselage (see figure 17-32). If you are short the extra hands to hold the mounting plate in place and measure the gap, a couple small dabs of super glue will come in real handy to hold the mount in place while you measure.

## Locating strut bracket

Figure 17-32



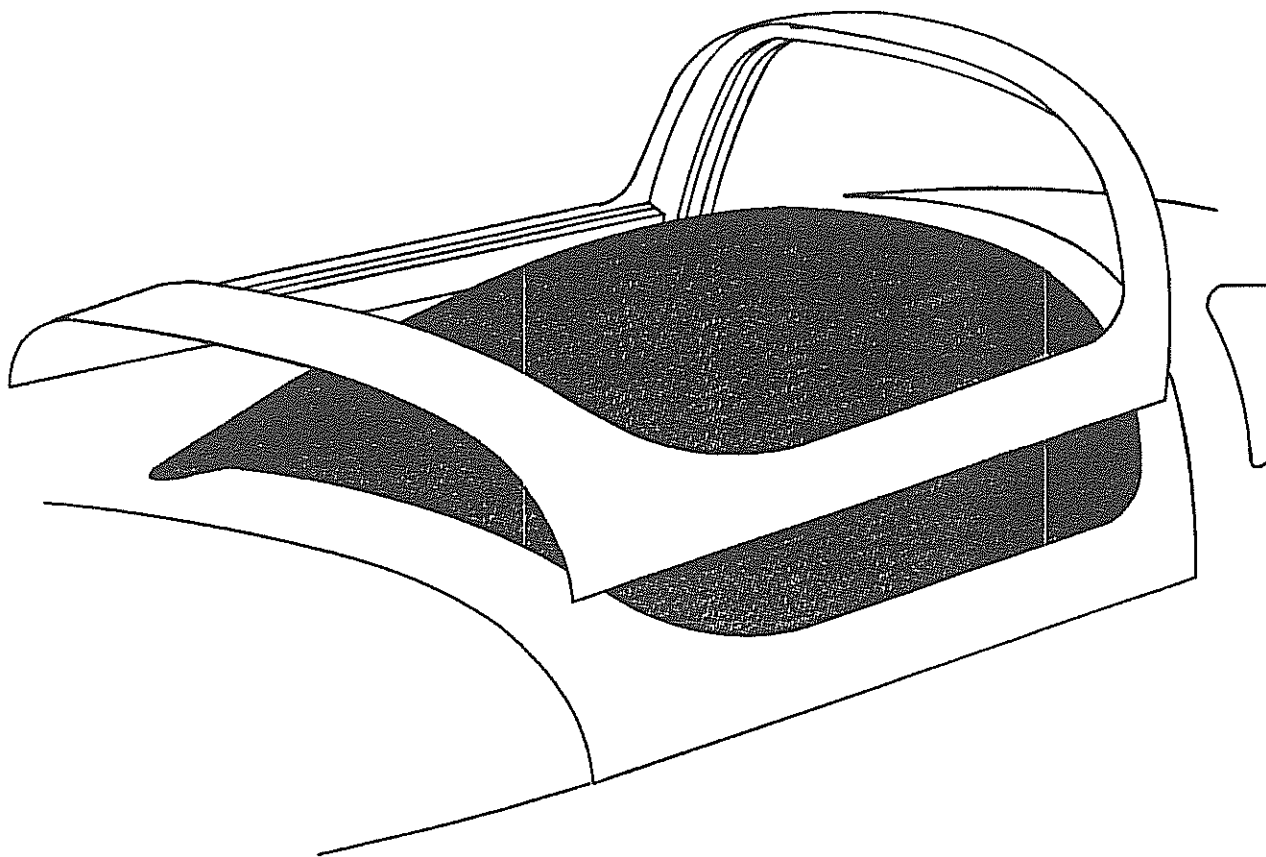
20. Shape a foam block as shown in figure 17-32 to fit between the mounting plate and the fuselage.
21. Shape another spacer from either foam or phenolic to go between the mounting plate and the longeron.
22. Pop the mounting plate loose from the fuselage and put a layer of duct tape on the outboard side of the mounting plate, covering the plate and the nutplates and bolts protruding from the outboard side.
23. Using epoxy/micro, glue the foam blocks into position and place the mounting block into position over them, making sure they space the mounting plate out properly. You will, of course, have to notch out some of the foam to make room for the nut plates and bolts sticking through the mounting plate.
24. When you are sure it is properly positioned and correctly spaced, remove the duct tape, put a little grease around the bolt threads and the nut plates where the bolt threads protrude and, using epoxy/micro, glue the mounting plate into position with the bracket and rod end installed. You can use a little more superglue as you did before to hold the bracket in place until everything sets up.
25. Use a little more epoxy/micro to fill in any gaps and to make a nice small fillet where the 5 BID will be placed over the mounting plate, longeron, fuselage and foam spacers.
26. Remove the screws holding the bracket to the mounting plate and remove the bracket and rod end.
27. Lay 5 BID over the mounting plate as shown in figure 17-32, extending it onto the top of the longeron and an inch in all directions.
28. After it has been applied, you can carefully work a pointed object such as a sharp pencil or knife point into the three bolt holes, enlarging them so the bolt can fit later. After the BID sets up, a quick hit with a sanding block will return the spots to a nice flat surface.
29. Re-install the brackets, with the gas struts attached. We will need them over the next few steps to be sure that we leave clearance for them. It might be a good idea to tape a clear plastic bag over them to keep them spiffy.



## D. Canopy frame

1. Since you have already established the fwd deck location, cleco it in place as shown in figure 17-35.
2. In order to have the canopy frame maintain the proper shape, and still be able to work on it, a brace for it must be constructed. Get two pieces of plywood or equiv. and make a contour pattern of the fwd deck at the junction of the canopy frame and also a pattern of the rear roll over. These do not have to be accurate at all, just pencil them in by placing the piece of plywood on the longerons and by laying a pencil flat on the decks, trace off the contour line all the way down to the longerons. These pieces of wood should be about 6" wider than the fuselage at their relative positions so that they hang over the longerons by 3" per side. They will be used later to make a quick and simple jig to hold the canopy frame when you remove it from the fuselage. By making sure that the wood is level, it will be easy to sit the frame upside down later without it "walking around" when you're working on it. See figure 17-34. Set the wood aside.

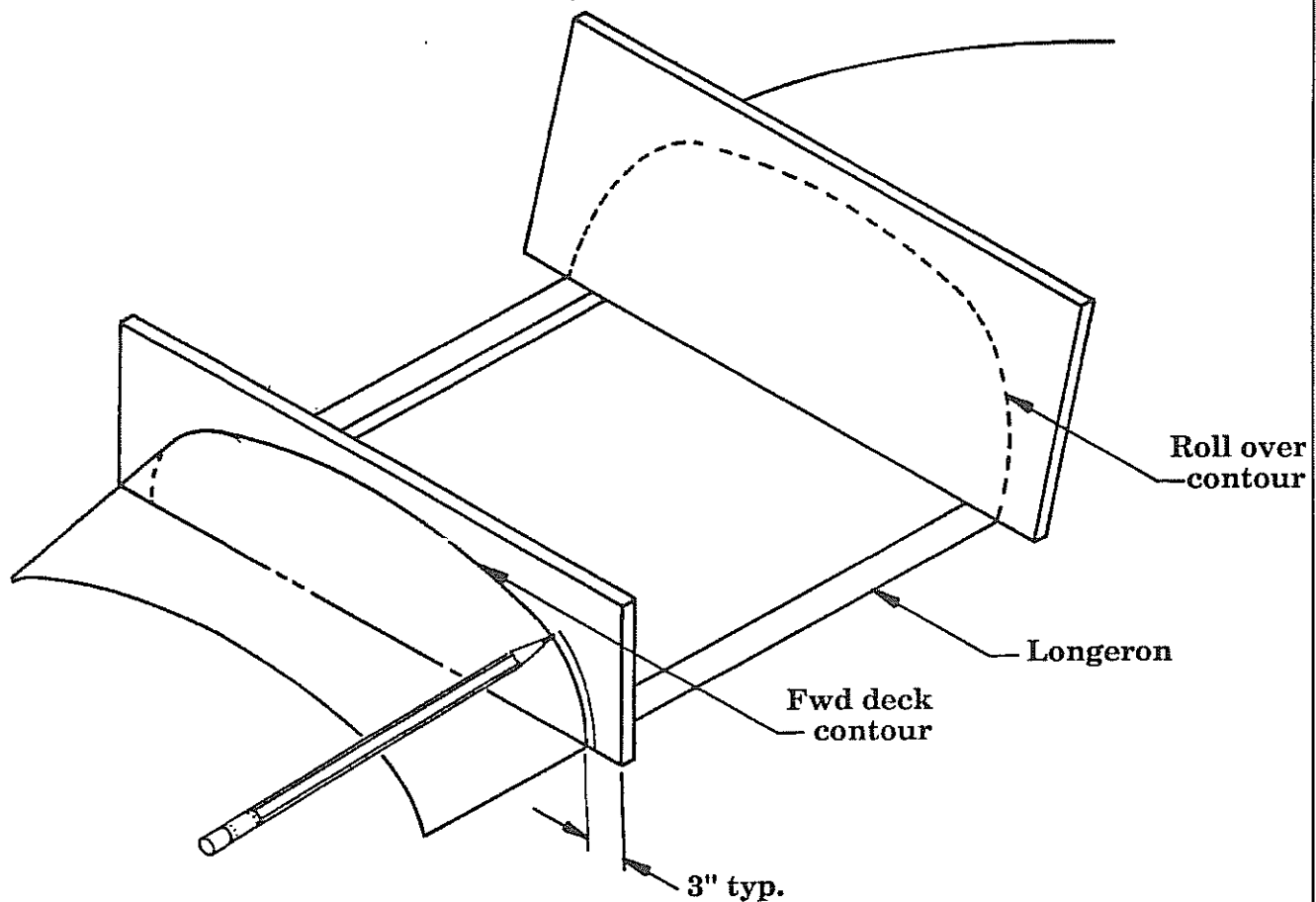
**Canopy frame assembly**  
EXPLODED VIEW  
Figure 17-33





## TRACING PATTERN for CANOPY BRACES

Figure 17-34



3. Lay the canopy frame over the airframe in relative position. Check for side rail alignment, the frame sides will eventually have approximately 1/8" - 3/16" clearance from the top of the longerons. This is to allow for a "P" strip seal or equiv. See figure 17-35.

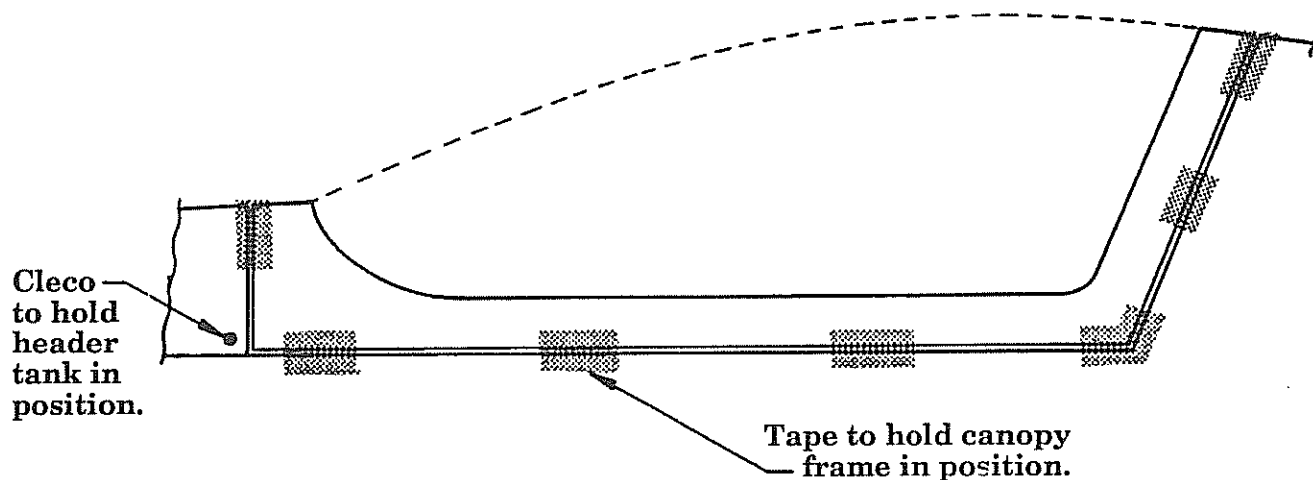
4. Locate the frame in a fwd/aft orientation that places it at a point which allows for complete coverage of both the fwd deck joggle and the aft roll over joggle. The frame has been factory trimmed to mate with these joggles. If at all possible, it is generally best to orientate the frame as far fwd as possible, this will provide additional instrument room since the distance from canopy to panel would be at its maximum potential. Trim and sand as necessary to establish an alignment with the L.E. of the fwd deck joggle and alignment with the T.E. of the aft roll over joggle.

**NOTE:** It is recommended that before you trim any of the material on the sides of the frame, first be sure that the frame is flushed up with the surfaces of the fwd deck and aft deck. The joggle may be initially too deep so use short pieces of mixing sticks to shim the frame up to a flush condition. Use dabs of hot or instant glue to hold these shims in temporary position as shown in figure 17-35. Also, review both canopy seal methods prior to trimming frame sides, as the alternate method benefits from this extra material.

**NOTE:** Do not trim the inside of the frame (where the canopy will install) until you have laid the canopy itself over and verified dimensions. You'll want to establish at least 5/8" overlap on all areas except for the front curved area where the overlap can be a little less. (The canopy will be bonded to the inside of the frame but you can verify dimensions by fitting it over the top initially.)

### Canopy frame taped in position

Figure 17-35



5. With the canopy frame fitted into the joggles you are ready to trim the lower edges as necessary to accurately match the frame side profile to the fuselage sides. By using mixing sticks and hot or instant glue, and cutting and sanding as necessary, position the canopy frame so that it is flush with the fuselage profile, with about 1/8" gap between the frame sides and the longerons, even fore & aft and on both sides. Either sand this to a smooth line now, or mark it well and sand it later after you install the bracing and remove the canopy frame for other steps.

**NOTE:** There are three different latch mechanisms described in this chapter, each system requiring canopy frame hardpoints in a different location. At this time you should review the different systems. The system we use on the standard opening canopy is fine, and requires only the aft latches, the installation of which begins on page 17-65. The second method is shown on page 17-75, a draw bolt style. This is a very simple system that you can do the "finish" design of, based on your seat location, etc., and will require a couple of hard points on each side of the frame. The third method is described on page 17-76, and is a very nice lever-style latch that works very well, but requires a bit more work. Please read all three installations first and then determine which system is to be your choice. After you have made your decision, proceed with step 6., below.

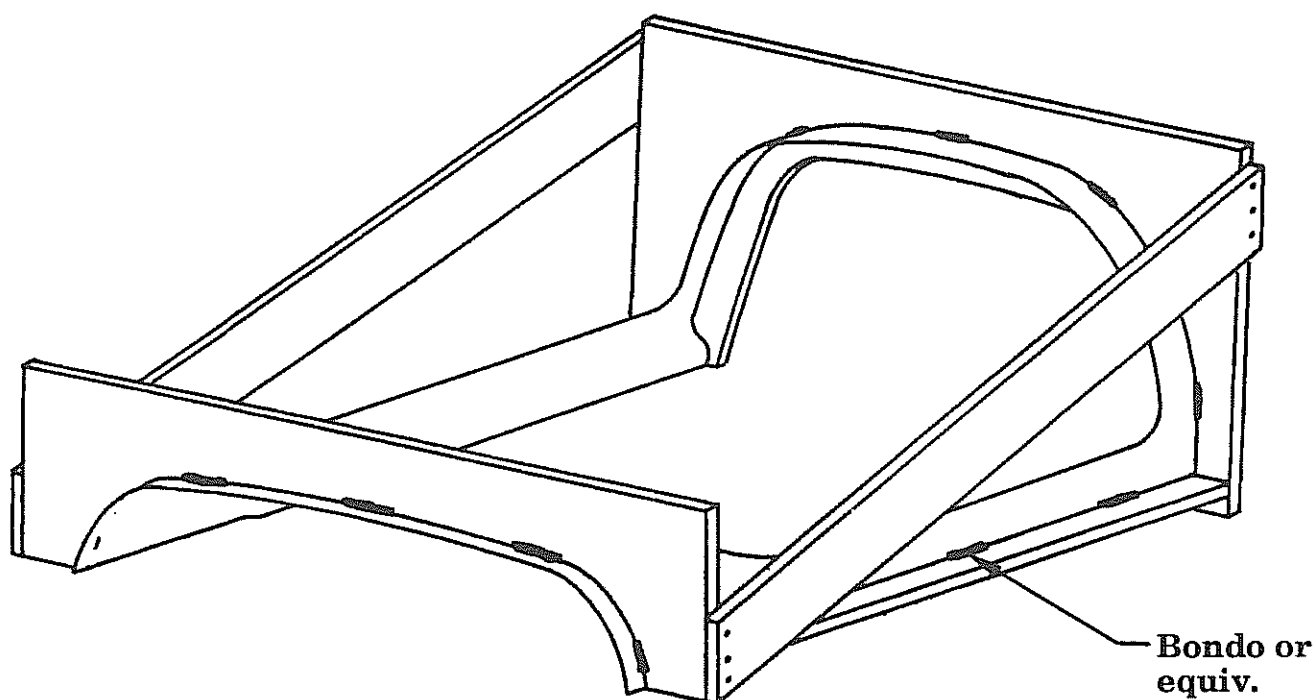
6. Referring to the dimensions given for the latch system you have chosen to install, carefully lay out the hard point positions by marking their lines onto the fslg sides. Draw a line that crosses the longerons vertically and thus provides position marking reference on both the canopy frame (inside and outside) and the fslg. Label them as "aft canopy lock", "latch", etc. (This can become confusing later so some simple labeling now will eliminate some later head scratching.) Also mark the area that foam will need to be removed from to make clearance for the hard points.
7. Measure from the center of the fuselage strut attach point aft 12-5/16" to a point 1 1/4" above each longeron (Refer to blueprint "Q"), and mark this spot on the inside and outside of your canopy frame. This will be the center for a phenolic hard point later.
8. Now that the exterior of the canopy is the exact shape we want it to be, and we have all of the hard point locations marked off, we need to construct a brace to hold it in that position while we do some extensive modifying on the inside. Using a sabre or jig saw, cut out the pieces you marked earlier, so that you have a silhouette that is slightly larger than the canopy frame itself. Don't bother trying to get it even close, Bondo will take care of that.
9. Sand the braces to remove any splinters that would get you later, and wipe the inside edge of the patterns with acetone or MC to clean them for the next step.



10. Referring to figure 17-36, mix up a big hot (lots of hardener) gob of Bondo, spread it along the forward part of the canopy frame from one side to the other, in spots about 2" long and a half inch deep. Squish the forward brace piece down into position, wiggling it a bit to get it down to the frame through the Bondo. Check that the top line of the board is level side to side (so it will be able to rest upside down) and true vertical (so it won't fold under when there is weight on it) and hold it for about 5 minutes while the Bondo cures enough to hold its position. Repeat this process for the aft brace.

### Canopy frame brace

Figure 17-36



11. Nail, screw or glue a couple of pieces of wood as shown in figure 17-36 between the two braces to make them a more rigid structure. Then use some more Bondo to put a couple of fore-aft braces down the sides of the frame, bedding the wood as you did in step 6, and then screw or nail it to the front and back braces. **BE SURE NOT TO DISTORT YOUR CANOPY FRAME WHEN YOU DO THIS -** When you are finished with the next steps, if you have distorted it here, the distortions will be permanent!

Later on, when you are finished with the frame, you can simply knock the boards off with a good smack of a hammer.

12. Referring to the appropriate data for the latching system you have selected, cut the necessary pieces of aluminum for the hard points. These will be potted into the canopy frame.

13. You will need to remove material from the front of the side stiffener for clearance for the gas strut. Holding the strut up to the frame, mark the area you will need to remove for it's clearance. Remember, the strut is fully extended now, but when installed it will be fully collapsed when the canopy is down, so only mark out the area you will need for the body in the collapsed position.

14. Remove the canopy frame and bracing from the fslg and place it inverted on a bench or on the floor. Sand a smooth line onto the bottom of the rails to create a finished line for the side rails, if you haven't done so already.

**NOTE:** The existing forward stiffener in your canopy frame is not stiff enough to handle the hinge pressure of the forward opening canopy. It will have to be removed and replaced with a stronger one. Also, the stiffeners in the canopy side rails are, for the forward opening canopy, much thicker than they need to be. They can be cut back, giving you a little more "elbow room" in the cockpit later. If you want the extra room, now is a good time to go for it. The side rail stiffeners in your canopy frame can be cut back until they are the same width as your longerons. While you are cutting away the forward stiffener, remove any excess width from the side stiffeners as well.

15. Cut around the forward stiffener and remove the covering BID.

16. Using the existing stiffener as a pattern, cut another one from 1/4" white foam, and set it aside until you get to step 21, below.

17. Chisel or grind away the exposed foam stiffener, being careful not to go into the glass beneath it.

18. If you want the extra space, cut away the side rail stiffeners as discussed above.

19. The remainder of the BID that held the old forward stiffener in place should be sanded away until you have a fairly smooth area to work with. It isn't necessary to remove all of the BID that held the stiffener, but at least smooth it down.

20. Remove the excess material from the canopy side for clearance of the gas strut.

21. Referring to "Q", cut a 1/4" thick white foam stiffener to wrap around the L.E. area of the canopy frame. This stiffener must stop short of the overlap where the frame rests on the fwd deck joggle. It can roll most of the way down the fwd sides (leaving room for the gas strut!), getting a little wider as it moves down the sides. Also, keep it back from where the canopy will lay against the inside of the frame (Keep about an inch or so of clearance). Sand a large bevel onto the stiffener so that it does not interfere with the instrument panel dust cover. This bevel should be along the fwd side of the stiffener. Also sand the edges to a smooth transition into the frame so the unidirectional graphite fabric (UDG) will lay up easily.

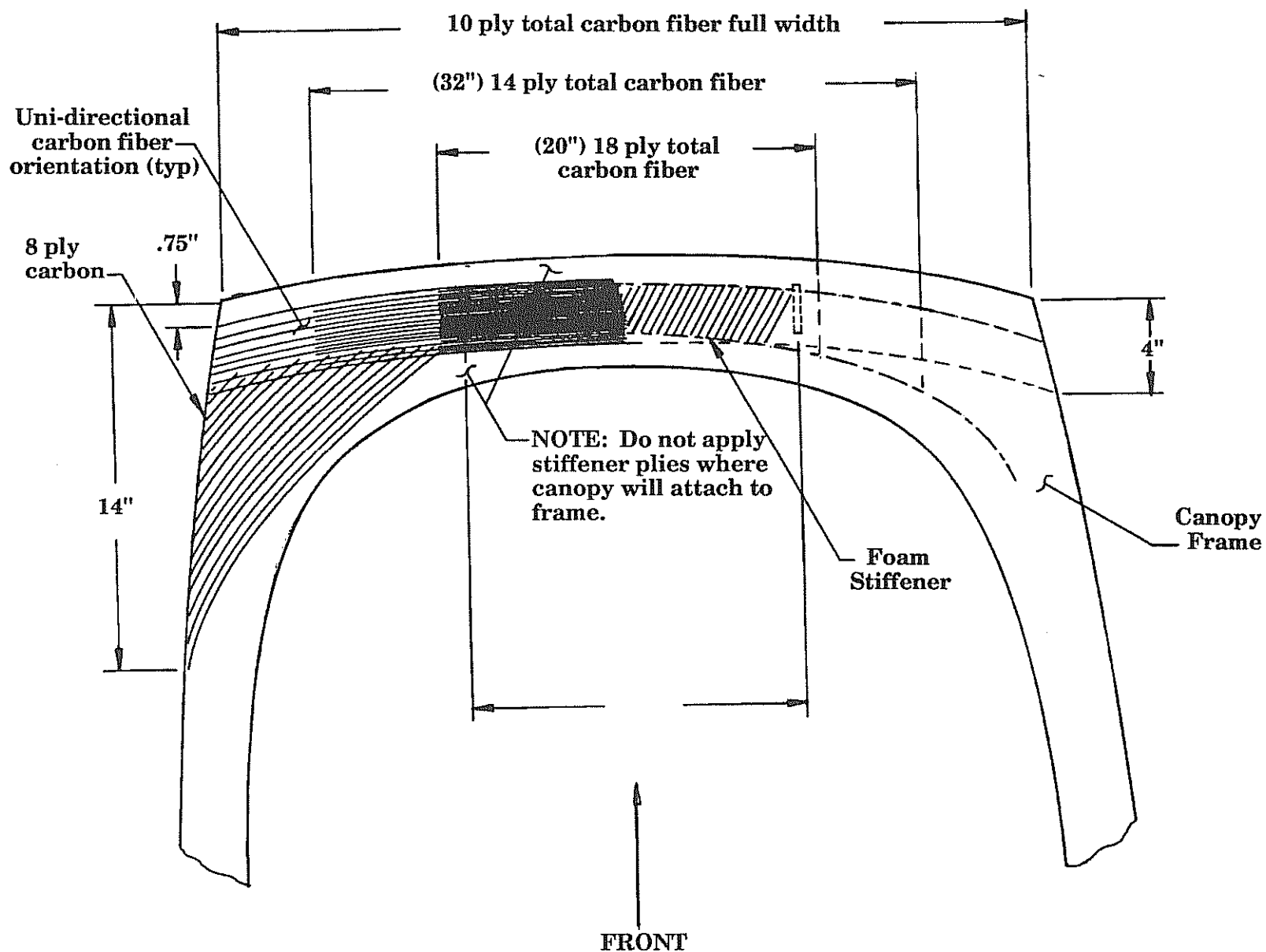


**NOTE:** The following steps are performed using **UNIDIRECTIONAL GRAPHITE FABRIC (UDG)**. Drawing "Q" shows how many *total* plies go where. The method, though, is to put on half the plies indicated, put in a foam stiffener, then lay up the rest of the plies. When making these lay ups, it is best to do them without waiting for the previous layer to harden. If A layer sets up before you begin applying the next one, you will have to stop and wait until it is hard enough to rough up, so that the next layer can properly adhere.

22. Refer to Dwg "Q" and figure 17-37. Using #40 grit, rough up the area shown (just enough to make a good mounting surface - you don't need to remove any material) and then clean area with acetone or MC.
23. Lay up 4 plies of UDG in the direction and area shown as "8 ply carbon".
24. Lay up 1 ply of UDG in the area shown as "10 ply total carbon f. full width".
25. Lay up 2 plies of UDG in the area shown as "(32") 14 ply total carbon f."
26. Lay up 2 plies of UDG in the area shown as "(20") 18 ply total carbon f."
27. Use micro to attach the stiffener you made in step 21 to the inside of the canopy frame. Use weights to hold it until it cures.
28. Apply a thin layer of micro over the foam stiffener to seal the foam pores.
29. Lay up 2 plies of UDG in the area shown as "(20") 18 ply - -".
30. Lay up 2 plies of UDG in the area shown as "(32") - 14 ply - -".
31. Lay up 1 ply of UDG in the area shown as "10 ply total - -".
32. Lay up 4 plies of UDG across the area shown in fig. 17-37.
33. Let cure.



# CANOPY STIFFENING FIGURE 17-37



34. Referring back to the mark you made in step 7 above, for the canopy strut hard points, prepare two pieces of phenolic about 1 1/8" square and 1/4" thick. Bevel the sides so the attaching lay-ups can smoothly cover them.
35. Drill and tap a 5/16-18 hole in the center of the phenolic pieces.
36. Remove the captive washers from the two remaining strut attach ball studs, and grind the threaded end off until, when threaded into the phenolic blocks, no portion of the threads sticks out the back.
37. Mix up enough structural adhesive for the next two steps.
38. Lightly coat the ball stud threads with structural adhesive, and put enough adhesive into the threaded hole in the phenolic blocks to make a good bond. Screw the ball studs tightly into the blocks.
39. Coat the back of the blocks with sufficient adhesive and position them onto the canopy frame, clamping them in place (tight, but not too tight!) until they cure.





## E. Side rail stiffeners

**Note:** You will want the bottom of the frame side rail to be at least 1/8" wider than the seal strip you will use. If you are using the inflatable "D" strip we use on our plane, you will need to make the side rail about 11/16" wide. This procedure covers our choice, using the "D" inflatable seal. Now is a good time to consider what type of seal and sealing system you are going to use, because it will have to be provided for here. Study the following steps, and review the alternative method shown on pages 17-69 through 17-74, until you are sure about the seal system you will use.

1. Cover the longerons, and anything else in the immediate area of where the canopy frame will mount, with plastic. You may "dribble" in the next few steps, and an ounce of plastic prevention is worth an hour of sanding cure later.

2. Place the canopy back onto the fuselage, still in the support frame.

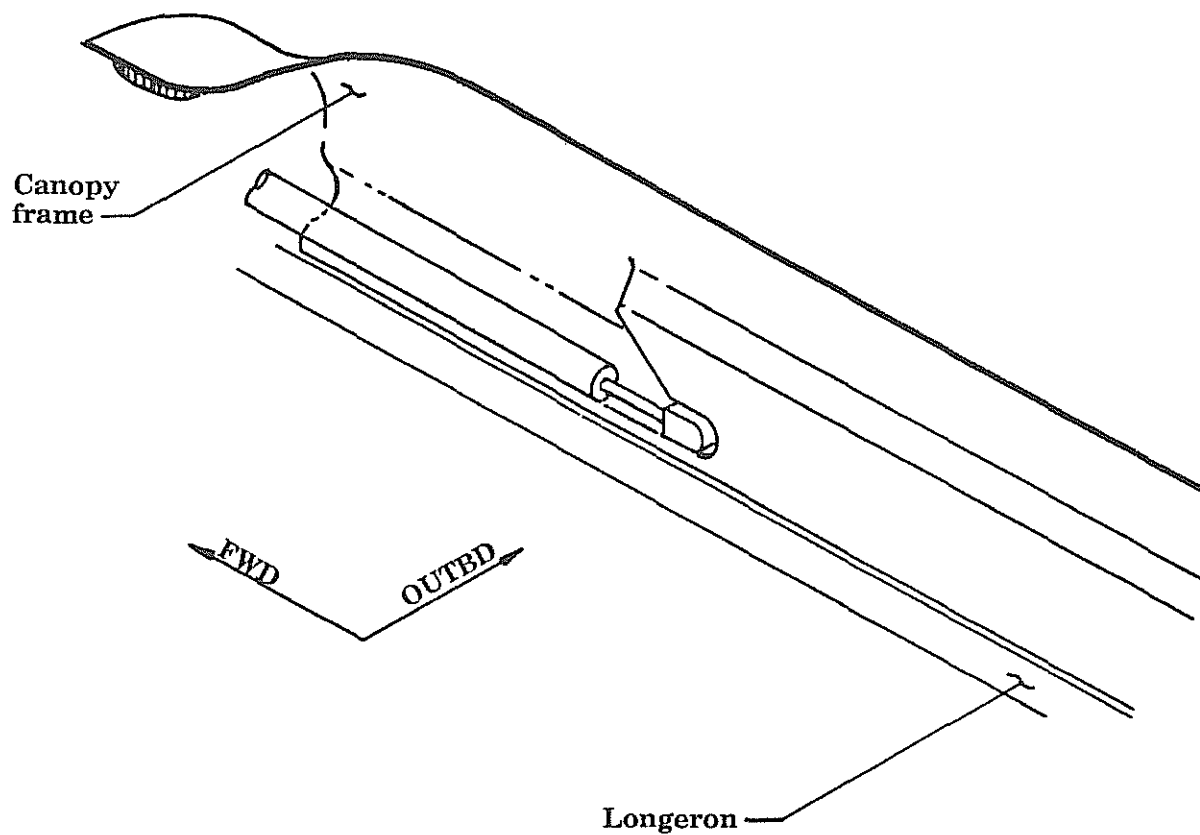
**NOTE:** On the Fwd hinge canopy system, you can reduce the width of the side rails to that of the longerons.

3. Sand a smooth finish (you may have to fill in spots with the micro first) on the side rail foam. Sand them down with a small 6" block sander and some #50 grit paper. Sand down to be flush with the inside of the longerons along the area of the side rails. Remember the clearance for the gas struts, using a little creative sculpting you can neatly "fair in" the gas strut, see figure 17-38.
4. Cover the foam side rails with micro (just enough to fill in the pores in the foam only) and lay up 3 BID over the top. Contact at least 1" onto the frame prepreg and roll over in the back. Trim the 3 BID so that it just extends a little past the bottom and hangs there for now. If you have more than about a half inch hanging over it will possibly put some waves in the finished part so trim it that close for initial layup. Let it cure.
5. Remove the canopy frame from the fuselage and place it inverted on the floor or workbench. Sand a smooth line onto the bottom of the rails to create a finished line for the side rails.



## FAIRING IN THE GAS STRUTS

Figure 17-38



## F. Canopy Hinge Installation

**NOTE:** At this time, you should have the header tank installed, with the 8 BID stiffeners installed in the pockets.

1. With the header tank mounted and the canopy frame off of the fuselage, refer to Dwg "Q". The header portion of the hinge is centered exactly 8" from the centerline of the aircraft. Using #50 grit sand paper, scuff the inside of the pockets in the area where the hinges are to be mounted, and make a vertical line through the pocket at the 8" point.
2. Center the LS 3 bearing in the small end of the two curved .250" brackets.
3. Using freezer or plastic tape and an Xacto knife, build up the surface around the bearing bushing until it is thick enough that, when it is bolted between the two pieces of tank bracket, it holds the two brackets together tightly, with the bearing shoulders just touching the two hinge halves. They should be tight enough so that they remain at any angle you set them.
4. Using #50 grit paper, rough up the area of the brackets that will later be bonded.
5. Cut a piece of 2x4 wood so that it is 15 3/4" long, with the ends **flat and square to each other**.
6. Lay the wood on a **flat** surface.
7. With the bracket ends flat on the surface, clamp or hot or instant glue them onto the ends of the 2x4.
8. Make sure the header tank brackets are vertical, 90° to the flat surface (remember, the assembly is now upside down).

**NOTE:** IT IS IMPORTANT to mount the hinges as high as possible in the header tank pocket so that you will have the maximum canopy travel, and the canopy to fwd deck transition will be as smooth as possible. The lower the hinge mounting point, the more you will have to bevel the edges of the canopy and fwd deck later.

9. To make this easier, find something that you can put inside the cockpit that you can use to prop up and hold the hinge/2x4 assembly in position while the adhesive is curing. **CLEAN THE BRACKETS WITH ACETONE OR MC.** Using structural adhesive, coat the mounting surface of the hinges and, turning the assembly right side up, bond it to the header tank. Remember, get the hinges as high as possible in the pocket, but **KEEP THE HINGES LEVEL TO THE AIRCRAFT.**

10. Clamp in place, wipe away any excess adhesive and wait until the adhesive has had sufficient time to cure.
11. Per Dwg. "Q", fill the bracket holes with flox, and the gap at the top of the bracket with micro. **Do not remove the tape from the bearing area yet.**
12. Finish the header tank portion of this procedure by laying the 6 BID attach over the brackets, being careful to not get any epoxy into the workings of the hinges.
13. After cure time, carefully remove the 2X4 and clean off any residue that may be left on the hinge bracket from the hot or instant glue, and apply plastic release tape to the area where it will attach to the canopy.
14. Carefully rough up the surface on the canopy frame where the hinge will attach (see dwg. "Q").
15. Place the canopy frame in position on the fuselage.
16. Raise the bracket arms up until they touch the canopy.
17. Following the pattern shown on drawing "Q", lay up first the 4 BID areas, then the four additional BID, then the final 6 BID, each layer going up the sides of the bracket arm about 2".
18. After everything has had time to cure, and without disturbing the position of the arms or the canopy, drill the two holes in each bracket, through the fiberglass, as indicated.
19. You can now unbolt the brackets from the header tank and remove the canopy. Remove the arms from the canopy, one at a time, and mark them so you will know which is left & right.
20. With the canopy upside down, fill the void area inside the brackets, between the bracket arms and the canopy, with solid micro/flox to stiffen the radius area of the 14 BID fiberglass fittings. Re-insert the arms (with their plastic release tape still on them) into their respective holes until they are in proper position, and wipe off any excess epoxy that is squeezed out.
21. After the epoxy/flox has set, remove the bracket arms.
22. Remove the tape from their ends and clean the brackets.
23. You can now proceed with mounting the lock and latches.



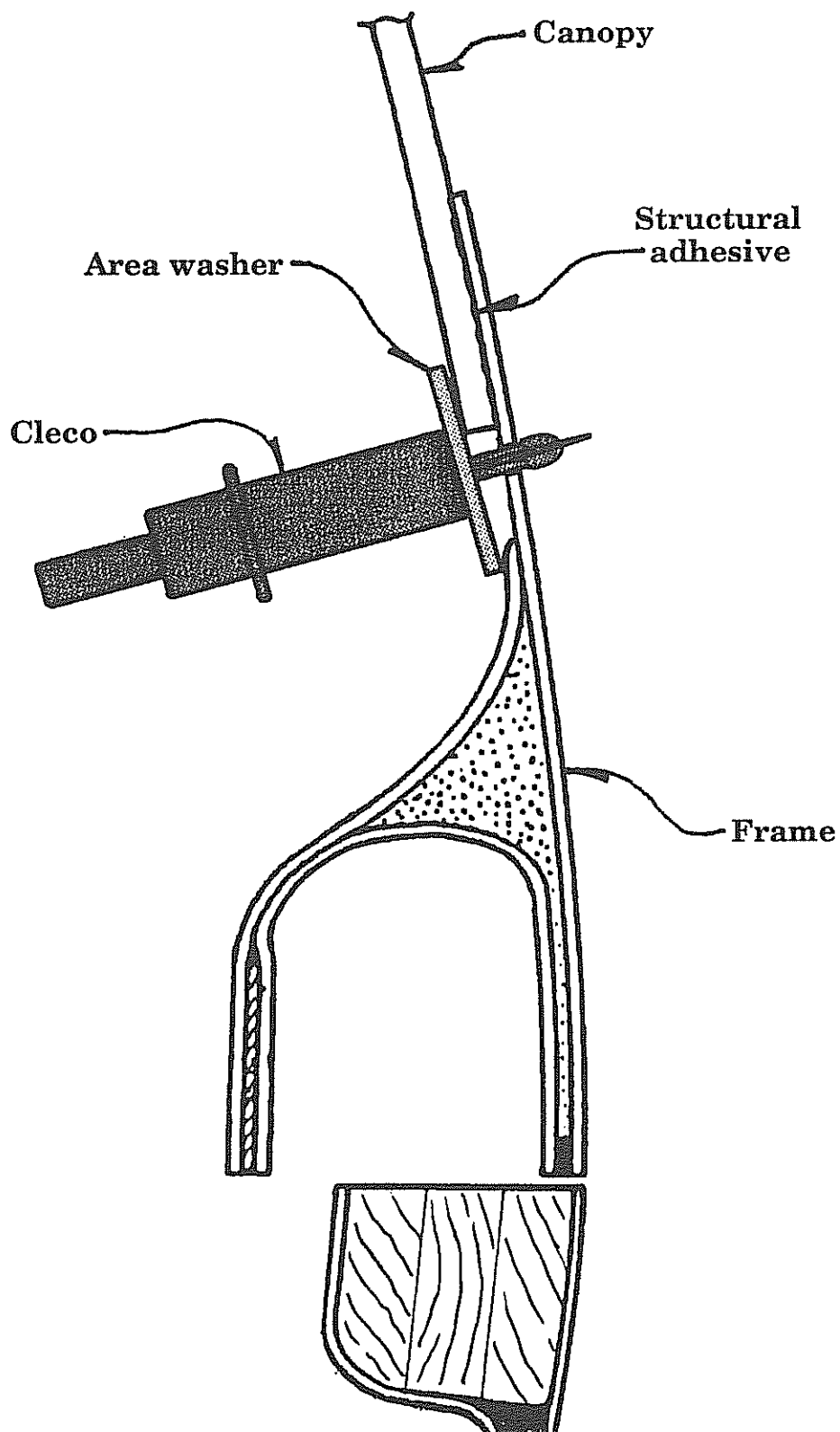
## G. Canopy plexiglass installation

NOTE: DO NOT REMOVE THE PROTECTIVE COATING FROM THE CANOPY UNTIL INSTRUCTED TO DO SO!

1. With the canopy frame upside down on the bench, STILL IN ITS BRACE, lay the canopy into it. Adjust it from left to right and fwd to aft until a good fit is established. Note the areas of overlap. You should have about 5/8" minimum around all sides with less around the front curvature.
2. Trim the canopy frame and sand the edges smooth. This will NOT be a finished paint line but it will determine that line to some degree. The actual finished paint line will be inside of the trim line by approximately 1/4".
3. Prior to bonding the canopy into the frame, sand a gradual bevel onto the outside of the cutout, this will help the transition during "finishing" later.
4. Also sand and smooth the inside frame surface where the plexiglass will be attached.
5. Now place the canopy back into the frame (inverted) and run a felt tip marker around the outside of it to indicate on the plexiglass wrapping exactly where it will register back into the frame for bonding purposes. Transfer this line onto the inner side of the canopy protective coating as well.
6. Trim the canopy if necessary. Consult the recommended directions for canopy cutting produced by Airplane Plastics, which has been reproduced in this chapter in section 7, "Plexiglass Hints For Perfect Canopies".
7. Using a #30 bit, drill holes through the frame about every 6" around the entire perimeter of the canopy, directly adjacent to the edge of the plexiglass. These will be used for clecoes which will serve as temporary clamps to hold the canopy in position during cure. Refer to figure 17-39.
8. Remove the canopy and peel back the protective coating, on the outside of the canopy, to a point beyond the felt marker line. Come back with plastic electrical tape (1/2" wide works best since it bends around contour lines easier) and remask the exposed canopy such that the tape line is just inside (by 1/8") the actual canopy frame line. You'll be able to see the reference line marked on the inner protective coating. Make sure there are no other exposed areas of the canopy showing. All little peeled spots on the protective coating (inside or outside) must be covered with a piece of tape.
9. Sand the exposed surface of the canopy with 50-80 grit sand paper.



CANOPY TO FRAME, CLECO MOUNTING  
FWD EDGE  
Figure 17-39



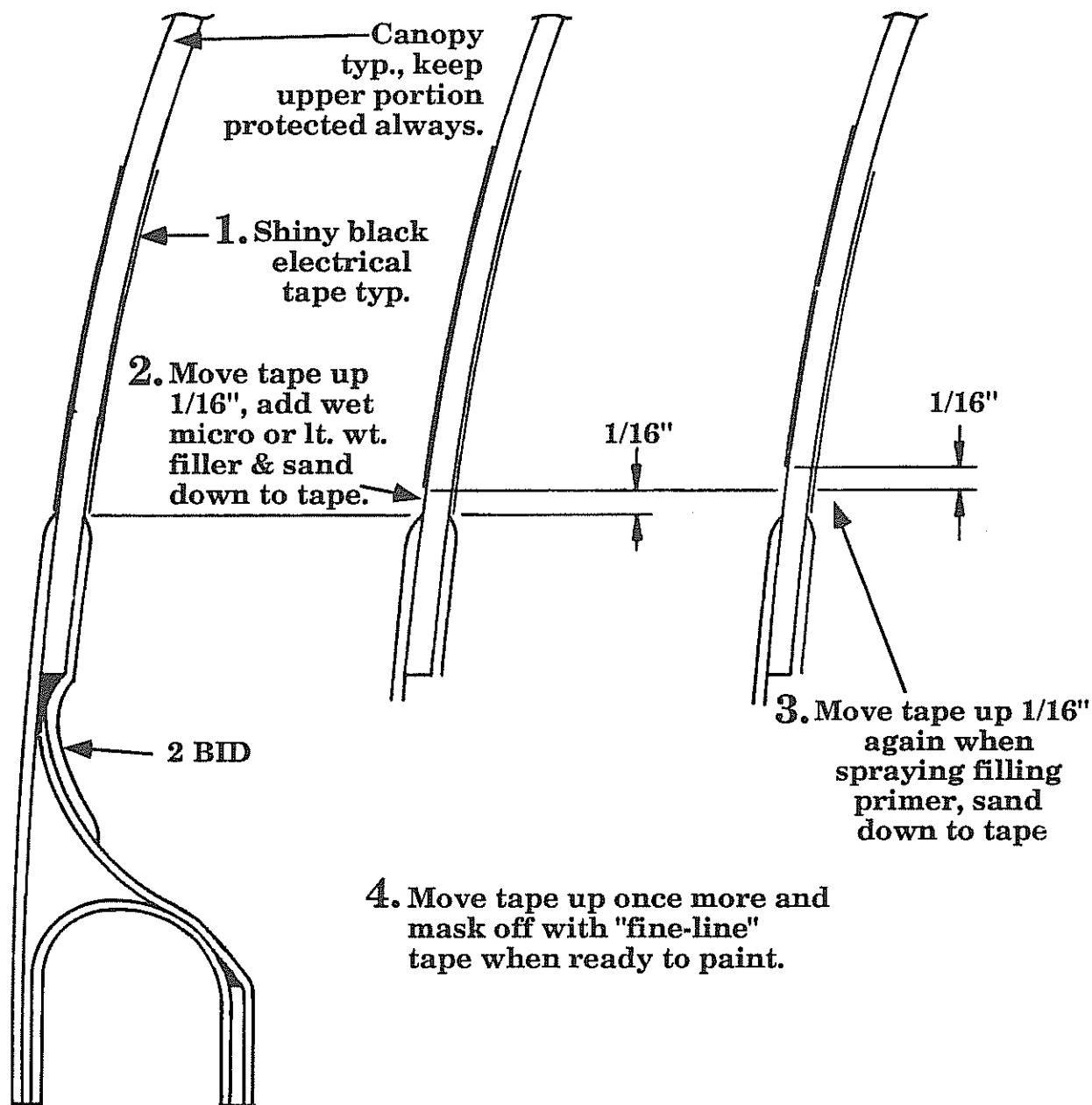
10. Mix up a batch of structural adhesive (with 5-10% flox added to thicken it up a bit) and spread a film on both the canopy and the frame.
11. With a little help from a friend, carefully place the canopy into position and set all the clecoes from the inside. It may be helpful to place an area washer over the cleco to attain a little more surface area on it while clamping however, it usually works quite well without these washers. If the clecoes have any tendency to slip off, then use the washers. As you set the clecoes, press down firmly on the canopy to squeeze out excess adhesive. Wipe this away as you proceed. You will generally be able to witness the bond area integrity by seeing the contact through the hazy (sanded) plexiglass. It turns darker when it has good adhesive contact. If you find that added pressure is needed in certain areas, just drill for a couple more clecoes.
12. When all the clecoes are set, carefully lift the unit off the bench and place it back onto the fslg to cure in the actual position. This is just a final safety measure to insure that you are not locking in any kind of twist in the canopy frame during this bonding process. With the canopy/frame positioned onto the fslg, wipe off any excess adhesive that squeezed out along the outside. Allow to cure at least 24 hours at room temperature.
13. Next, remove the canopy/frame and invert it back onto the bench top. Remove all the clecoes and clean away the protective coating from the inside. Peel it back about an inch and retape with plastic electrical tape to within 1/8" of the bond line. This bond line should be the same as on the other surface.
14. Sand with 50-80 grit and clean. The fwd area of the canopy will form a ridge where the glass extends down away from the frame. Sand the edge of the canopy slightly and fill the remaining area to form a micro fillet so the BID tapes will install properly. This will also help to stiffen the front end. See figure 17-11.
15. Add 2 BID all around the interior perimeter of the canopy. Overlap at least 1" onto the frame. On the side rails, extend the BID tape down 1" past the point where the channel begins to roll out. This is to add additional stiffening to that area. See figure 17-40.

**At this time you may carefully beat the brace off of the canopy!**



## Canopy fairing

Figure 17-40





H. **Latch strike installation - STANDARD LATCH, fwd hinge canopy**

The standard in flight latch mechanism is a very straight forward installation using Cam-Loc® safety latches. These latches will pull over center for a positive lock with an additional safety catch to prevent accidental opening. These are each load rated at more than 4 times the required strength.

1. Decide where you want to put your latches - with this canopy opening configuration, we find that one on each side, just forward of the seat back, is just fine. Draw a vertical line that crosses the longerons and the canopy to provide a reference on both the canopy frame and fuselage representing the center of the latch positions of your choice.
2. Cut 2 pieces of .090" aluminum that are 2" long and 1-1/4" high. These will be potted into the inner sides of the frame where the latches will anchor.
3. Using a drill or Dremel tool with a router bit, remove the foam from the inside bottom of the side rails at the point you have chosen for your latches. You will need enough room to lay BID around the hard points, and the area will have to be completely free of foam for a good bond. See figure 17-41A and 17-41B.

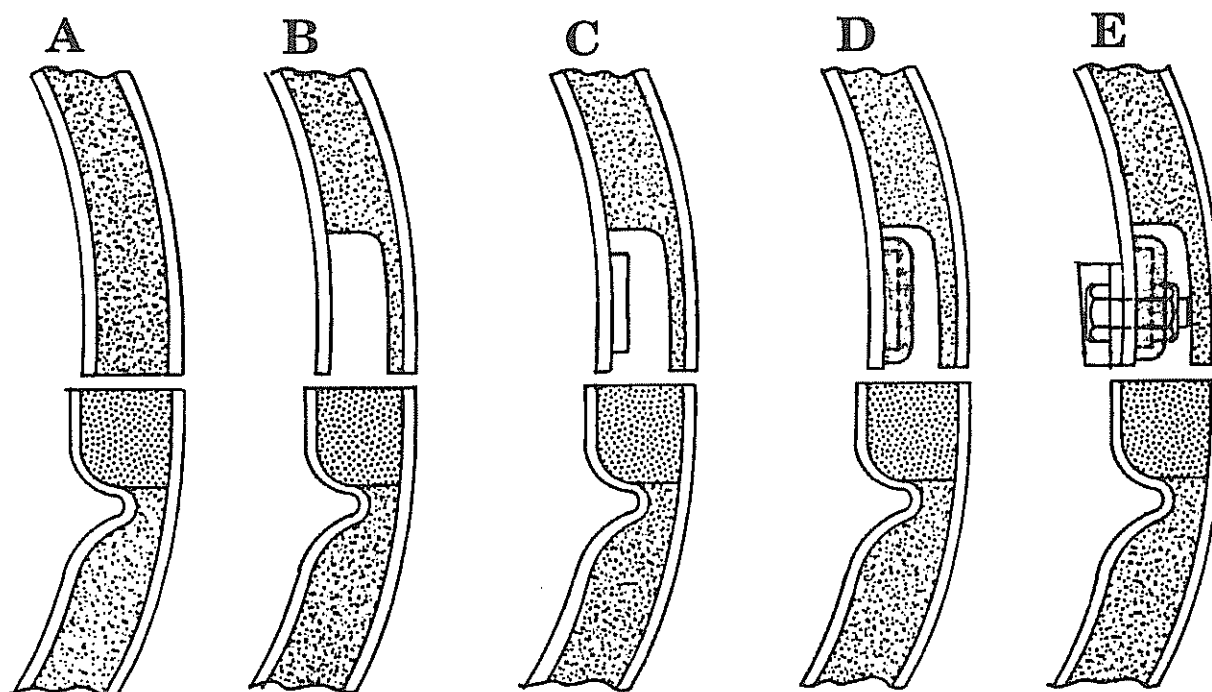
**NOTE:** the hard points that will attach the latches will require the full elimination of foam against the aluminum inserts on the inboard side of the channel. For structural integrity, all foam must be removed from these areas, so the inner BID will attach directly to the aluminum inserts.

4. Once the channel is carved out for your hard points (fig. 17-41B), go in by hand with a piece of 36-50 grit sand paper and give it a final sanding to smooth everything up.
5. Using epoxy/micro (or preferably, structural adhesive), bond the hard points to the canopy frame (figure 17-41C), about 1/8" up from the bottom edge. Rough the aluminum up and clean it with acetone or MC immediately before bonding in place.
6. Lay 2 BID over the hard point (figure 17-41D) and let cure before proceeding to next step.
7. Position and mount the 'strike' for the latches by drilling two #19 holes through the strike as a guide and through the inbd side rails of the canopy frame. The strikes should be positioned even with the bottom of the side rail, see figure 17-41E).



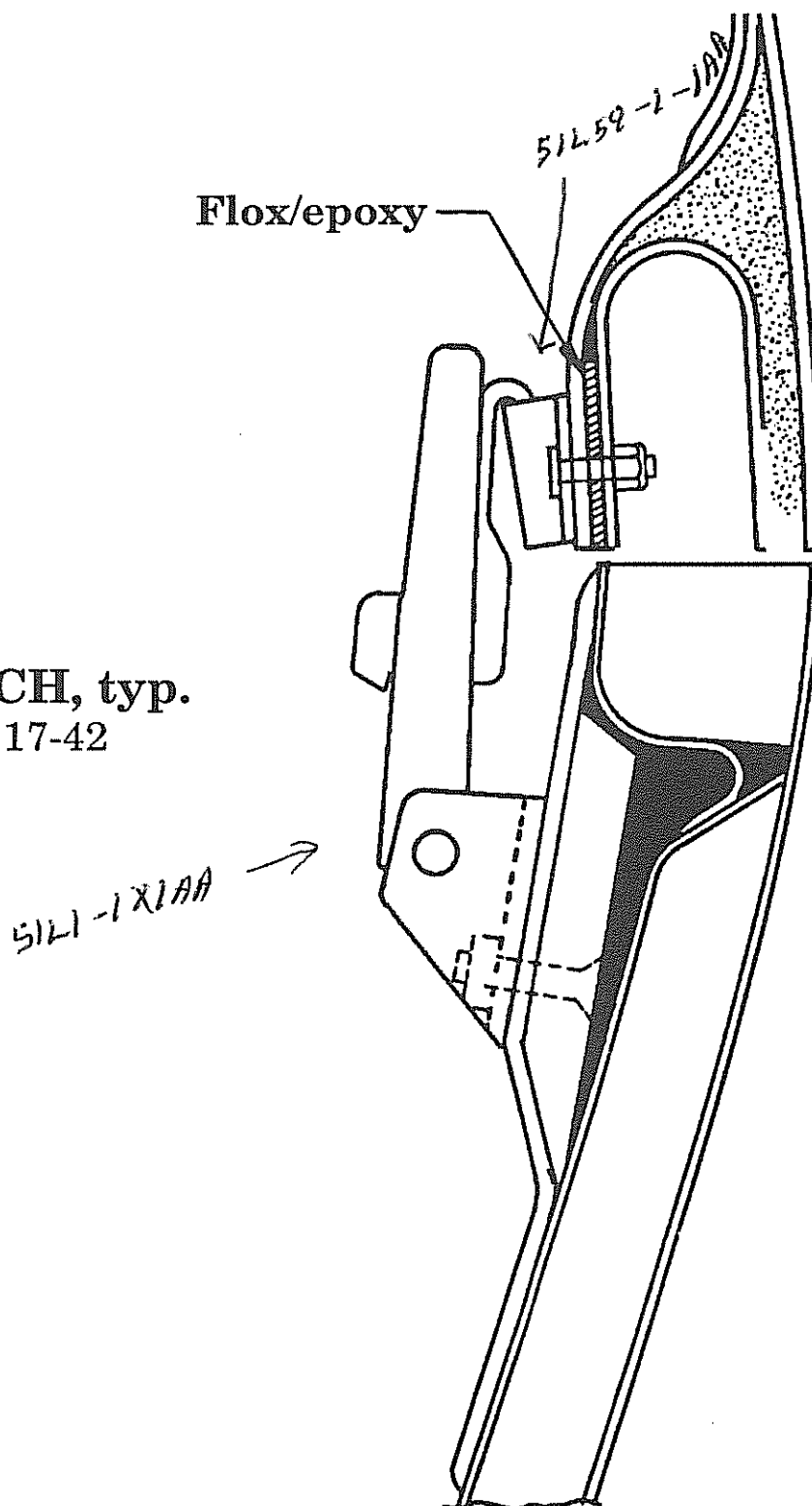
## Canopy latch striker installation

Figure 17-41



8. Next position the latch onto the strike and mark a reference position onto the sides of the fslg to show the location needed for the latch build up attachment block. See figure 17-42. Note the distance inbd from the fslg sides required for the latch when it is properly hooked on the strike. This will require the latch to be positioned off of the inner surface of the fslg skin.
9. Form a phenolic block that shims the latch out to the required position and orientation. Cut a smaller phenolic piece to fill the cavity under the longeron. This does not have to be a real snug fit, simply use epoxy / floc to pot this in and fill any little voids. See figure 17-42.

AFT LATCH, typ.  
Figure 17-42



10. Drill and install the two machine screws that will pot in from the back side of the phenolic to secure the latch onto the face block. Use the MS24694-S8 screws and pot them into the phenolic in the usual manner (or you can install them as shown in figure 17-42, and pot in the all metal lock nut).

**WARNING:** When potting the machine screws into the phenolic block for the latches, do not remove any more of the phenolic than is absolutely required to lock the heads into the piece. Remember to file flats on the screw heads to prevent the screw from slipping. You may also use 1/2" phenolic if the installation of the latch requires additional shim distance.

**NOTE:** When setting the proper vertical alignment of the latches, check to verify that the internal latch adjustment is set to a mid range. The hook on the latch can be screwed up or down to fine tune the amount of pull produced when the latch is closed. This should be in the middle of its adjustment range to provide final adjusting room on both directions.

11. Now bond the phenolic onto the fslg using epoxy/flox. Clamp in position and allow to cure.
12. Wrap the machine screw studs with a piece of tape to keep the upcoming resin off of the threads. Now sand to smooth the edges of the phenolic, apply a flox fillet where necessary and add a 4 BID lay up over these four attach points. Contact at least 2" all around on the fslg sides. As always, be sure to clean and sand the bonding areas first. Make a good effort to keep the area of the phenolic (now with the 4 BID over it) smooth and flat so a good base is established for the latch to tighten up onto. Allow to cure then remove the tape and clean up the BID around the studs so that the latch will again seat solidly against the phenolic/BID base attachment.
13. Secure the latches with the two small (MS21042-832) all steel lock nuts. These are required since the available space is limited. Also mount the "strikes" using MS24694 machine screws. It is sometimes best (for clearance reasons) to insert them from the inside of the channel and attach the all steel lock nuts onto the outside. This will require a little hand operation of the counter sink. If there is room, you can of course run the screws in from the outbd side and place the nuts on the inside.



## 6. PROCEDURE: CANOPY COMPLETION (BOTH STYLES)

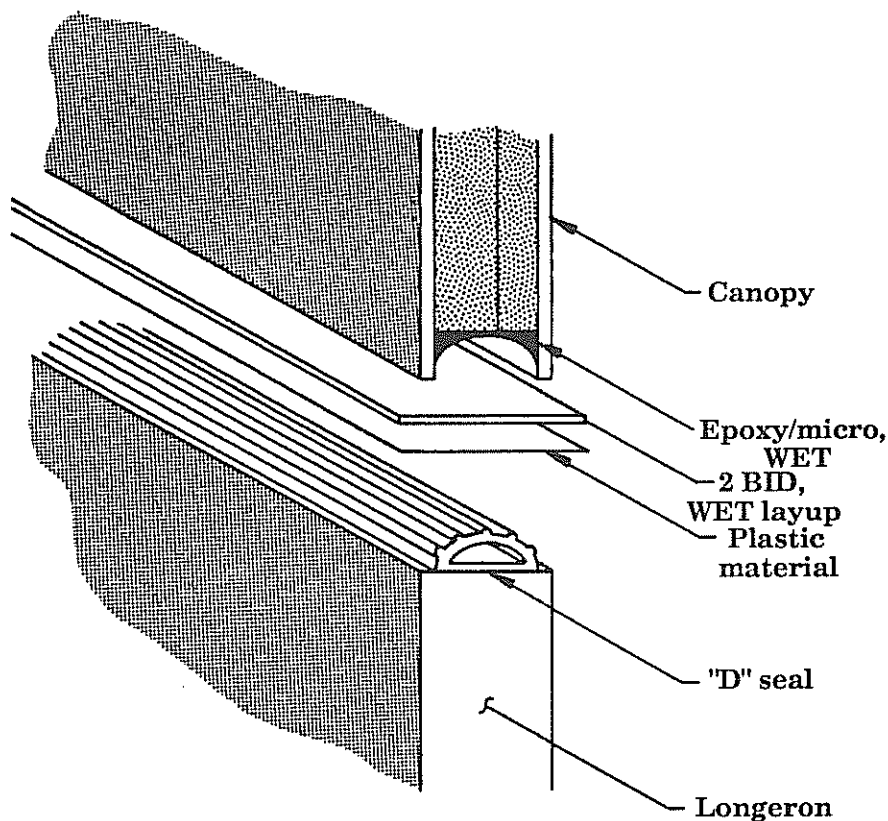
### A. Canopy sealing surfaces preparation

There are almost as many 'preferred' methods of sealing the canopy as there are kits out there. One of the ones we've tried with excellent results is outlined here, and another is described for you to choose from, or give you ideas for a system of your own. They are both based on using the inflatable "D" seals we offer, and either one should require no more than 18 feet for a finished installation.

1. Where the longeron meets the roll over at the aft of the canopy, build up a smoothly rounded transition in the area where the seal will go from the horizontal longeron and go up the face of the roll over, using micro/flox. Sand it smooth. It should not have a radius that is too tight, or it will distort the seal. About 1-3/4" to 2" radius is good.
2. Smooth the aft portion of the canopy frame to match this transition area.
3. With the canopy frame back on the bench or floor, inverted, use the router or sand paper to remove a rounded channel from the side rail foam about 3/8" deep along the whole bottom of the rail, rounded, as shown in figure 17-43, below.

### Routing channel for "D" seal

Figure 17-43



4. Clean the top of the longerons and the fuselage roll over surface where the seal strip is to be mounted.
5. Using some thin double-sided adhesive tape (available at most art/craft stores), tape the "D" seal into place on the longerons and fuselage roll over.
6. Using thin plastic (like the supermarket grocery bags), cover the seal completely from end to end, taping the plastic lightly into place so that the plastic can still move enough to closely conform to the shape of the seal in step 9, below.

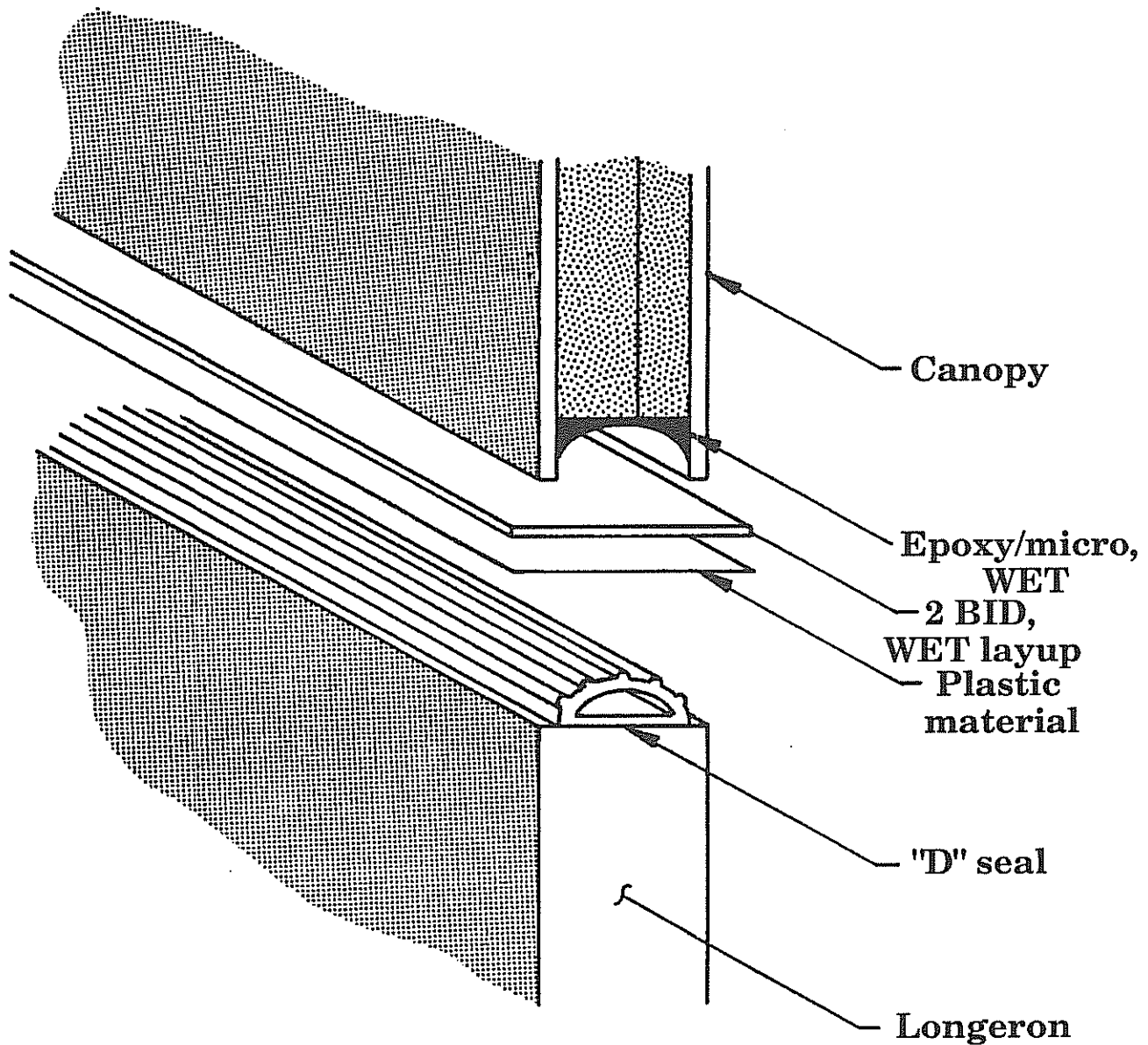
**NOTE:** These next few steps can best be performed with a couple of extra hands. Make sure everything is covered that might be hit by dripping epoxy:

7. Referring to figure 17-44, lay up a 2 BID strip long enough to go over the "D" seal for the length of the longerons. Don't force out the excess resin, leave it a little 'juicy'. Lay this over the plastic, leaving it just lay flat. It is best to do both longerons at one time.



## Sealing side rail channel

Figure 17-44



8. With the canopy upside down, use a mix of epoxy and micro to fill any voids in the channels you sanded out. Now pour into the channel an epoxy/micro mix about 1/4" deep, then spread it inside the channel so that it is evenly coating the channel.

9. While the 2 BID layup and the micro mix are both wet, turn the canopy right side up and carefully place it in position on the fuselage. Weight the canopy frame down so that it forces out all of the excess micro, and you should now have a channel that precisely conforms to your seal, even without inflation. When you are done installing your latches, they should put just enough additional pressure on the seals to make them work perfectly.
10. After the curing process is complete, take off the canopy, invert it on the bench or the floor, and trim off the excess BID, sanding the bottom of the rail smooth.

**NOTE:** You can use this same process later to do the seal at the roll over.



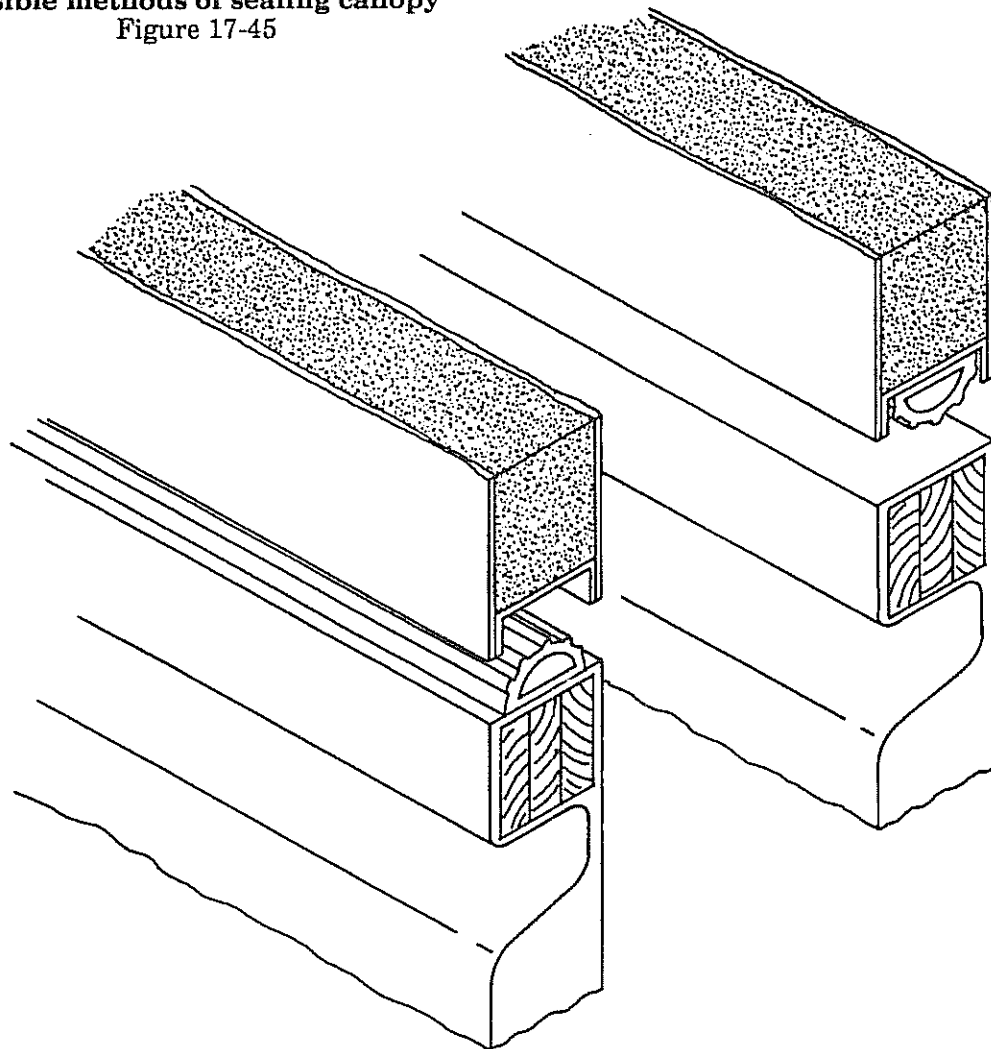


## B. Alternative sealing methods

There are as many alternative mounting methods as there are kits out there. One alternative is to mount the seal into the canopy, leaving the top of the longeron flat to act as the sealing surface.

Some drawings and thoughts to help you, if you decide to take this approach, are included herewith:

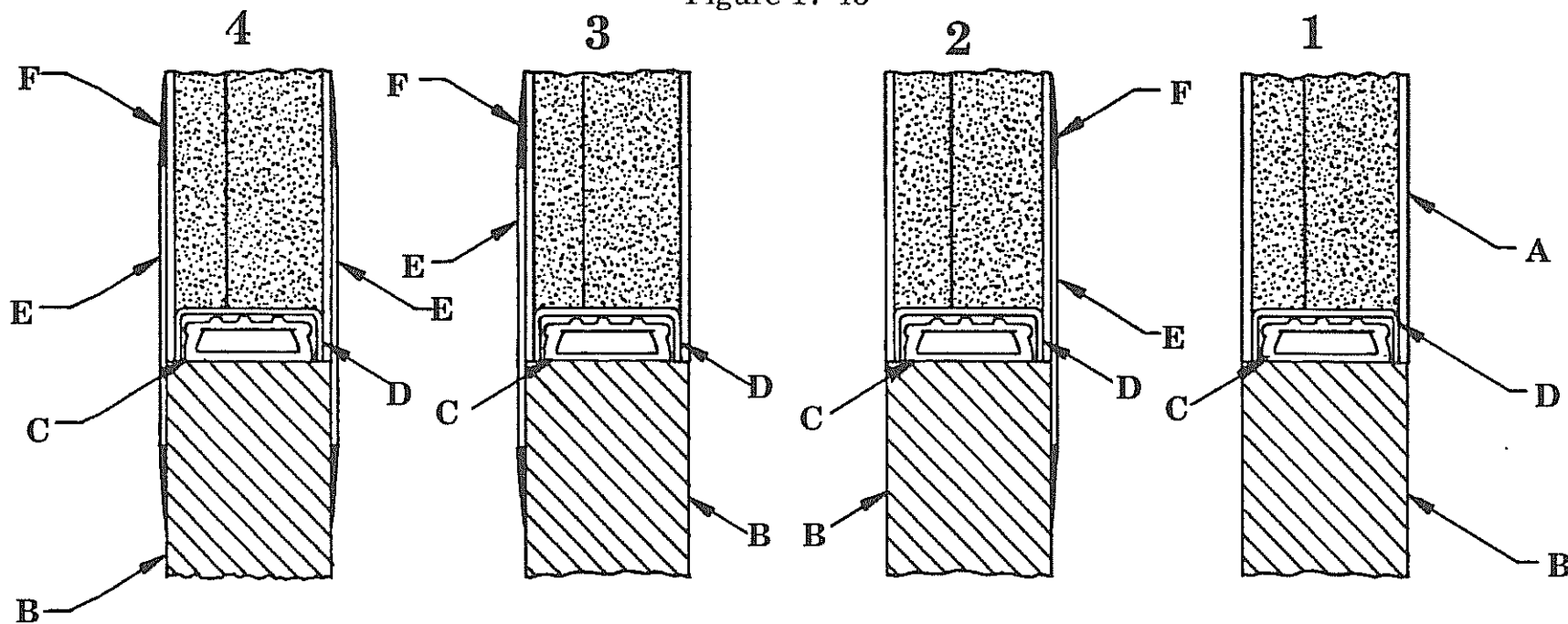
Possible methods of sealing canopy  
Figure 17-45



In stead of mounting the seal on the longeron as shown the left of figure 17-45, route a channel in the canopy wide enough for the channel, and just deep enough so that when in place, the seal will be compressed about 1/8", as shown at right.

## Alternative sealing methods to consider

Figure 17-46



"A" = Canpoy frame

"B" = Longeron

"C" = "D" strip

"D" = 1 BID lay up

"E" = 2 BID, bonded to frame,  
released from longeron

"F" = Micro fairing

Figure 17-46 shows several alternative methods to consider, each having it's own merits. In any of these methods the "D" strip could be mounted either in the canopy or on the longeron.

Method 1:

A channel is routed into the canopy frame, a 1 BID layup is inserted to give the "D" strip a good surface to be attached. Relatively simple, it gets the "D" strip out of the way, so people entering/leaving will not submit it to wear and tear.

Method 2:

Same as "1" above, but a 2 BID layup is bonded onto the outside of the canopy frame, extending down past the longeron. Keeps lateral movement to a minimum, and decreases noise significantly, but requires some fairing in to keep your lines nice.

Method 3:

A variation of "2" above, it puts the 2 BID on the inside. Makes the outside lines nice, but should be faired in on the inside.

Method 4:

A combination of all three methods above, it gives excellent noise rejection, virtually eliminating any air noise around the seal, requires a lot more work to fair in both inside and out.

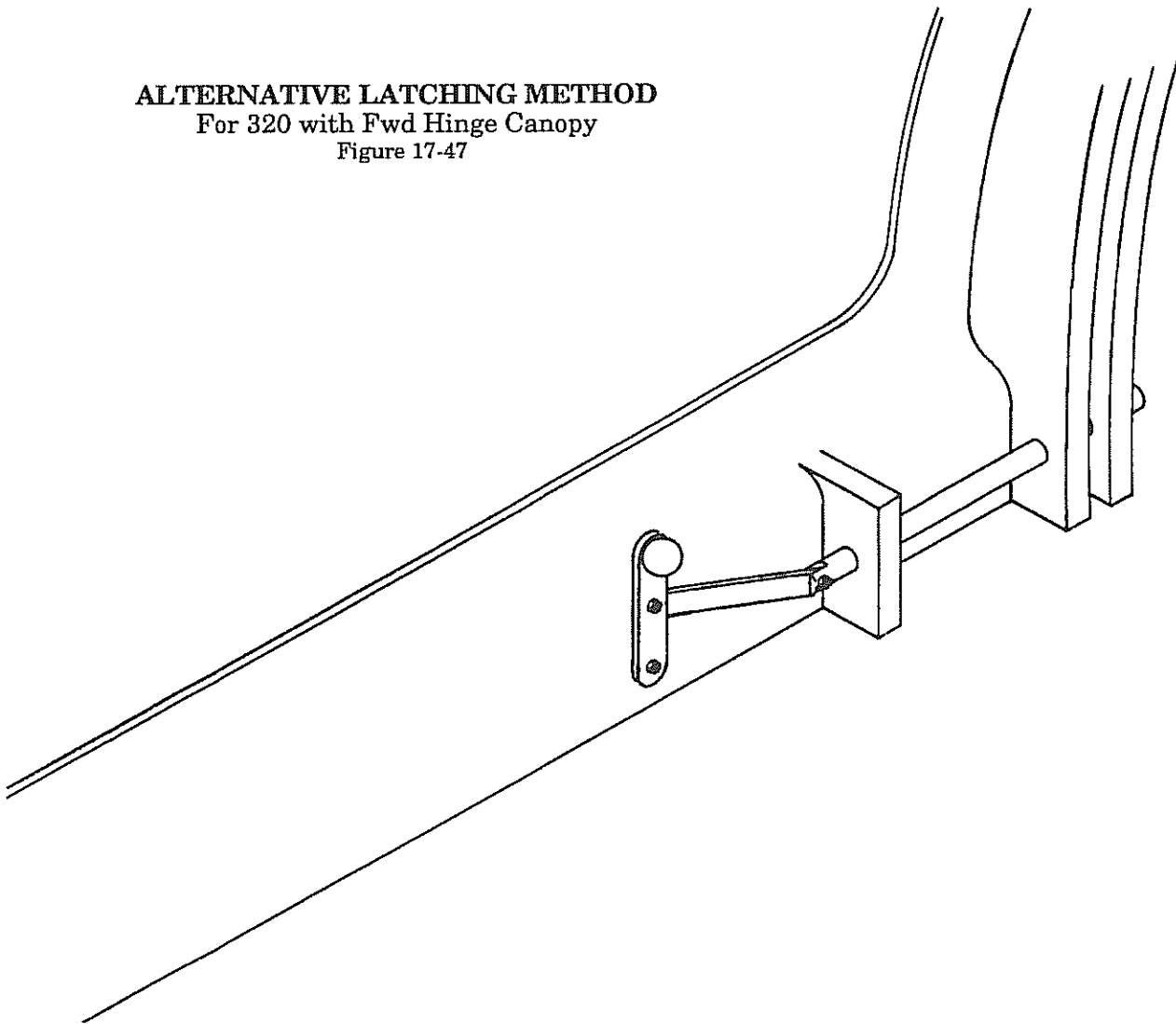
These are just some of the possibilities. If you come up with a good one, document it and let us know, we'll try to put it in the newsletter for others to enjoy.



- C. **Alternative latching method for fwd hinge canopy - draw bolt style**  
If you consider using this method, you may want to install bushings in the roll overs, and then you can use a tapered pin to draw the hatch down as the pin goes into the fuselage roll over, giving you the 'crush' you need on the "D" seal to make it work. Be sure you set it up so that it is "over-center" locked, and cannot be accidentally released in flight.

**This should only be used with the fwd hinge system, unless a similar latch is used at the front of the canopy as well as the rear, shown here.**

**ALTERNATIVE LATCHING METHOD**  
For 320 with Fwd Hinge Canopy  
Figure 17-47

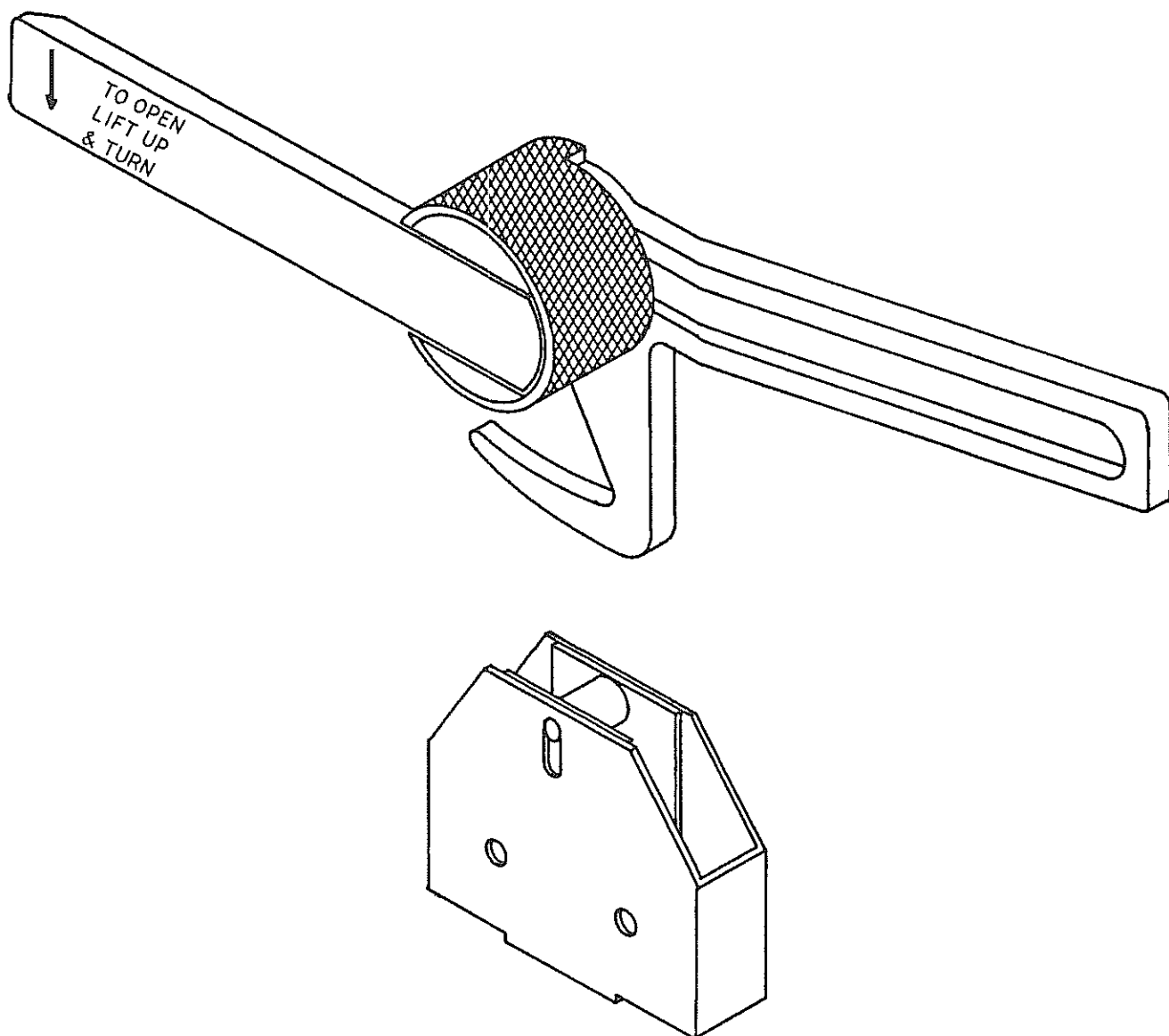


**D. Alternative latching method for fwd hinge canopy - Lever style**

Referring to figure 17-48, the lever style latching mechanism is ideal for the forward hinge canopy system (but not recommended for the standard parallel style canopy opening system, since four would be needed). It is more expensive than the other systems, but it is a fine touch to give your plane, and the ease of operation is unmatched in any other latches we have found. This latch should be installed *AFTER* you have installed the canopy seal, so that proper spacing and pull will be achieved.

**Lever style latch mechanism**

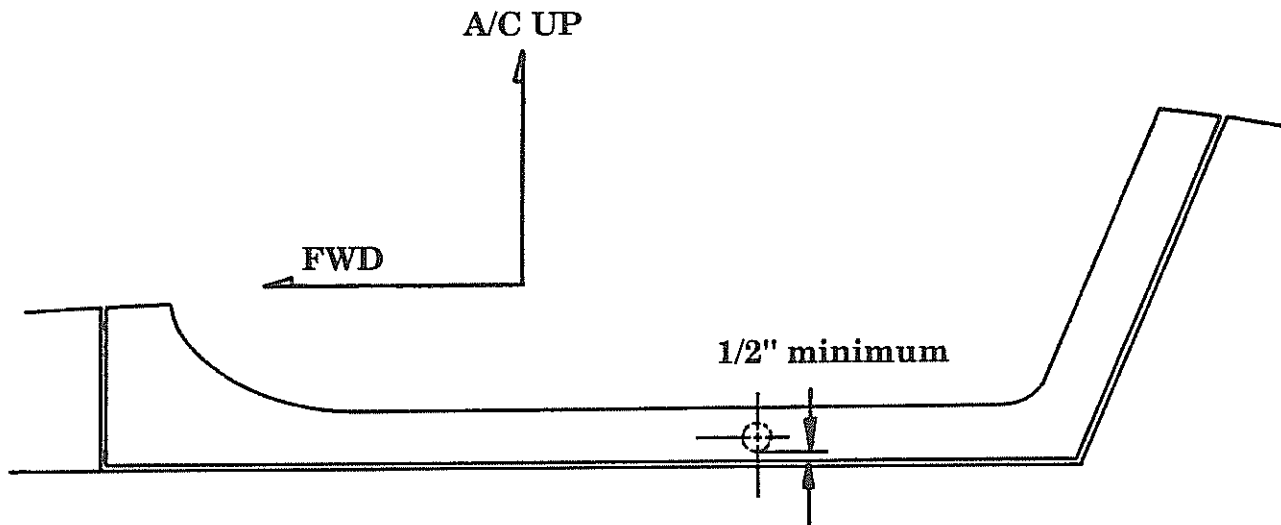
Figure 17-48



1. Select a location as far aft on the canopy frame as is comfortable to reach, and will not interfere with normal pilot or passenger movement while seated.
2. Mark a location per figure 17-49 at the positions you have chosen.

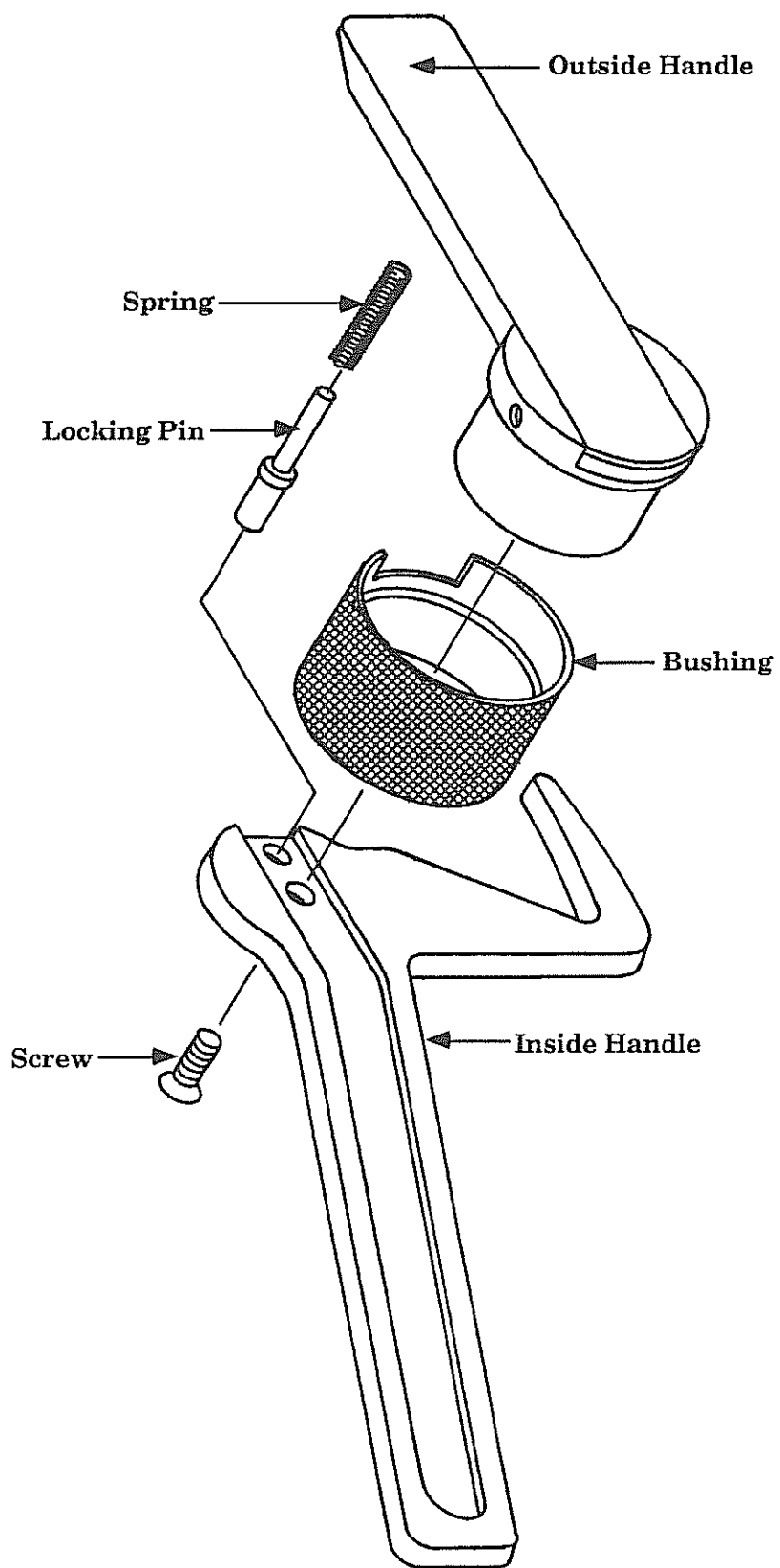
### POSITIONING LEVER LATCH

Figure 17-49



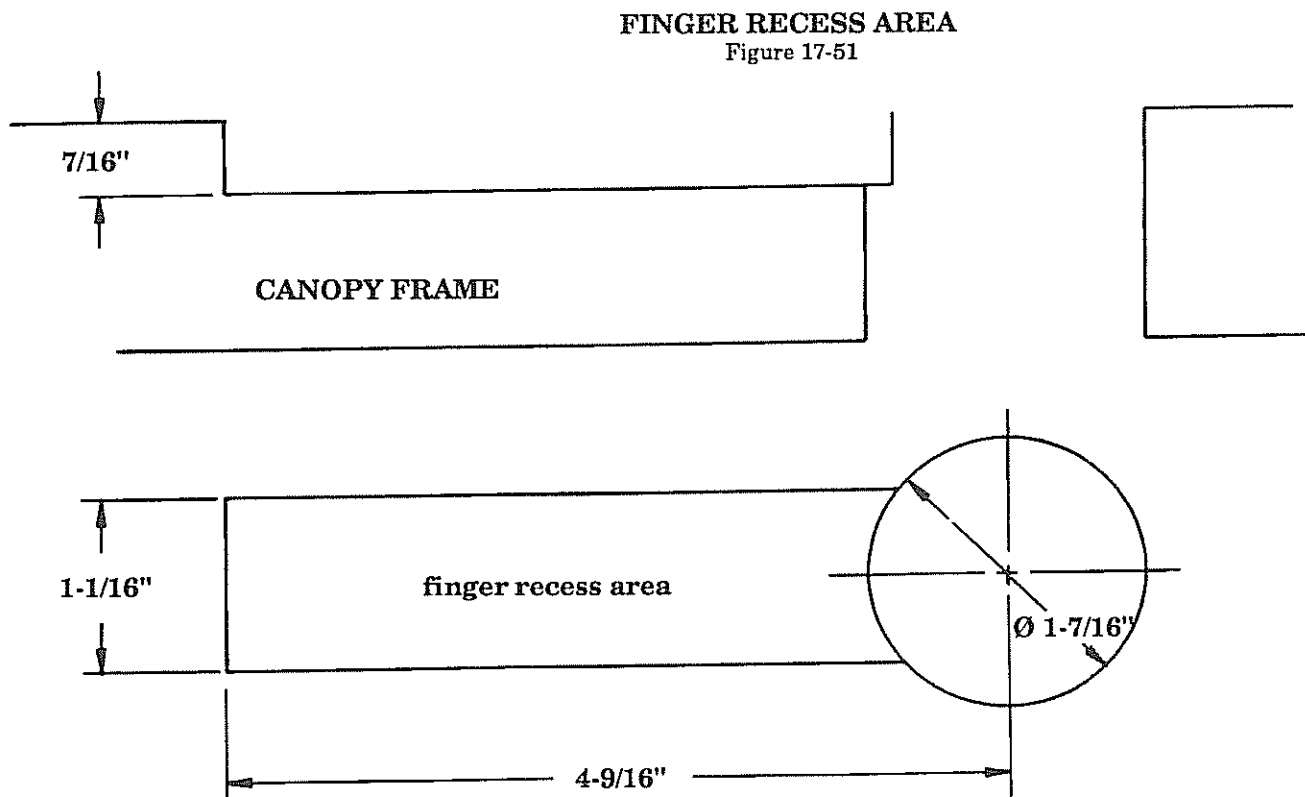
3. Starting with a small drill bit and working your way up, drill or grind a hole completely through the frame that is 1-9/16" in diameter, which is slightly smaller than the bushing (refer to figure 17-50). The more snug the fit of the knurled bushing, the easier the next steps will be. You can remove the phillips head screw and the handles will come off, leaving you with just the aluminum barrel you can use to establish the fit. The goal here is to get the inner and outer skin to hold the bushing in exactly the right position so that clamping later will not be necessary. Sand or file the hole out until the bushing can be inserted through, but is held firmly in place by, the inner and outer skin of the canopy.

**NOTE:** While it is ideal if the canopy frame matches the bushing thickness, it is not really necessary. If the frame is narrower than the bushing, it can be built up later in just the bushing area. If it is wider, then some material will have to be removed, smoothed down and then covered with 4 BID for reinforcement.



**LEVER HANDLE ASSEMBLY**  
Exploded view  
Figure 17-50

4. Using a Dremel or similar tool, route out the finger recess area on the outside of the canopy frame as shown in figure 17-51. This slot should be parallel to the canopy frame line.

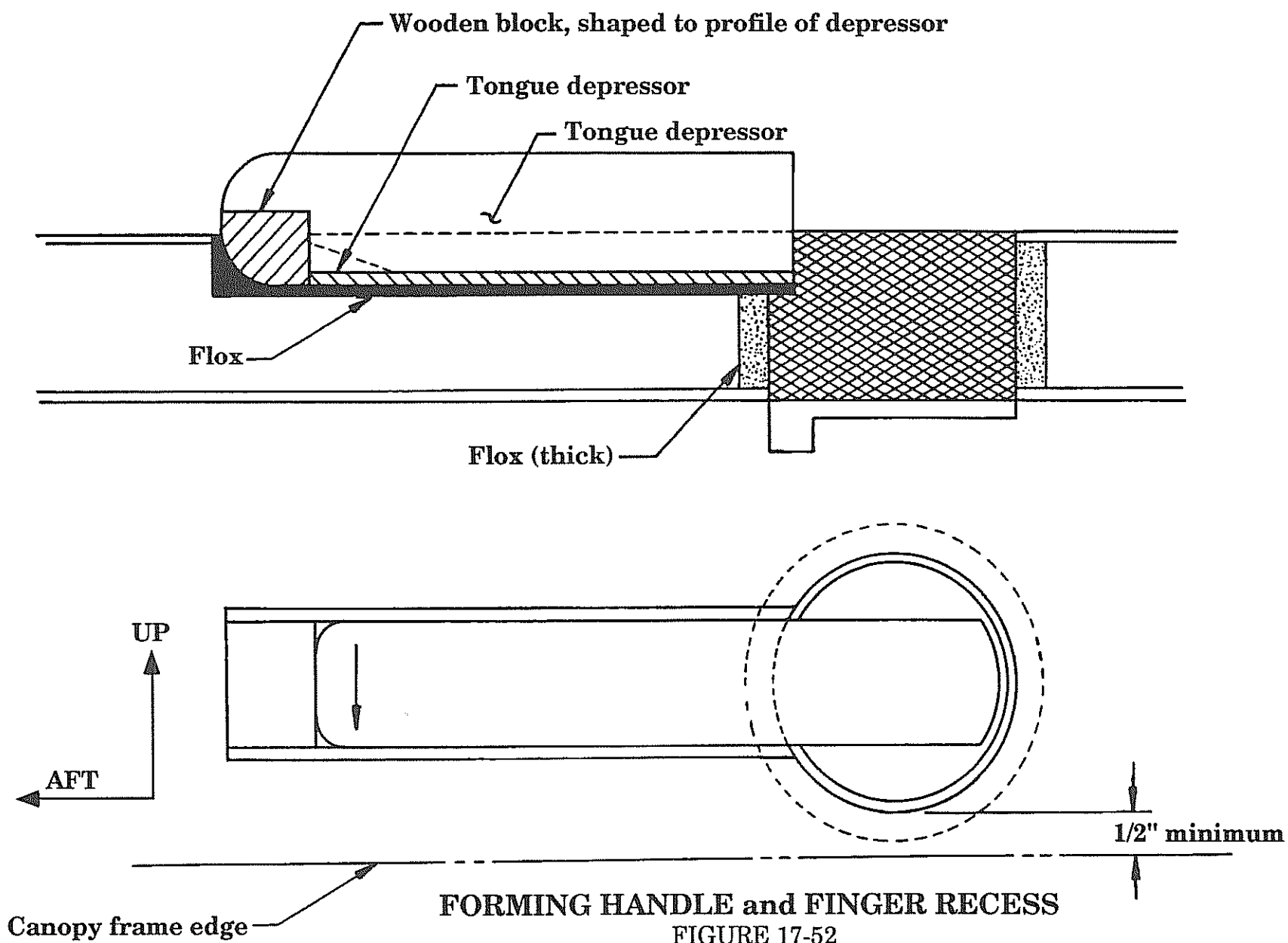


5. Per figure 17-52, prepare 3 tongue depressors about the handle as shown. Shape one piece to go under the handle and fit snugly to the bushing. Secure it there to the handle with a small dot of hot glue or equiv. Do not get any adhesive on the bushing!
6. Shape the other two tongue depressors, and hot or instant glue them along the sides of the first stick and handle as shown in figure 17-52.
7. Shape a small piece of wood to the same profile as the tongue depressors, and glue it between them at the end of the handle as shown. The outside shape of this will be the indent for your handle, and provide the necessary finger recess and handle clearance. Sand the end radius smooth between the two sticks and the small piece of wood, and lightly sand a radius onto the tongue depressors running the length of the handle.



8. Apply either wax or plastic release tape to the exterior of the wooden block and tongue depressors.





9. Remove 1/8" to 3/16" of the foam from inside the canopy frame around the area the bushing will be placed using a rotary router or equiv., being careful not to remove any of the glass that will be holding the bushing in position.
10. Mix up a sufficient batch of epoxy, then brush a light coat of epoxy into the handle recess area to make sure you will get a good bond. **DO NOT GET ANY EPOXY IN THE AREA NEAR THE BUSHING LOCATION. LEAVE AT LEAST 1/2" BETWEEN THE EPOXY AND THE HOLE FOR THE BUSHING.** Then add micro and flox to the remaining epoxy and put it into the recess, so that it is covered entirely with at least 1/8" of micro/flox, *except for that last 1/2" near the bushing, which should be left free of micro/flox.* **WE ARE ONLY DOING THE HANDLE AREA AT THIS TIME.**
11. Slide the bushing, with the outer handle and it's protecting tongue depressors in place (the inner handle removed, of course), into position and press it in until the bushing and the handle are flush with the exterior surface of the canopy frame, as shown in figure 17-52. Wipe off excess micro/flox that squeezes out.
12. Before the micro/flox can completely harden, remove the bushing by pushing it through to the inside of the frame, being careful not to disturb the position of the handle. Using acetone, clean off any micro/flox that might have gotten onto the bushing.
13. After the micro/flox has cured, remove the handle from the tongue depressors, leaving them in place, if possible. If they come out with the handle, separate the handle from them and reinsert them into the frame. The sticks will have to be in place for the next steps to properly align the lever assembly to the position of the handle recess.
14. Carefully tape the inboard portion of the bushing, where there is no knurling, with release tape.
15. Paint a thin coat of epoxy inside the frame where the bushing will mount. Add some flox to the remaining epoxy, mix and paint the knurled area of the bushing with it to completely fill in the knurling. Add more flox to make a stiff mix, and fill the area in the frame shown in figure 17-52.
16. Carefully insert the bushing from the inside to the outside of the frame, lining it up by eye with the handle location as it emerges. Wipe off any flox that is on it when it emerges with acetone.



17. Insert the outer handle and use it to line up the bushing, so that the handle fully seats into the tongue depressors, flush with the frame side, and the bushing is also flush with the frame exterior side. When the flox is set sufficiently to hold the bushing in place, remove the handle and clean it, and remove the tongue depressors. You can now add a little more epoxy/micro to fill in that 1/2" area that you carefully kept clear earlier.

**NOTE:** be sure you have removed any micro or flox from the handle and the inside of the bushing while it is still easy to do so. You could sand off the epoxy/micro/flox residue later, but that might scratch the anodizing, and you paid too much for these beauties to scratch them up now.

18. After the flox has cured, sand a nice radius to the edges of the finger recess.
19. Install your canopy onto the fslg and assemble the complete latch handle into the bushing.
20. Next we need to mount the latch striker such that the center of the roller pin is directly below the center of the phillips head screw. Since your canopy seal is new and fresh and thick (and hopefully already installed), you can easily establish the best position for the roller assembly by loosening the stop nut until the inner roller yoke can be pulled up to the edge of the roller housing. Sitting inside your plane with the cockpit closed, put the latch handle in the closed position and hang the roller assembly from it as shown in figure 17-53. Gravity and the precision roller will automatically level it for you.
20. Looking down into the assembly, slide the assembly inbd or outbd until the latch arm is centered on the roller. You can now measure the gap, if any, that must be filled between the roller assembly and the longeron.

**NOTE:** The roller pin extends out slightly from the roller housing on both sides. THIS IS INTENTIONAL, should not be tampered with to make it flush, and must be taken into account when mounting the assembly. A small groove should be ground behind the roller assembly so that it can be adjusted in the future without distorting anything.

**NOTE** also that there will be 4 BID placed behind the roller assembly, so leave a little space in your calculations for this.



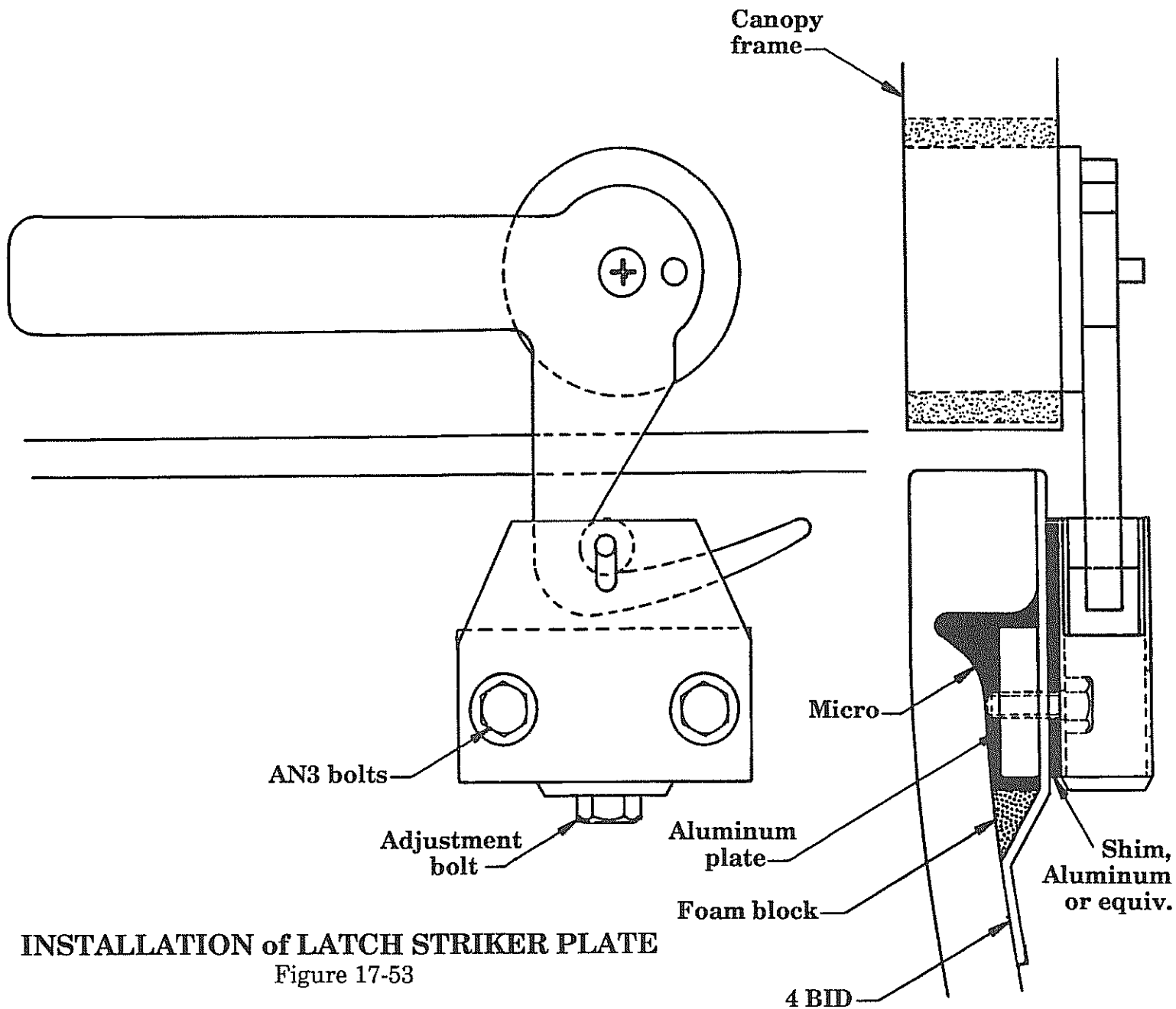
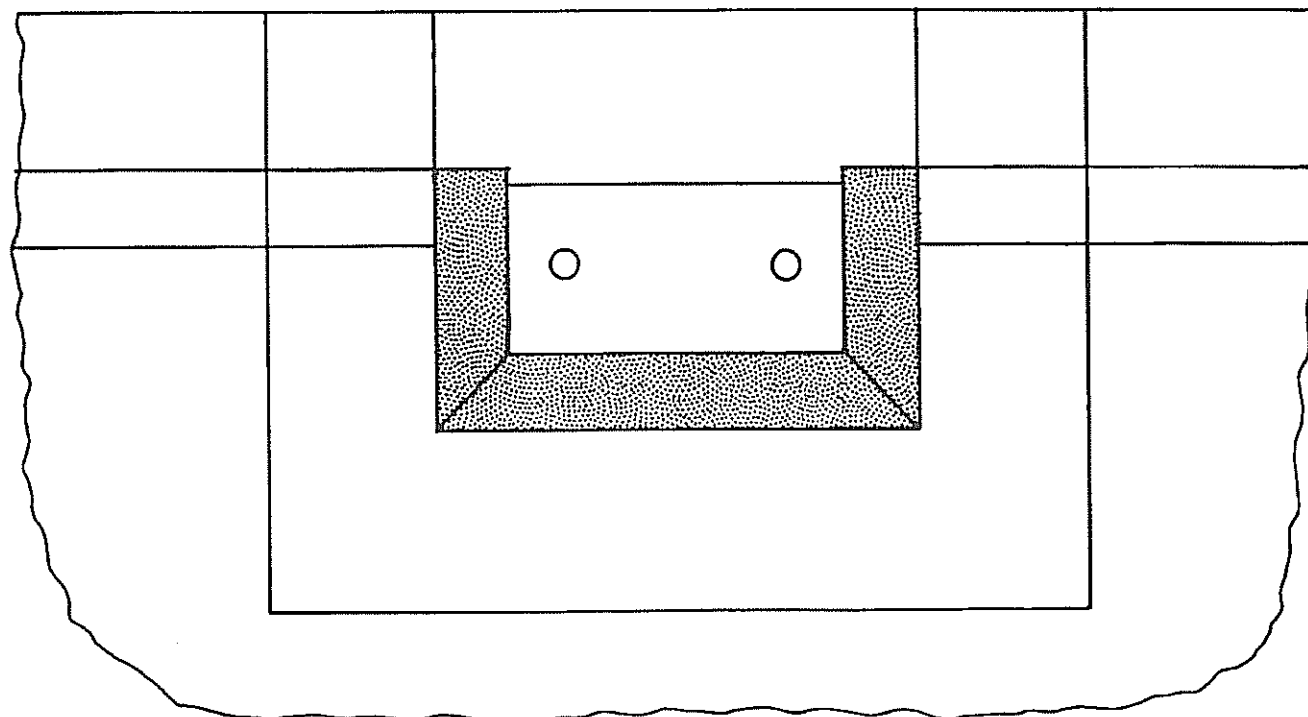
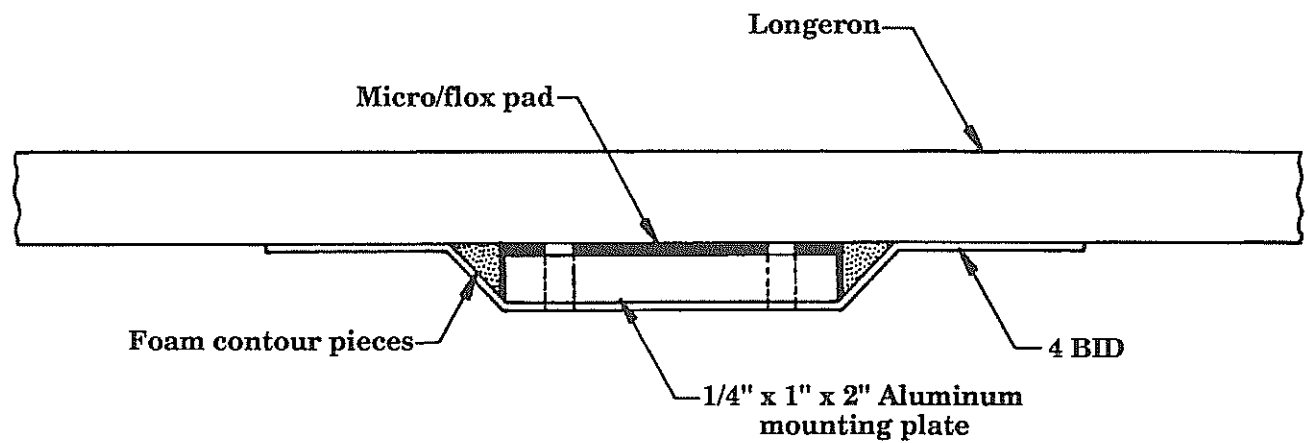


Figure 17-53

21. Referring to figure 17-53 and 17-54, carve a foam block to fill the gap between the latch striker plate, longeron and inner fslg skin.
22. Using epoxy/micro, bond the block into place.
23. Reposition the pin assembly and mark the outline of the assembly onto the foam.
24. Cut two pieces (one for each side) of 1/4" x 1" x 2" aluminum plate.
25. Cut a slot in the foam for the plate so that it is positioned as shown in figure 17-48e, and remember to bed it deep enough to allow for the 4 BID lay up between it and the roller assembly.
26. Using epoxy/flox, bond the aluminum plate into position, being sure to rough up the surfaces with 40 grit and clean it with MC just prior to bonding it in place.
27. Lay 4 BID over the foam and aluminum as shown in figures 17-53 and 17-54 and let cure.
28. Reposition the roller assembly and mark for the 2 mounting screws.
29. Remove the roller assembly, drill and tap the aluminum plate for the two 10-32 screws (be careful with the drill, you just need to go through the aluminum plate).
30. Install the roller assembly using two AN3-6A bolts (be sure you have a groove behind the assembly for the roller pin to travel freely in).
31. You can now close the canopy, latch it and, using the stop nut adjustment on the bottom of the roller assembly, draw the canopy down for a nice snug closure.





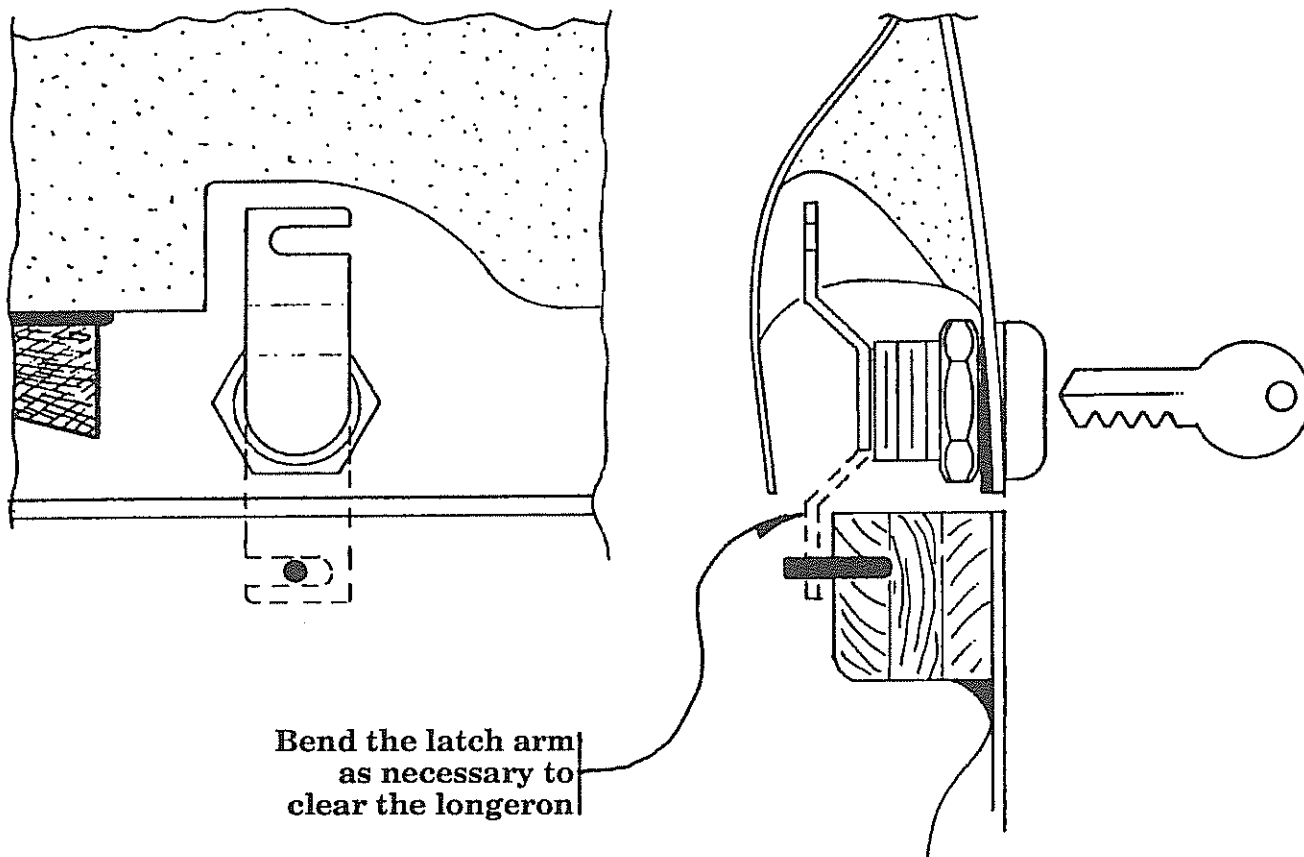
**Bonding striker plate into longeron**  
Figure 17-54

### E. Canopy locks - External

For the standard opening canopy, two standard hardware store variety tumbler locks can be easily installed to secure the canopy down from the exterior. One is required per side (on the fwd hinge canopy, you may want to consider just mounting one at the top aft center, if you can conveniently reach it). See figure 17-55.

#### CANOPY LOCKS

Figure 17-55



1. It is important to calculate the rotation of the latching arm on the lock tumbler and verify that it does have room to swing.
2. Drill the hole into the outboard canopy frame side and install the tumbler.



3. Drill the hole into the longeron to install an AN3 bolt used as a stud pin upon which the tumbler arm will swing around and catch upon. Pot this into the longeron from the inside using epoxy/flox or structural adhesive.
4. Adjust the arm only when you have the final "P" strip or equiv. on for the canopy seal. The lock should be set to require just a little downward pressure in order to set the arm around the pin.



**F. Aft window installation**

1. These aft 1/4 windows will be installed in a similar manner as used for the canopy, refer back to canopy glass installation, page 17-61.
2. It is recommended that one rear window be left out until the very last. This will provide easier reach through access into the baggage area, etc.
3. Use the same 2 BID ply schedule to secondarily attach the aft 1/4 windows on the inside.



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## G. Final canopy fairing - in process

It seems builders often get anxious about achieving a good canopy installation. It is really quite simple.

1. Fairing the fslg/canopy seam: With the canopy completely built, reach through the aft 1/4 window holes and secure the four latches. The "P" strip or equiv. should be in place. If you want to save this sealer material for final use, you had better cover it with tape. It is best to have some throw away material that can be used here.
2. Mix up a batch of dry micro and after cleaning and sanding the mating surfaces, spread a thin layer along the joint lines of canopy to fslg. Don't worry about keeping it away from the actual seams, just spread it right over them. Then follow back by running a knife blade or mixing stick edge, all along the seam line. This will redefine the part line. Allow to cure and sand with a flat board.
3. Fairing the canopy frame/windshield seam: While the canopy is on the fslg, peel the tape back and retape it about 1/8" back on the plexiglass.
4. Go around with a small piece of 50-80 grit sandpaper (folded over) and sand the resultant edge and freshly exposed plexiglass. Follow up with micro that is not too dry so that it will go on smoother but not drip. Apply just a little all around the perimeter and allow to cure. Sand that down later which will start a smooth progressive taper from the outside of the canopy frame down to the level of the glass.

Later, you'll do this again prior to primer and once again prior to painting. The result is a smooth transition that is easy to do.

**NOTE:** You'll also want to line up the canopy line with the aft 1/4 window line.



#### H. Canopy closure guides

These should not be needed, but if you feel that they are necessary for your particular canopy system, here is a simple method of making the canopy come down in the precise position on the longerons that you desire. Make them from aluminum, and install them much the same as the latch strikers. Note the bevelled edge on the upper plate to guide it onto the lower plate. See figure 17-56.



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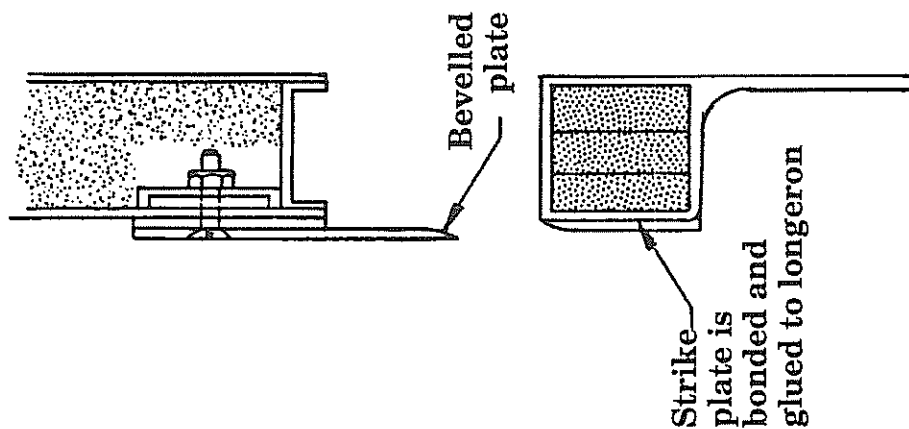
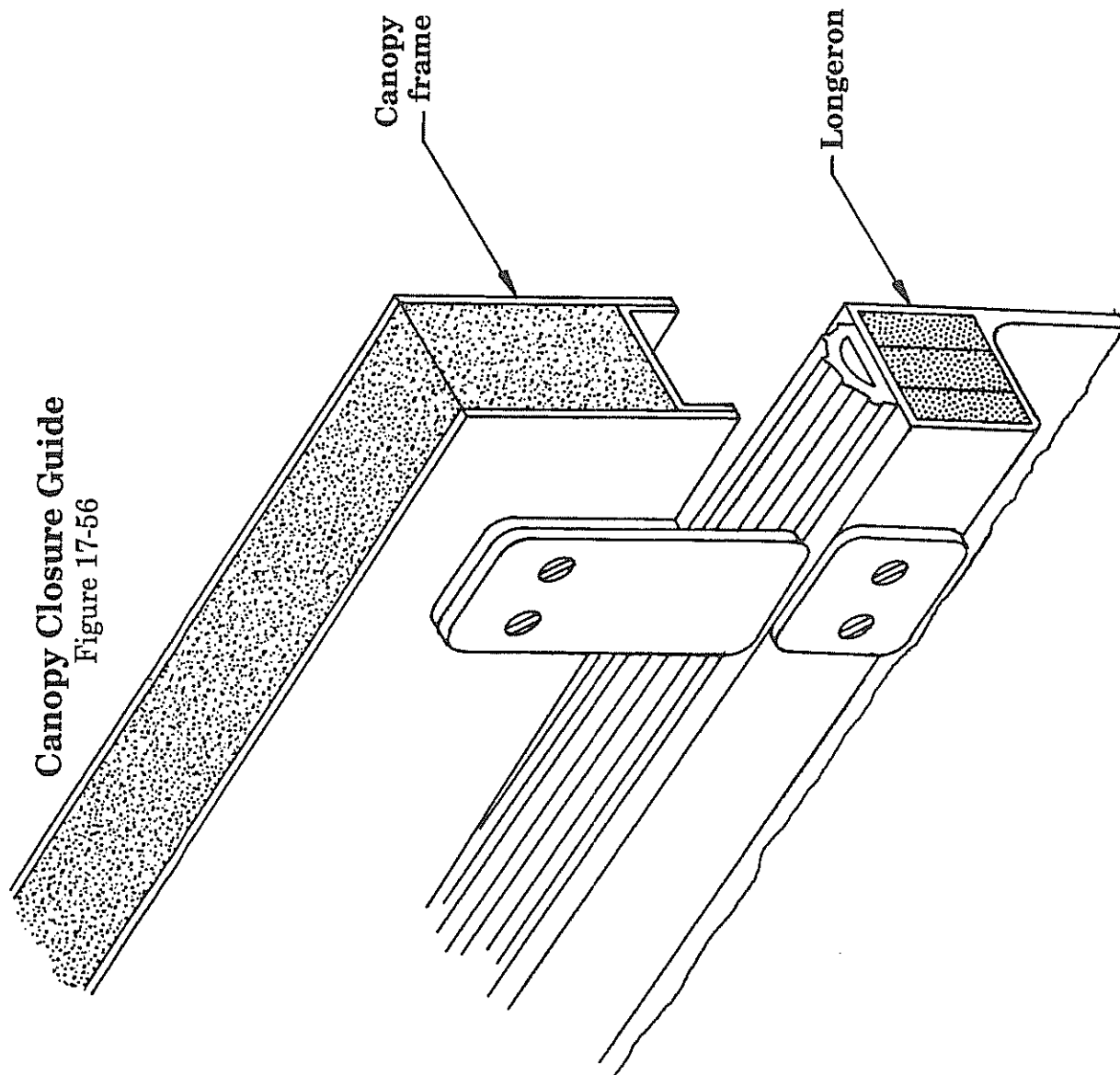
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CANOPY SYSTEMS



Canopy Closure Guide  
Figure 17-56



## 7. PLEXIGLASS HINTS FOR PERFECT CANOPIES

**From:** The Airplane Factory, Inc.  
7111 Brandyvista Ave.  
Dayton, Ohio 45424

### A. Cutting:

An abrasive disc powered by a high speed drill, a Dremel tool, or a hand held circular saw is recommended. We have found that abrasive cut-off wheels of aluminum oxide or silicon carbide provide excellent cutting results. A six inch disc is available at most hardware stores for around \$3.50. A small grinding disc or Dremel saw disc will also give good results. Reciprocating saws like saber saws are NOT RECOMMENDED and will probably break your canopy. A tool that progresses slow and hot to grind through the canopy is best. Tape a poly plastic cover on the canopy and mark your outline with masking tape.

Never cut a cold canopy. Allow the canopy to warm to 70° or more for at least an hour. Don't allow the canopy to vibrate or chatter during the cutting or it may chip and crack. Support your canopy on a flat surface so it will not twist or spread during the trimming. Duct tape is handy to hold things in place. Remember: cut slowly, don't push the cutter. Let the tool do the work. Be sure to use eye protection. Plexiglass chips can be a problem in your eyes since they are clear and difficult to see.



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**B. Drilling:**

The drill should be ground off to a zero rake angle to prevent digging in, chipping and cracking the Plexiglass. A standard drill bit, ground with no cutting edge pitch, is a safe method of making holes. Be sure to make the holes oversize to allow for motion caused by thermal expansion and contraction. The drill bit should not be allowed to chatter or it will chip and break the Plexiglass. Don't push the drill. Let it cut at it's own rate.



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*(This area is intentionally left blank for additional notes or calculations.)*