CHAPTER 18

CANOPY

OVERVIEW - You have finished most of your airframe now. Hang in there for one more chapter; your Long wouldn't be a very good open cockpit airplane anyway. In this chapter, you have to trim the canopy's edges, make a composite sandwich frame, fit the hinges, latches, locks, and cockpit vent. An excellent quality, formed plexiglass canopy is available through RAF.

It is free blown into a 3-dimensional frame to match the fuselage contours while maintaining excellent optical quality. The following prefabricated canopy actuating components are available from a distributor: C1-L handle, C2L arms (2 required), C3 lugs (2 required), C4 block, C5 rods (2 required), C6 tubes (2 required), CS13 (2 required), SC1 catch, and C21 handle.

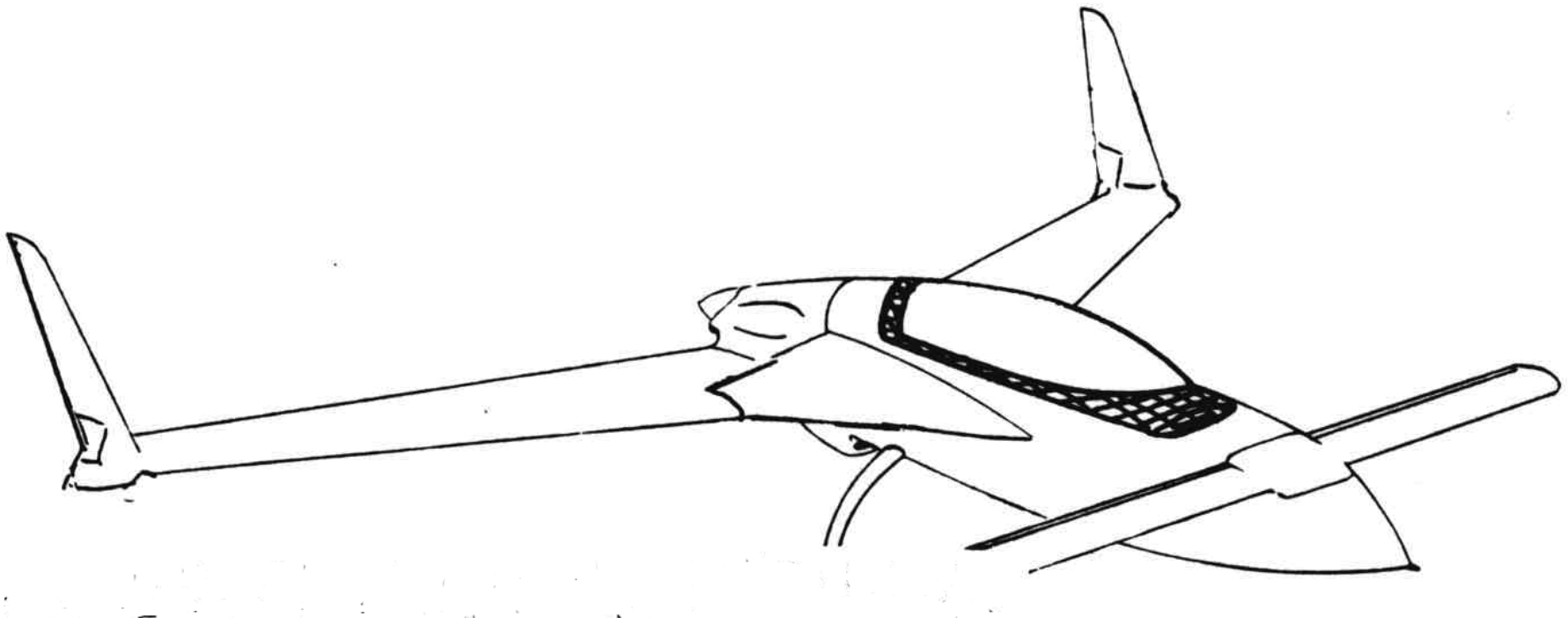

Figure 18-1:Canopy

Note: Do not use the old-style VariEze canopy from the original vendor. It does not provide sufficient visibility.

Step 1 - Trimming the plexiglass

This step should take about one to two hours. Your canopy comes crated to protect it from scratches during shipment. No protective coating is applied, so you can inspect your canopy on receipt. We suggest that you protect your canopy from scratches by spraying or brushing on a "peel coat" (you can use Spraylat "A" – you need about 1 qt.) or by taping paper or plastic over it for protection while you are building the fraeme and while you paint the aircraft. Leave this peel coat in place except where the instructions call for its removal. When your canopy is complete and the airplane is painted, this coating will peel off easily if it is painted on thick. If your peel coat appears thin, paint on at least 4 coats.

Trim the canopy plexiglass along the lines shown. A band saw, an abrasive cuttoff disc in a hand-held grinder or skill saw, or a saber saw will do the job, **but** in any case, go slow or you'll ruin your whole day (not to mention your canopy). We've found the abrasive disc to be the easier method. Another excellent tool is the number 406 steel saw blade (about 1" diameter disc) that's available as an accessory for your dremel hand grinder. Save the end that you cut off. You may be able to trade it to another EAA'er for something you need. It makes an excellent windshield for an open cockput airplane!

Remove **all** nicks from the plexiglass edges with a file. Polish the edges with 320-grit sandpaper. Nicks or scratches can start cracks in the plexiglass.

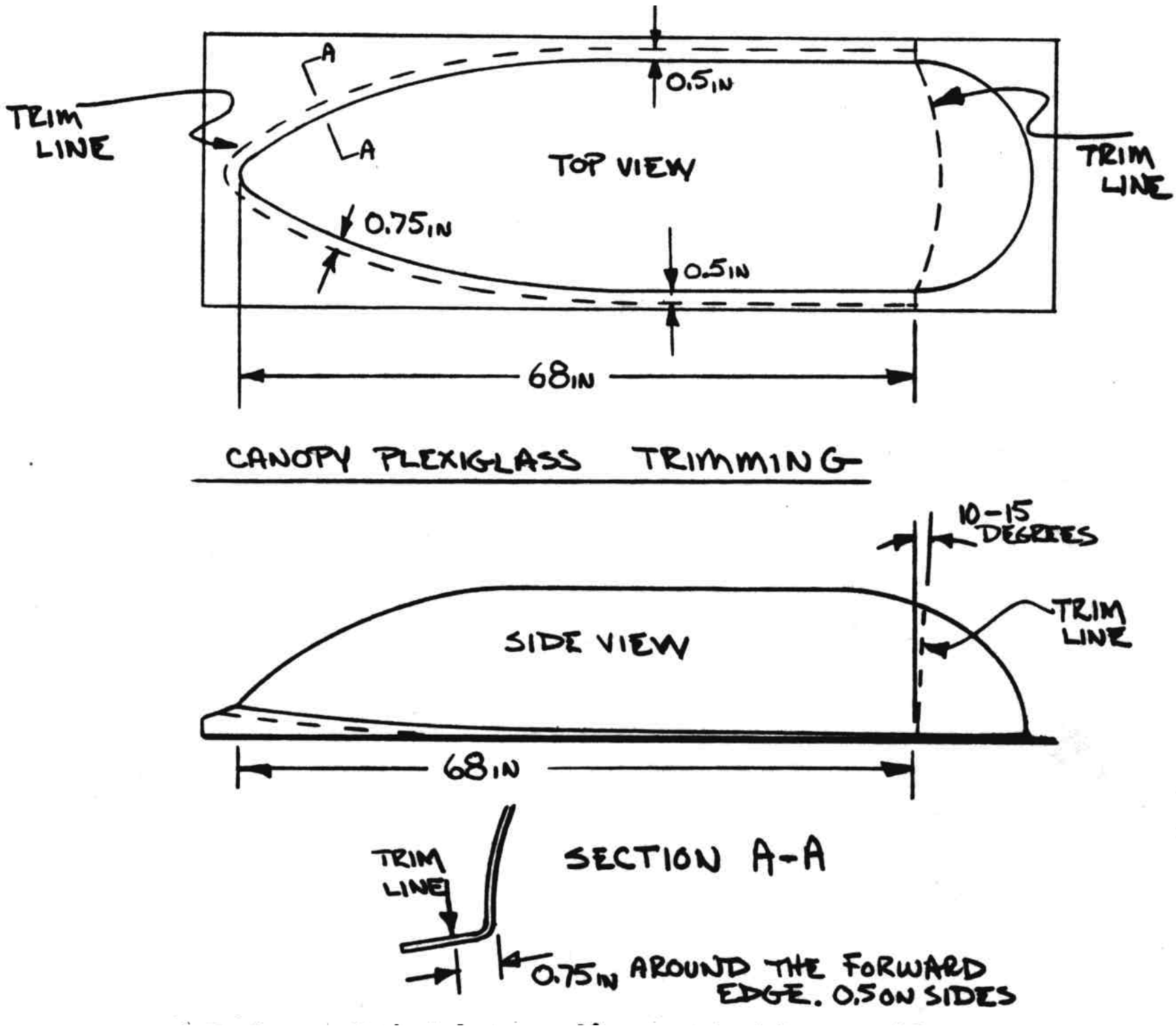

Figure 18-2: Canopy trim line

***Note: See owners manual fo care and repair of plexiglass. ***

Step 2 - Locating the plexiglass on the fuselage

This step should only take 30 minutes or so. Make four blocks from the full-size patterns shown. The blocks are made from 1" lumber. These are temporary supports for your canopy and are discarded later. Tape the plexiglass edges with gray tape and prep the surfaces as shown.

Bondo the four wood blocks to the inside surface of the top longerons as shown. You can make a small up or down adjustment of the aft blocks, if necessary, to get the canopy top line tangent to fair into the top of the firewall. Don't trim the firewall to accomplish this. If you do, the cowling will not fit.

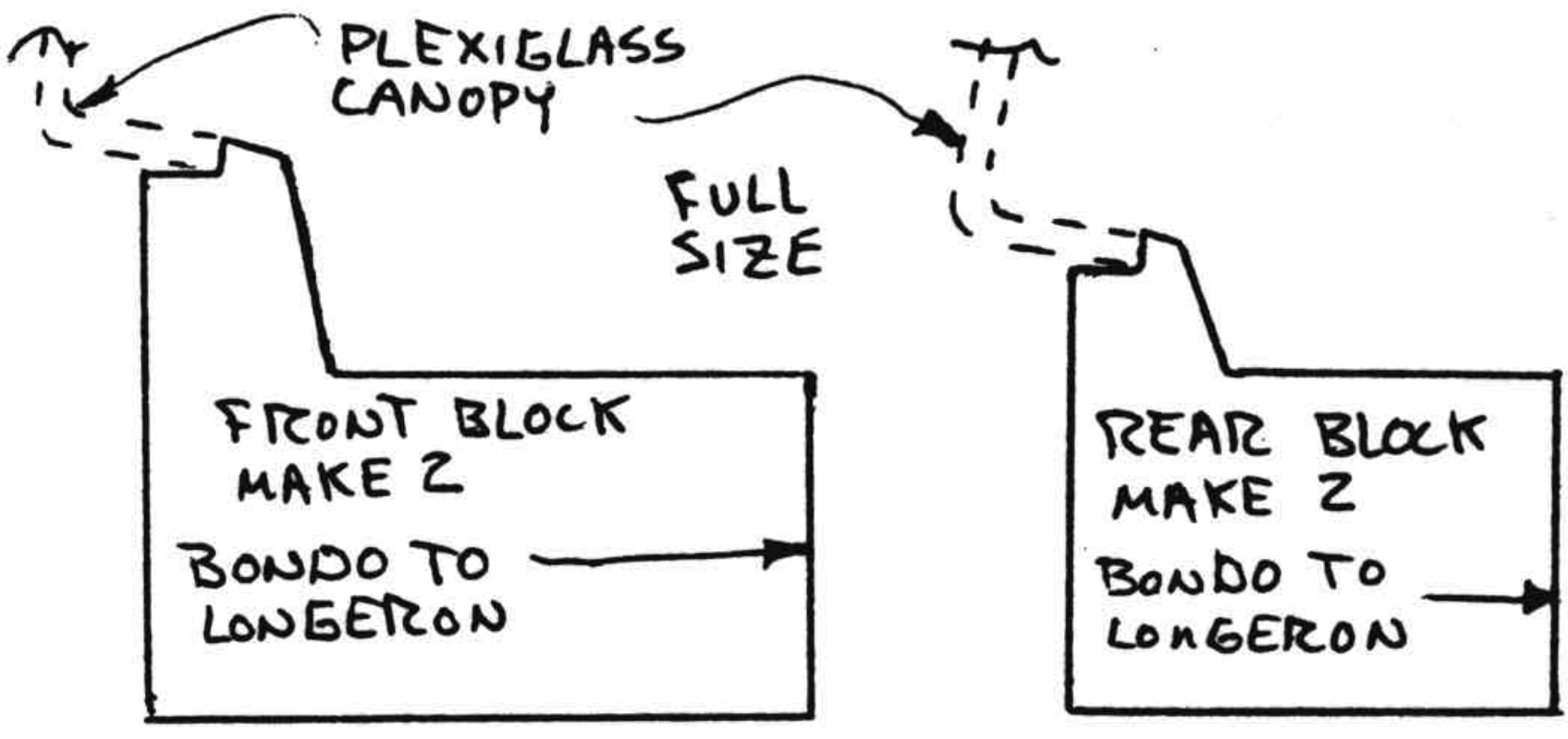

Figure 18-3: Temporary support wooden blocks

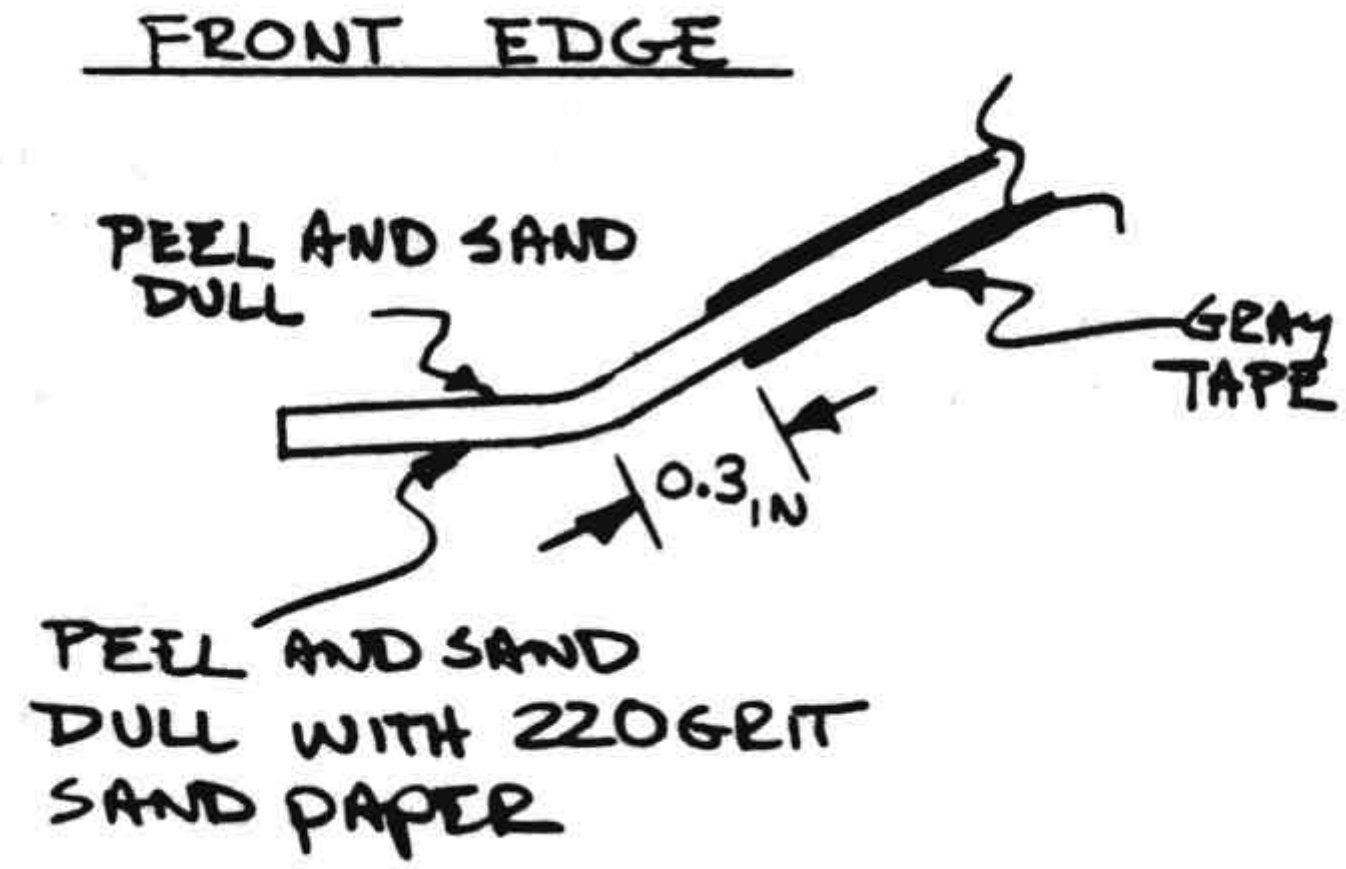

Figure 18-4: Prep canopy front edge

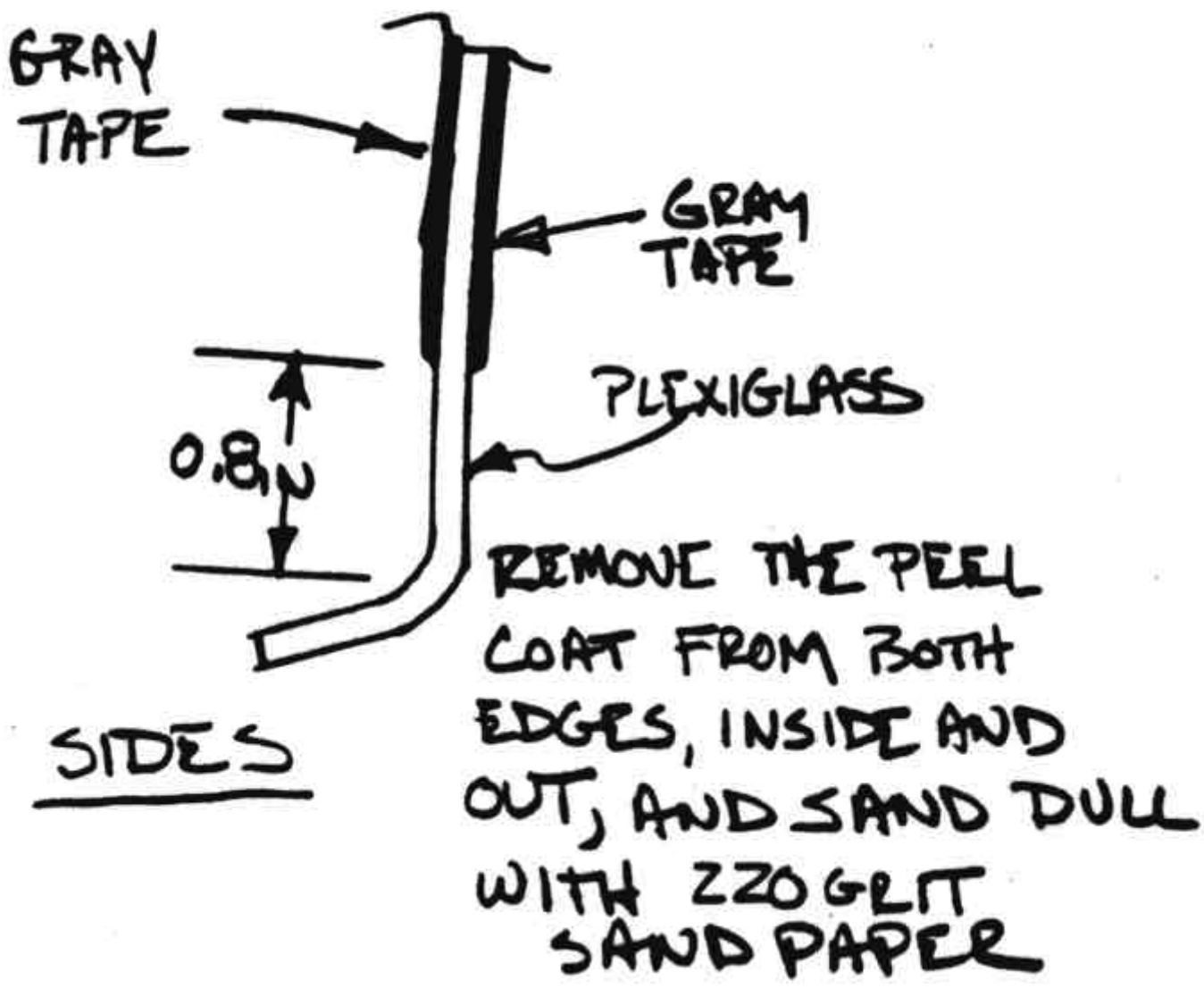

Figure 18-5: Prep canopy sides edge

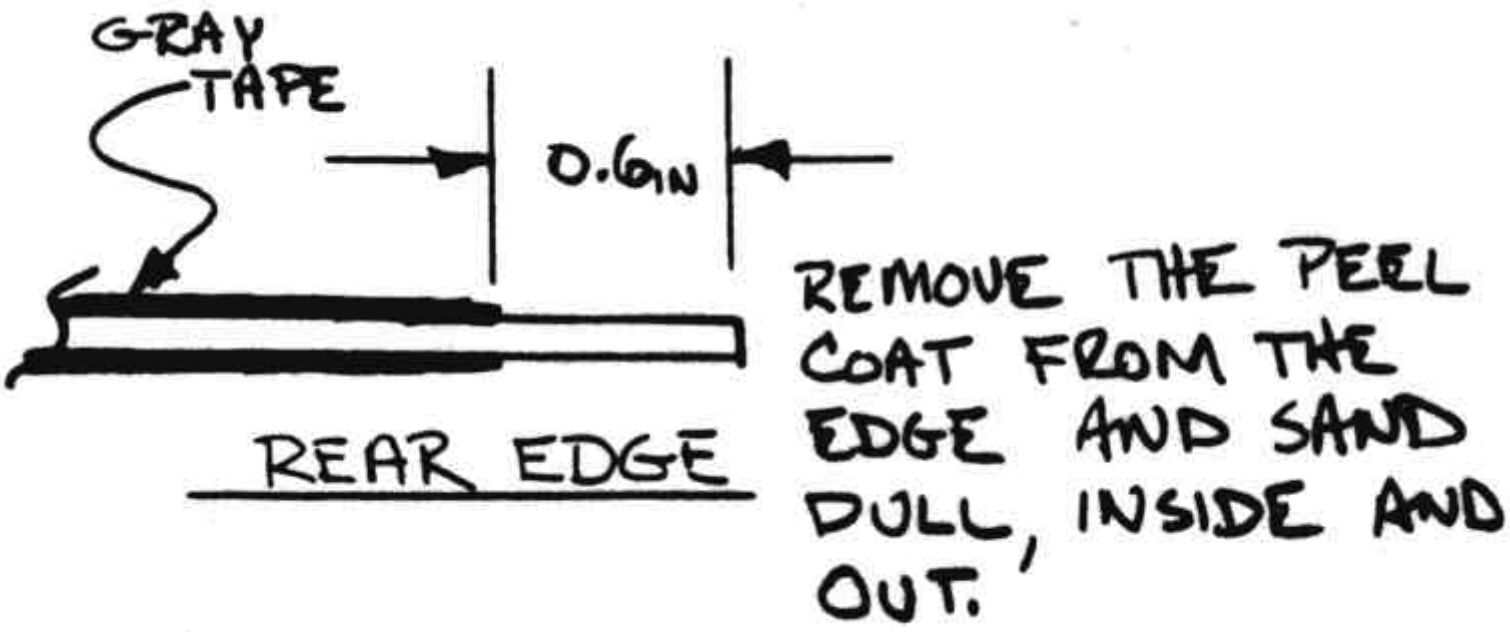

Figure 18-6: Prep canopy rear edge

{Refer to figure 18-8.} Check that dimension A measured from the top of longerons (WL 23) to the canopy top is at least 13.5". A should be measured 6" in front of the headrest. If A is less, forward visibility will be less. Dimension B at 15" forward of firewall should be 12.3" so the canopy will fair in well with the cowl. Adjust blocks if necessary.

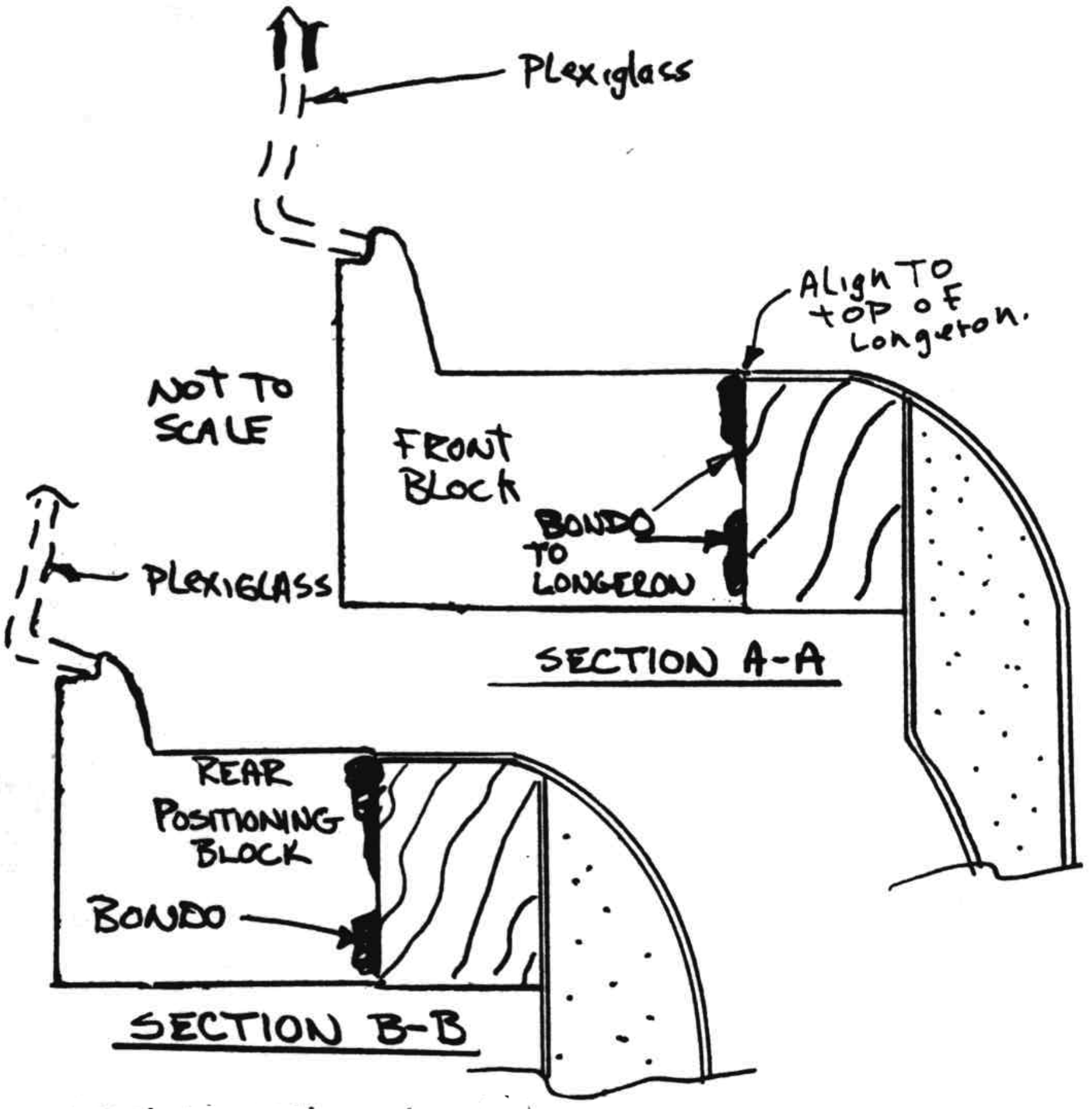

Figure 18-7: Bondo support blocks to longerons

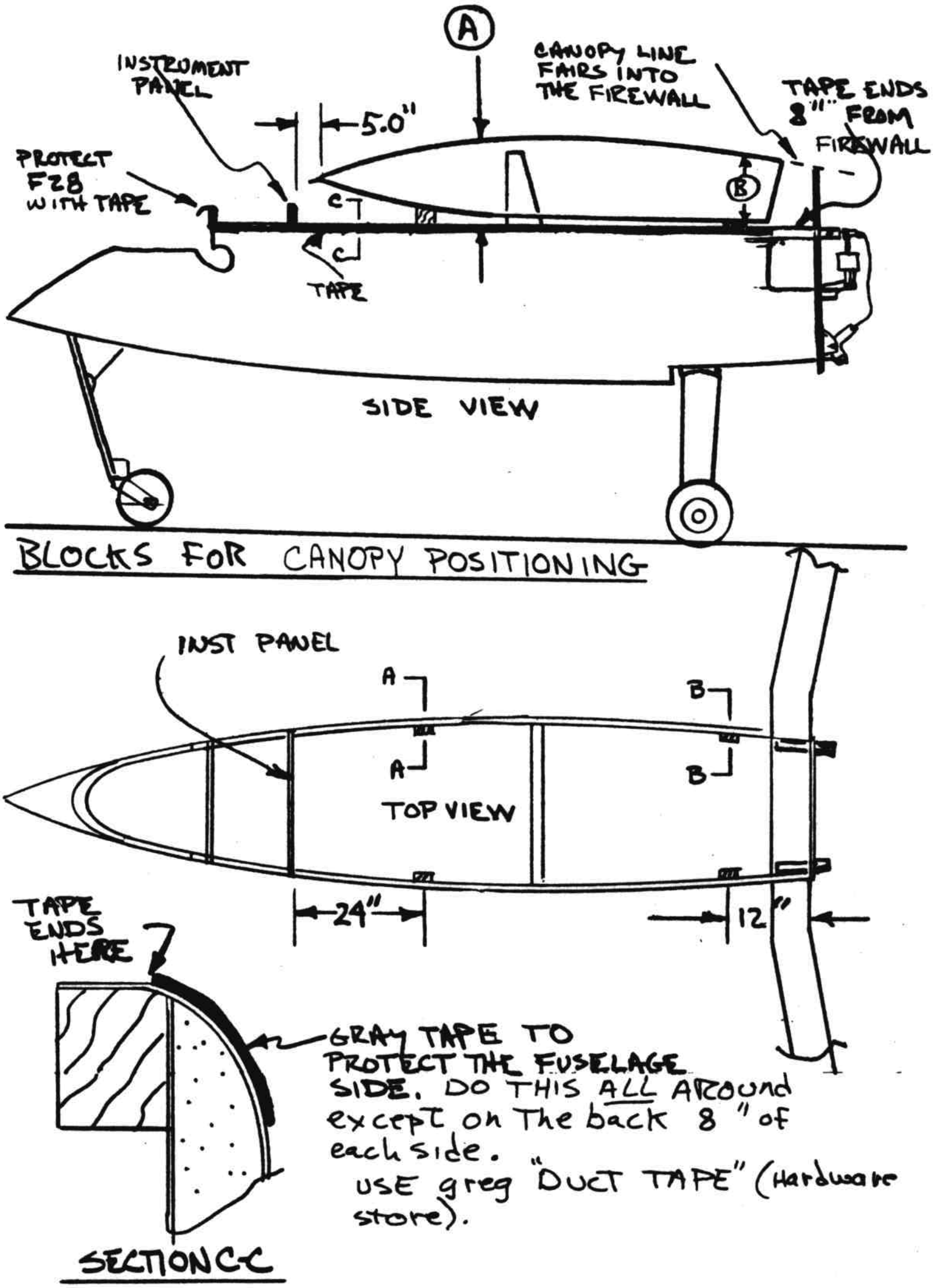

Figure 18-8: Location of support blocks on fuselage

Step 3 - Assembline the canopy frame foam core

This step should take two to three hours. This step involves mounting some over-sized urethane foam blocks all around the canopy. These are later carved to the shape of the canopy frame. Round up your box of 2"-thick urethane foam scraps. Fit pieces of 2" urethane to the canopy plexiglass and fuselage sides as shown. Working with 1 to 2-foot long pieces at a time is fairly easy. Bondo and micro the blocks as shown. The micro and Bondo are applied to the foam block, then it is held in place while the Bondo sets. Where foam blocks join, keep the micro joint low (no squeeze out on surface) to make later carving easier.

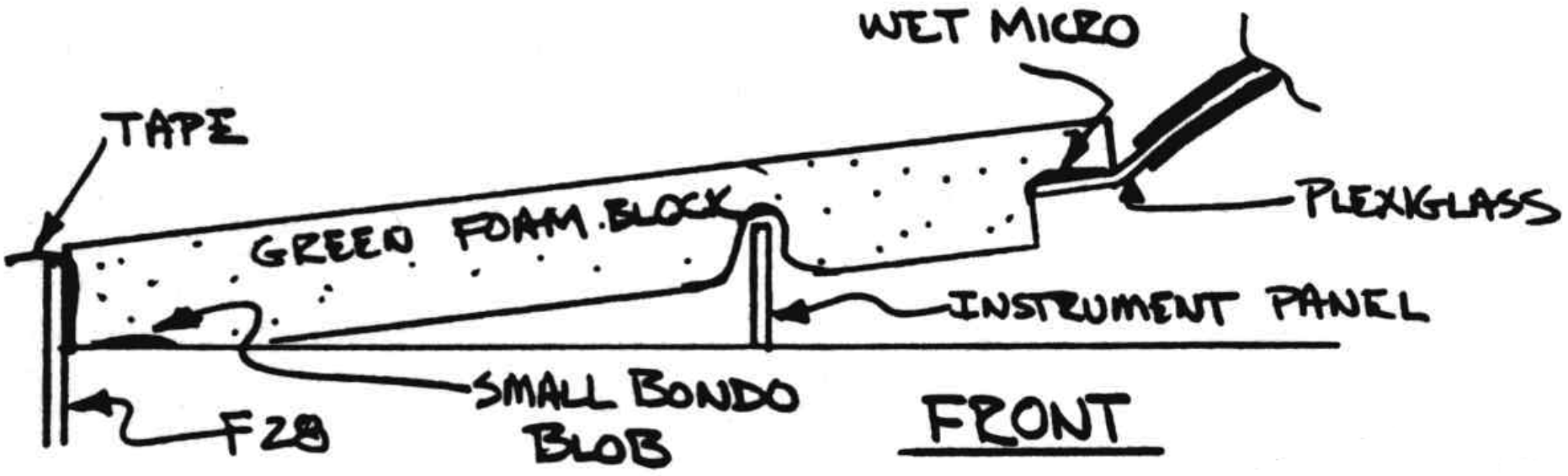

Figure 18-9: Canopy Frame Foam - Front

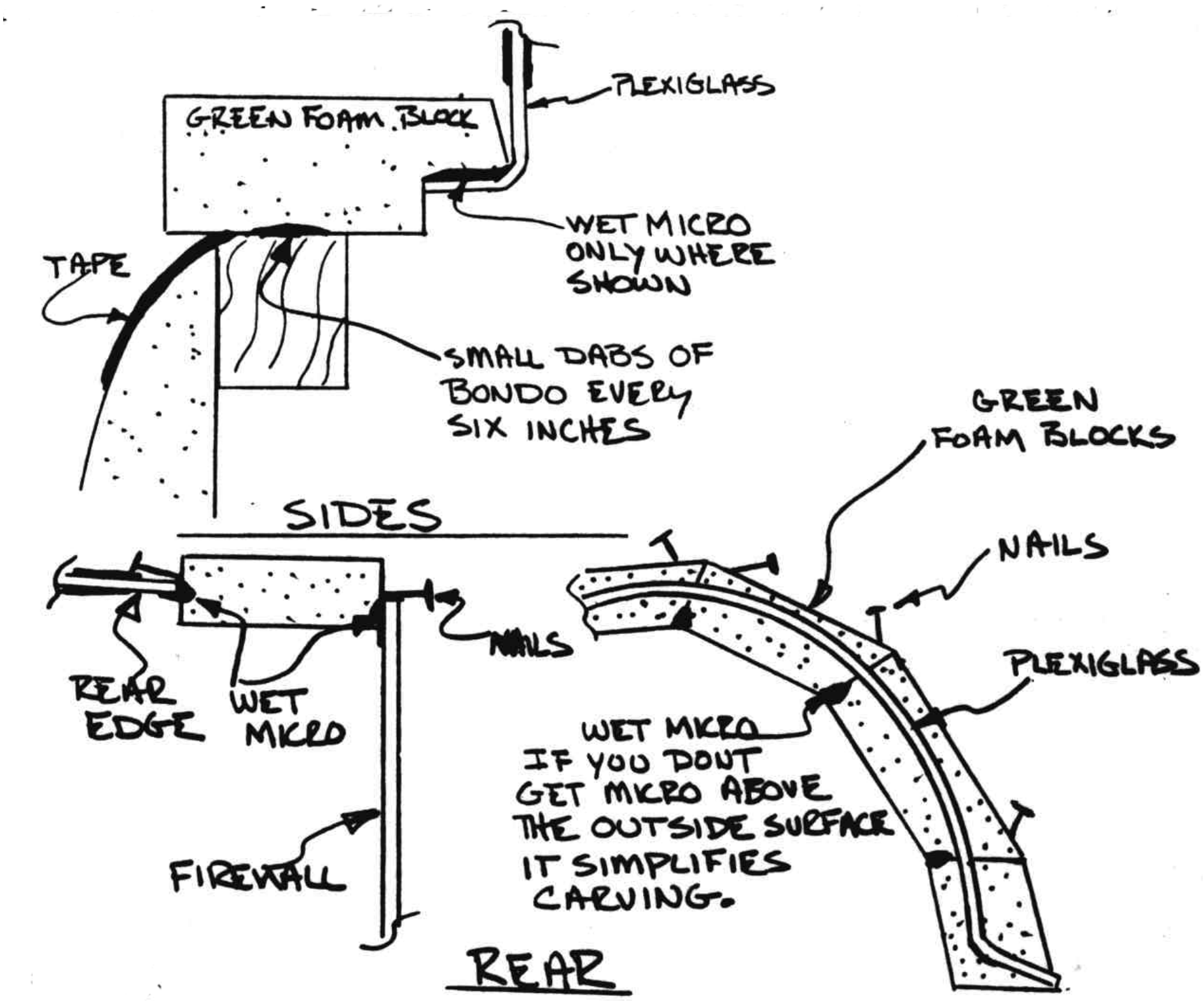

Figure 18-10: Canopy Frame Foam - Sides and Rear

Step 4 - Carving the outside to shape

This step should take about two to three hours. Use your foam shaping tools to carve the outside to shape, as shown in the photos and sketches.

Note: Photos in this chapter are VariEze. Ignore presence of fuel tank and any dimensional reference.

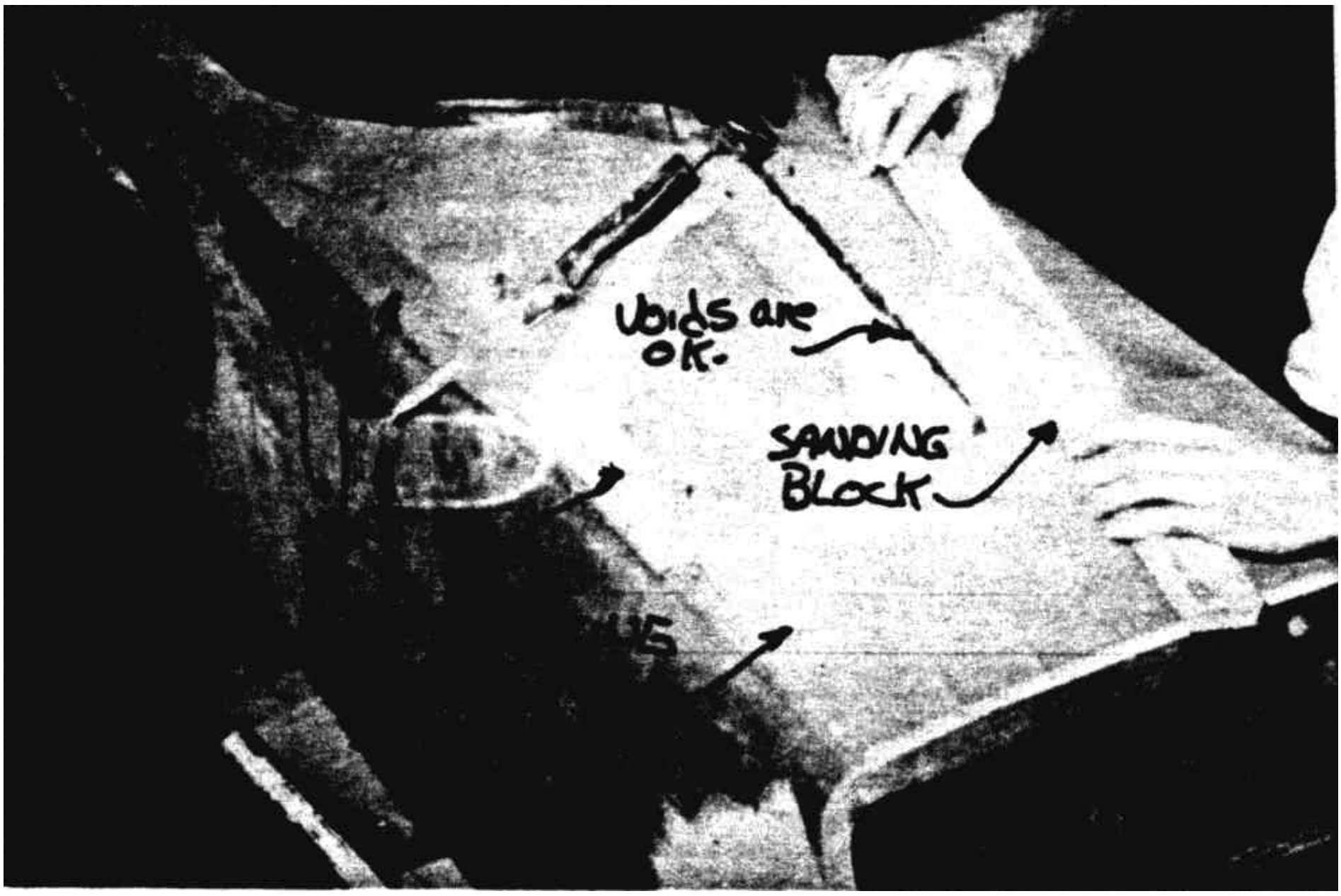

Figure 18-11: Shaping Canopy front foam

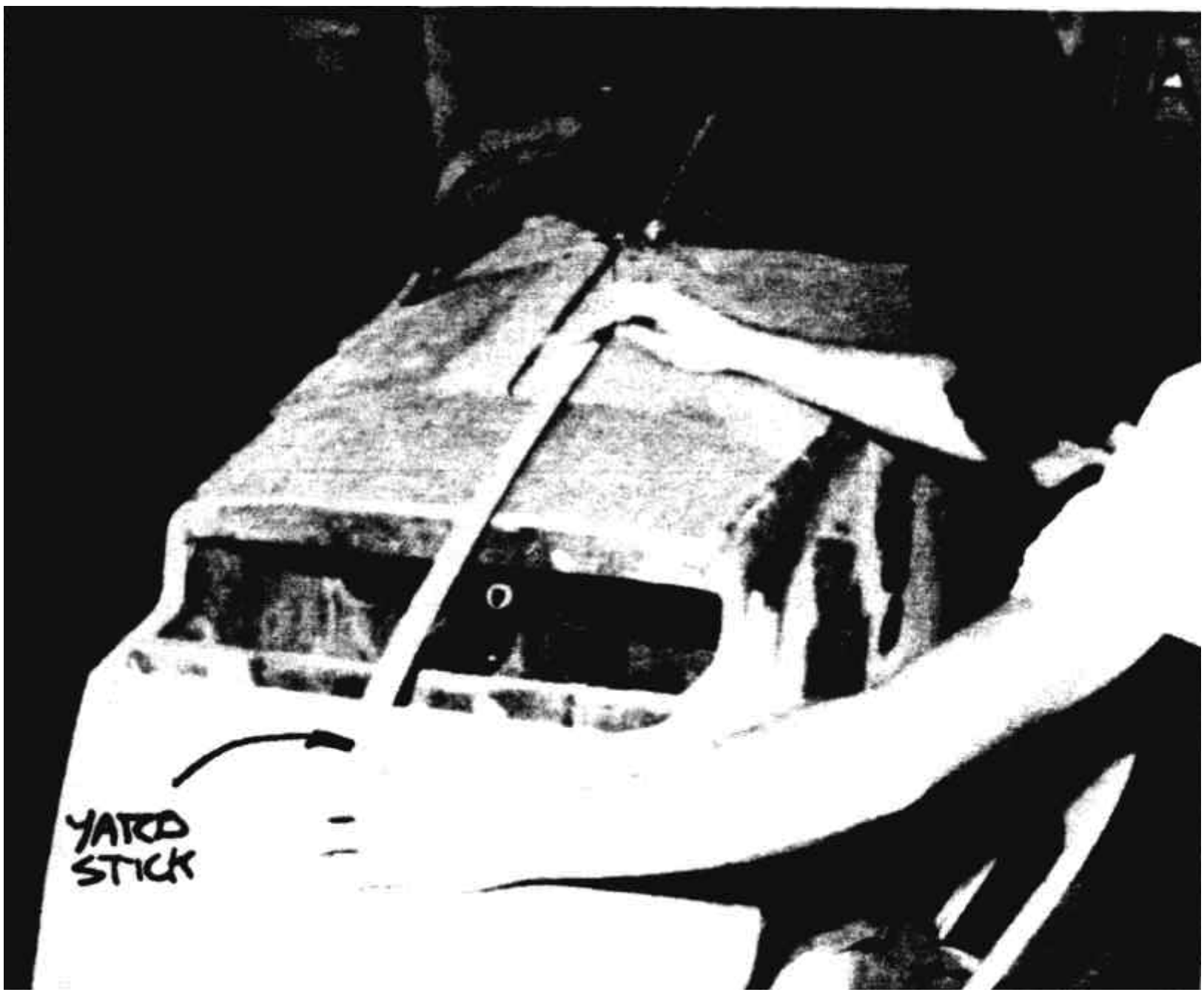

Figure 18-12: Check front foam contour

Figure 18-13: Forward carving detail

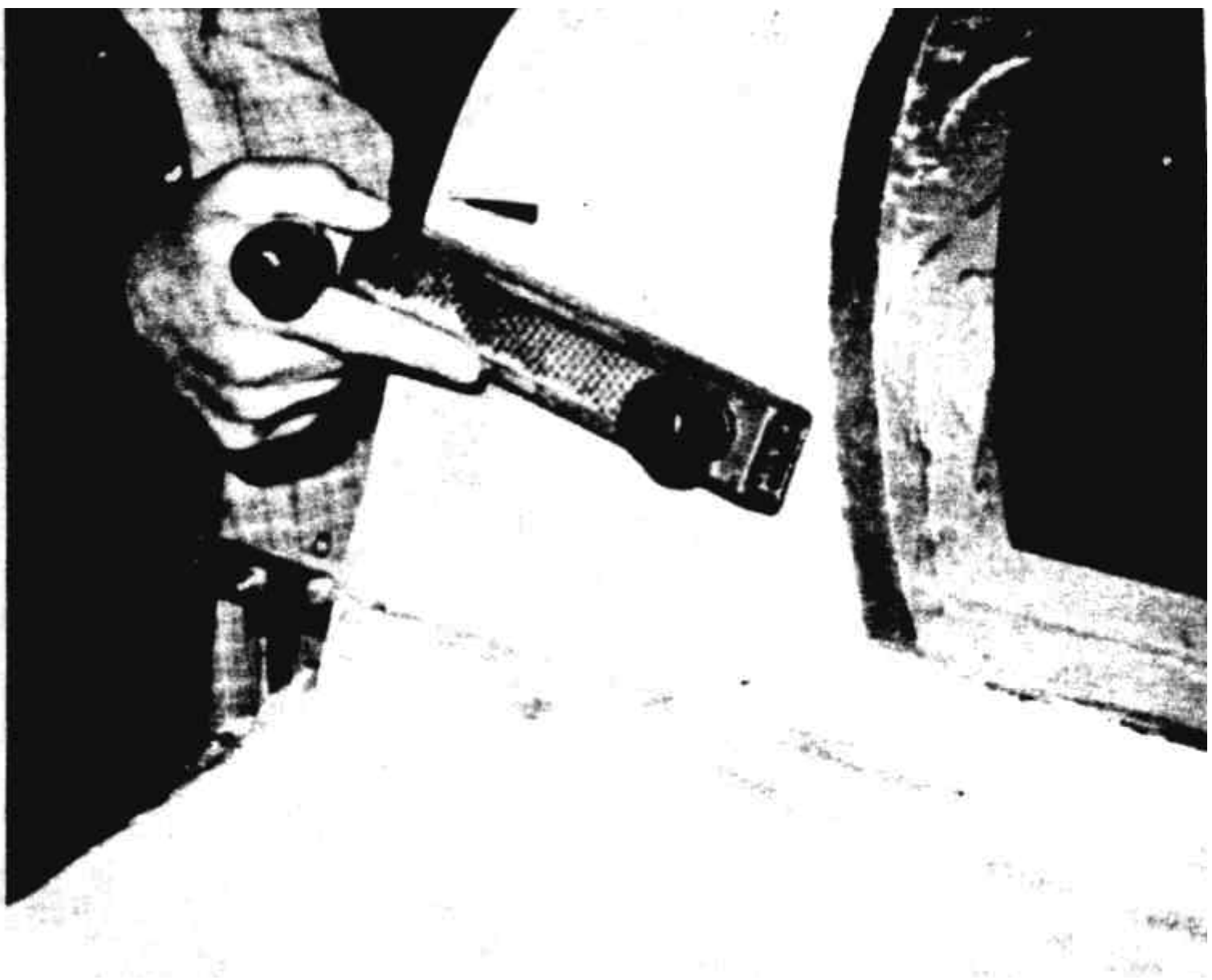

Figure 18-14: Rough carving the rear

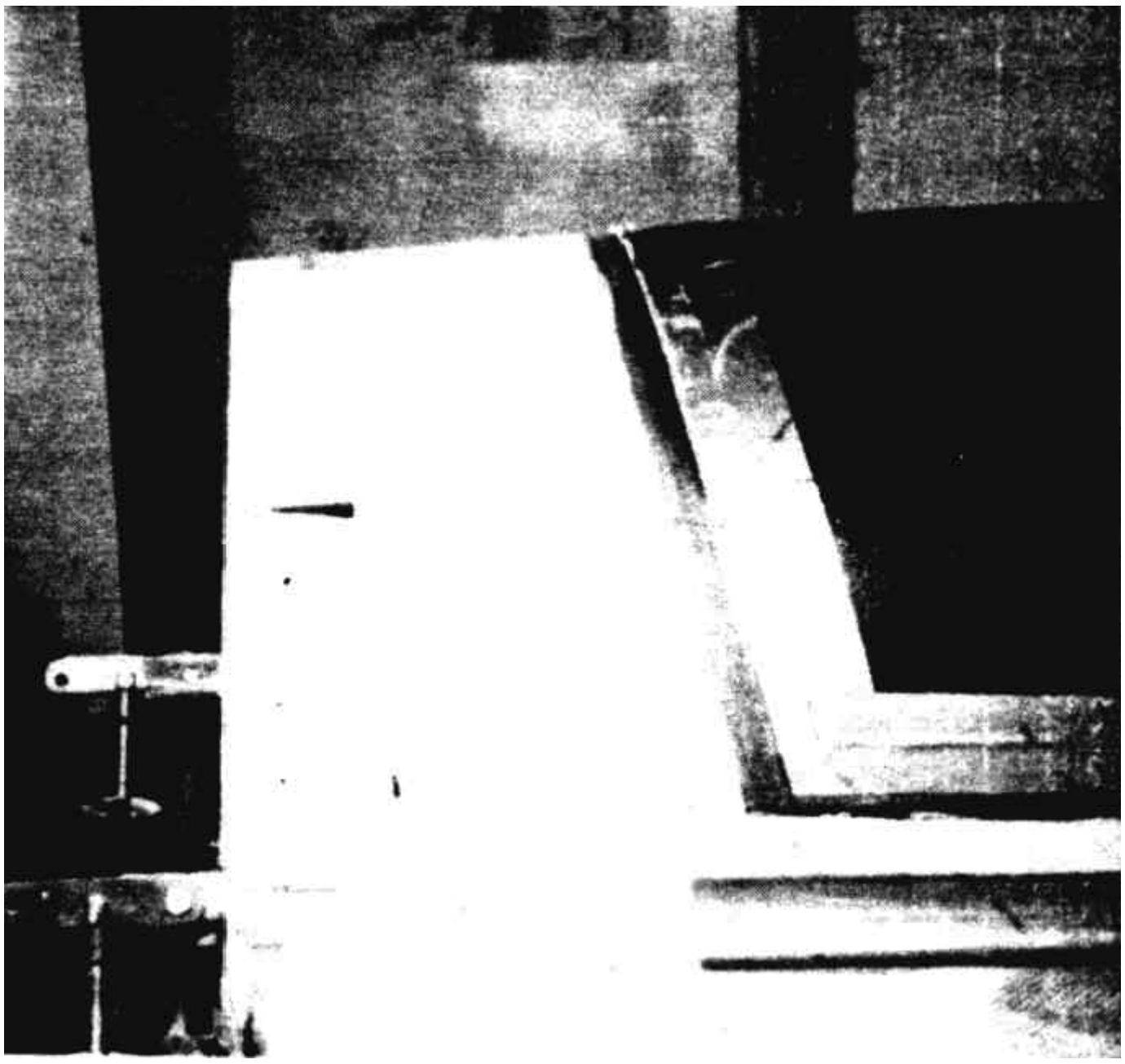

Figure 18-15: Rear of canopy after shaping

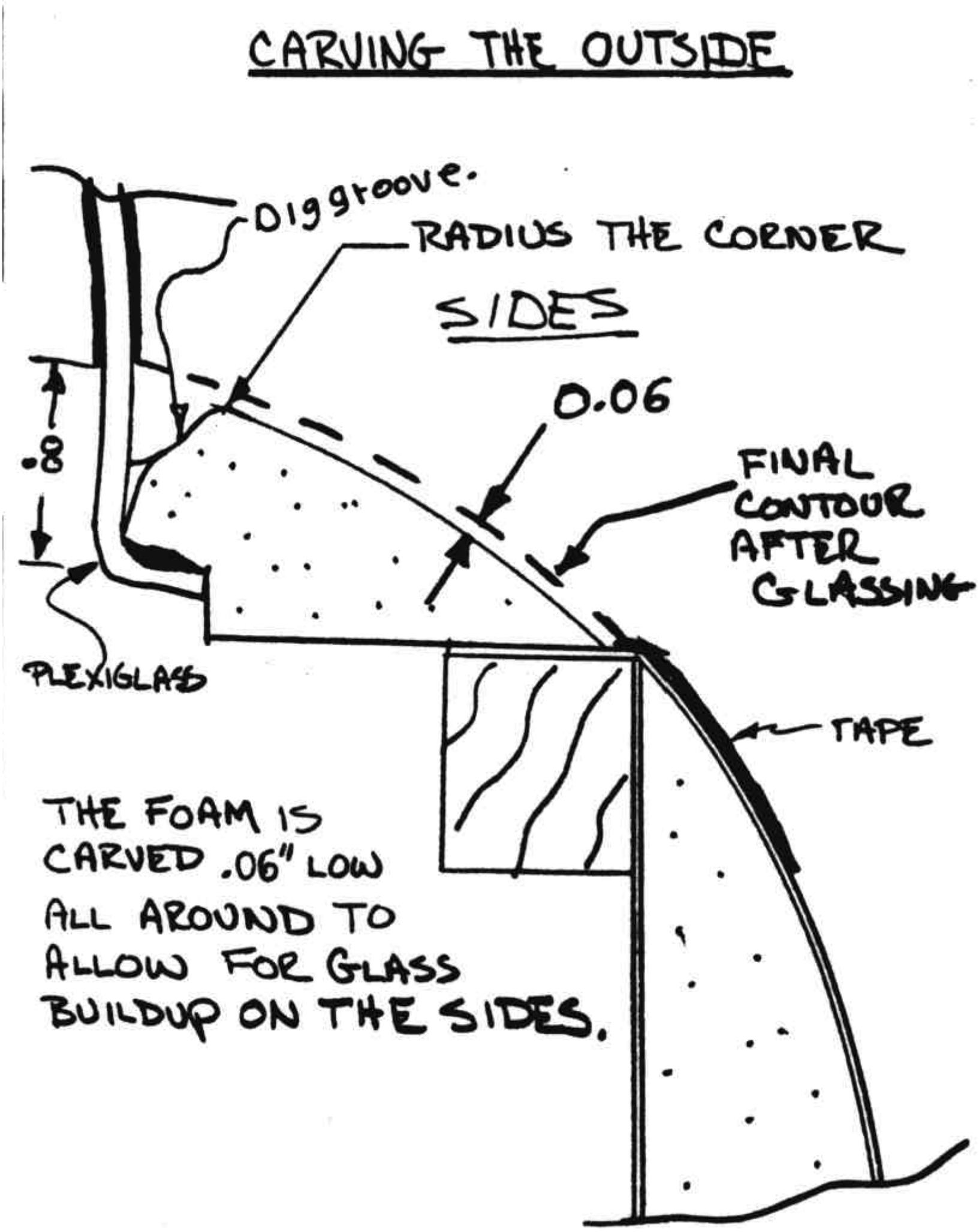

Figure 18-16:
Carving the sides to match the fuselage

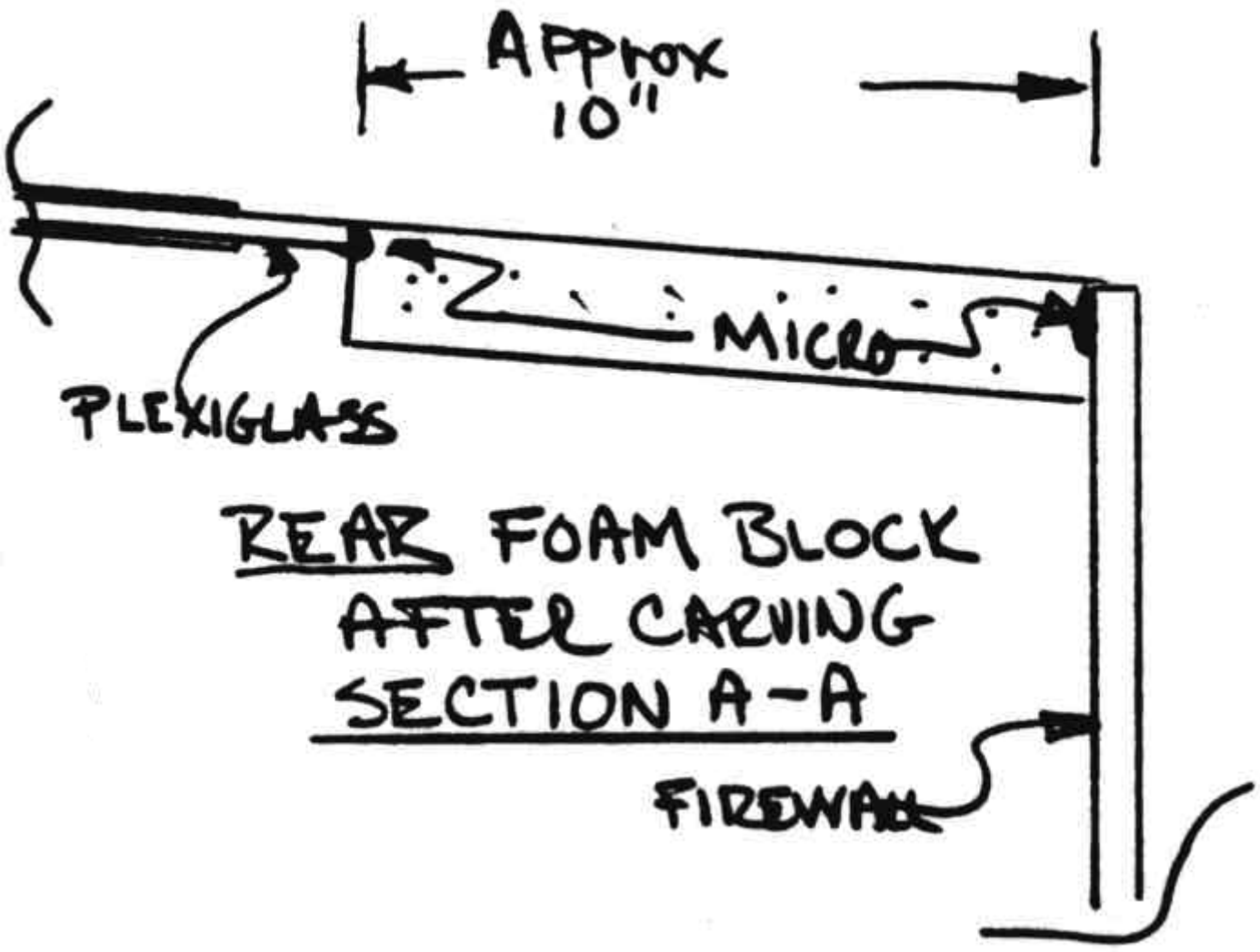

Figure 18-17: Rear foam between canopy and firewall

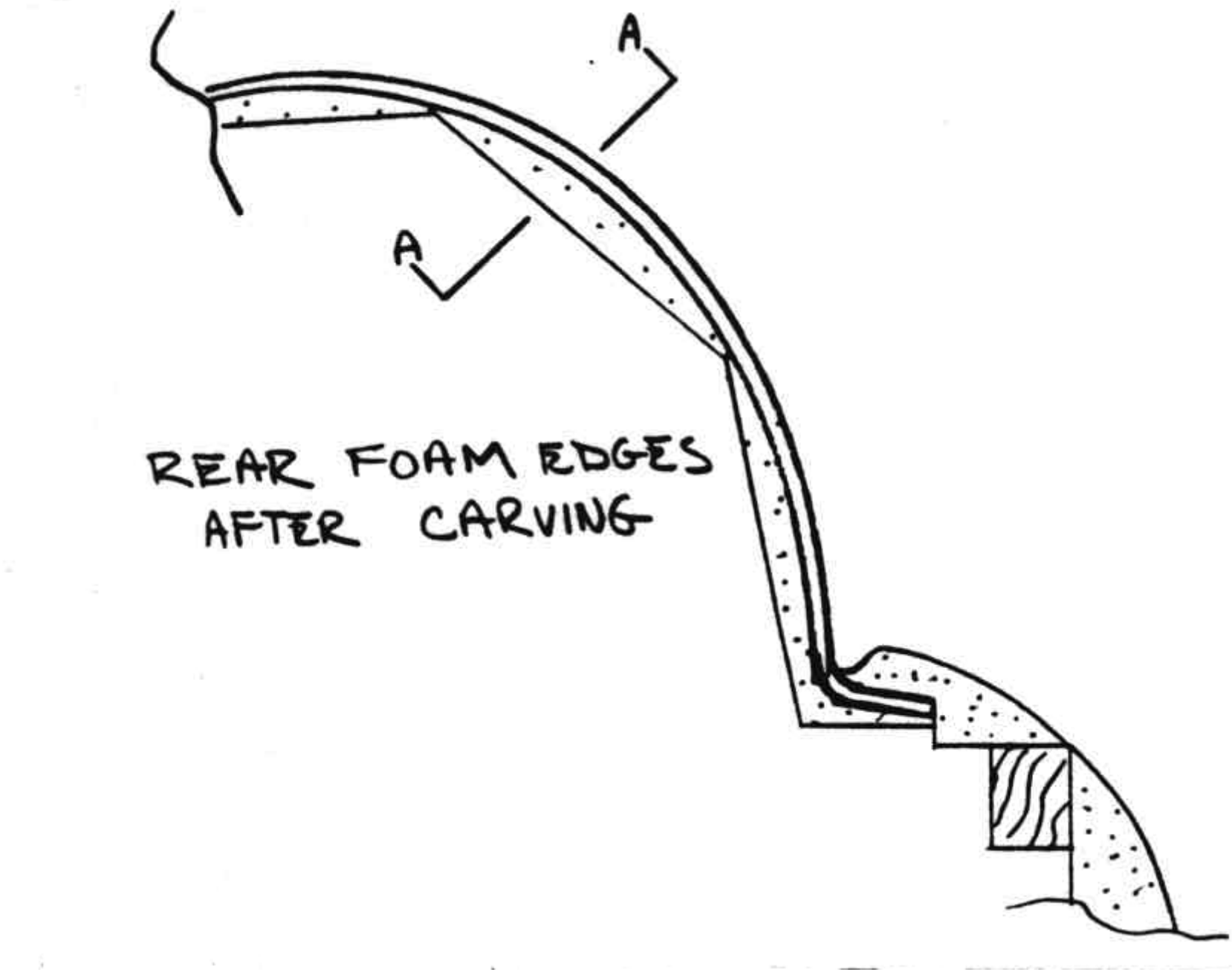

Figure 18-18: Front foam block after carving

Step 5 - Glassing the outside of the canopy frame

This step should take two hours. The fuselage sides within 8 inches of the firewall should be sanded dull for bonding. Micro slurry all foam surfaces and lay up BID plies and UND plies, fiber orientation as shown. Not that along the sides, the first ply us laid down **into** the groove. The groove is then filled level with flox and the last 3 plies go over the top.

Knife trim around the taped longeron areas and firewall. Do not knife trim into the plexiglass! The scratches from this would give cracks a place to begin. If trimming is required along the taped plexiglass edges, it is done after a full cure, using a round bit in your dremel (grind down just to the tape edge as shown). Be careful to cut the fiberglass and not into the plexiglass under the tape. Let the layup cure for 48 hours.

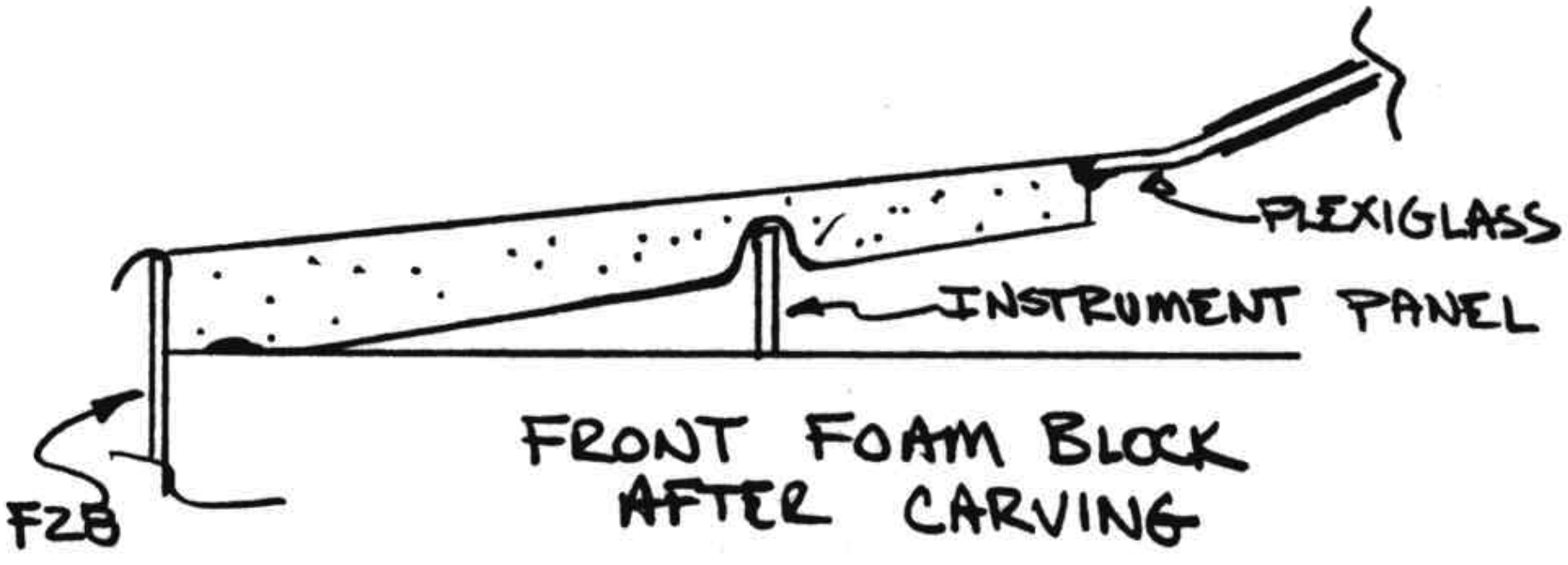

Figure 18-19: Front foam block after carving

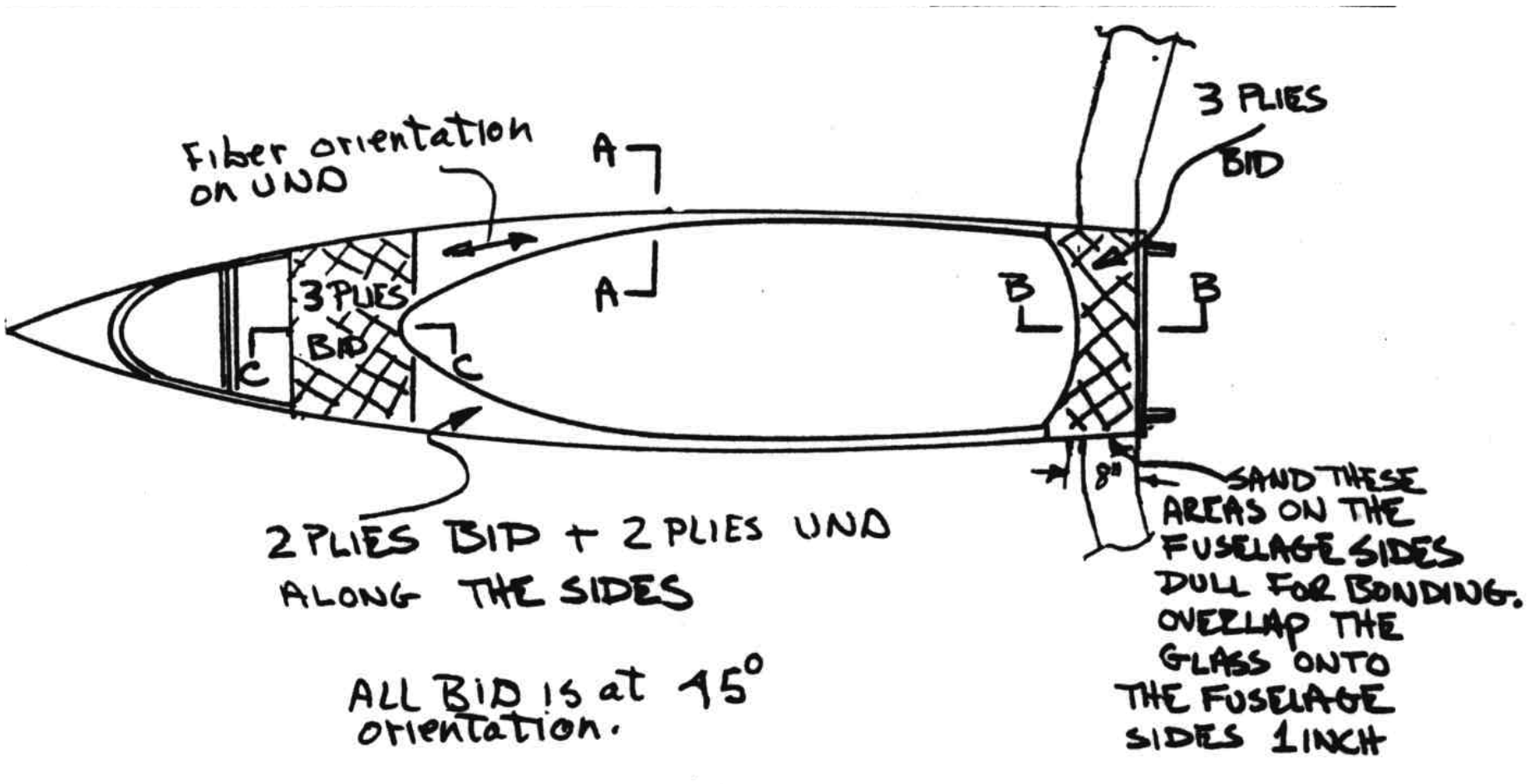

Figure 18-20: Glass Layup Overview

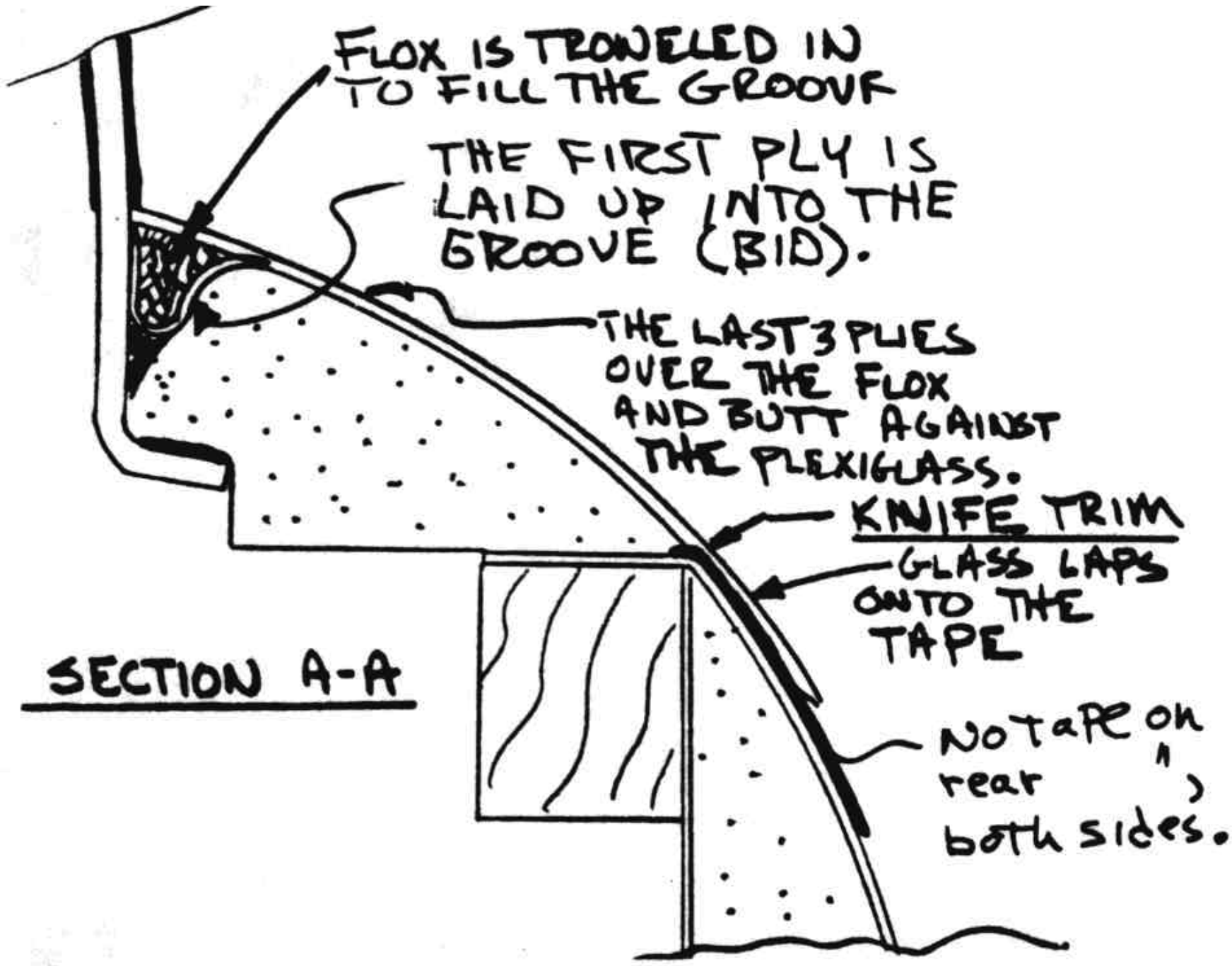

Figure 18-21: Glass layup over rear foam

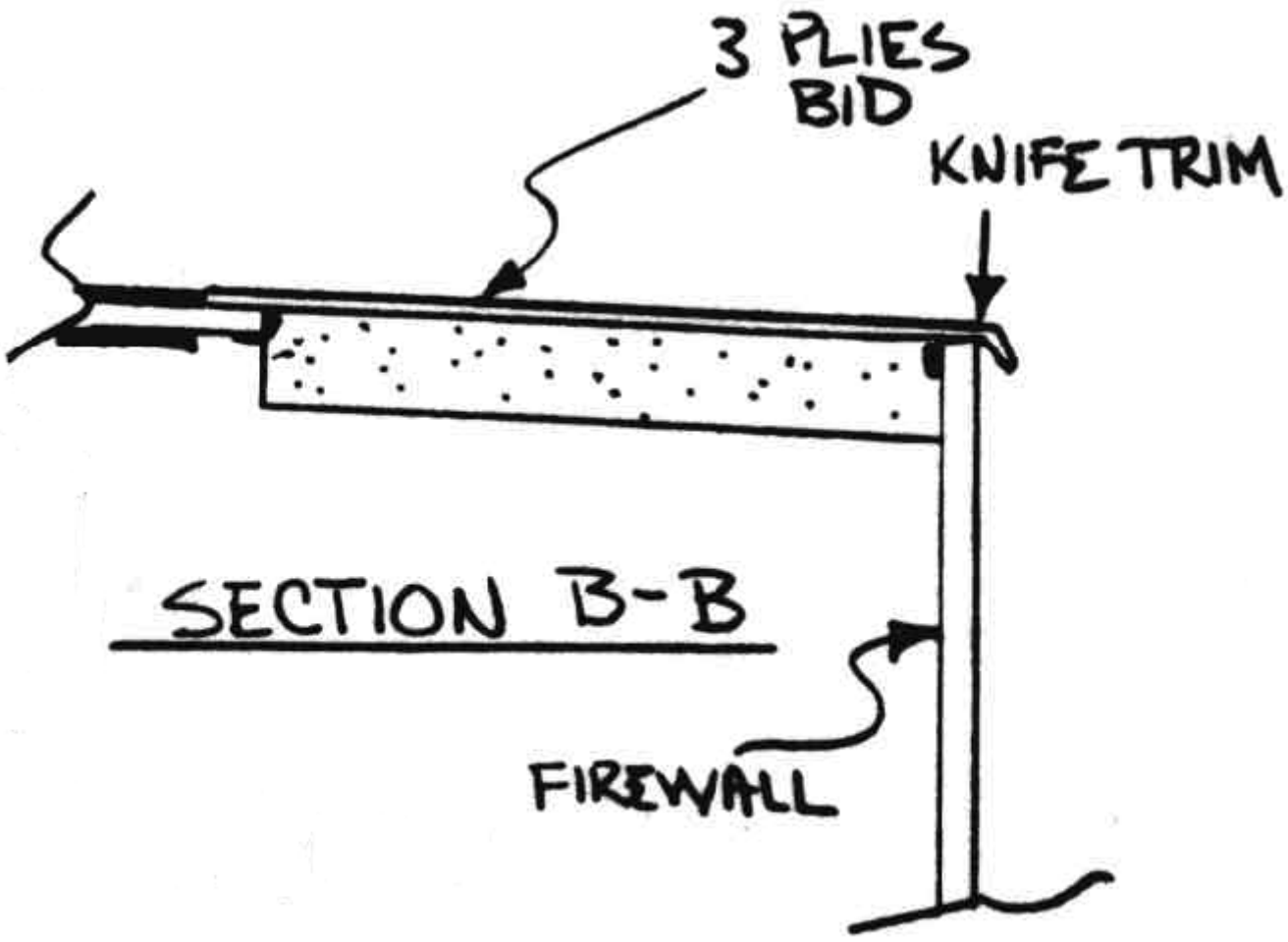

Figure 18-22: Section B-B BID layup over rear foam

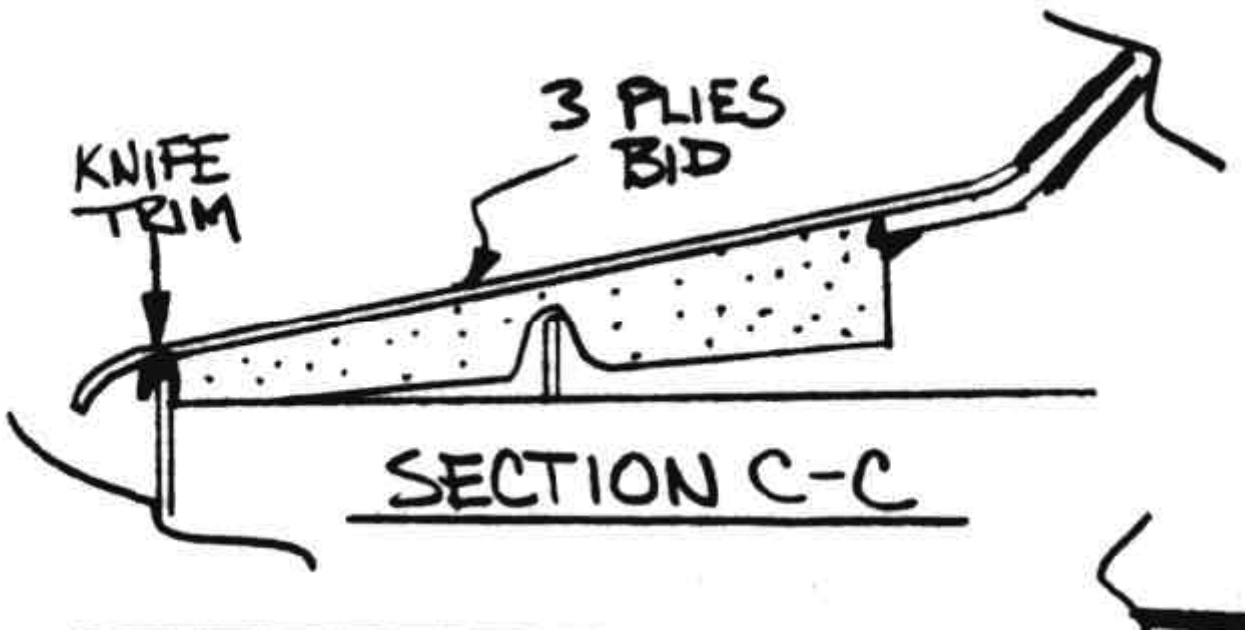

Figure 18-23: Section C-C BID layup over front foam

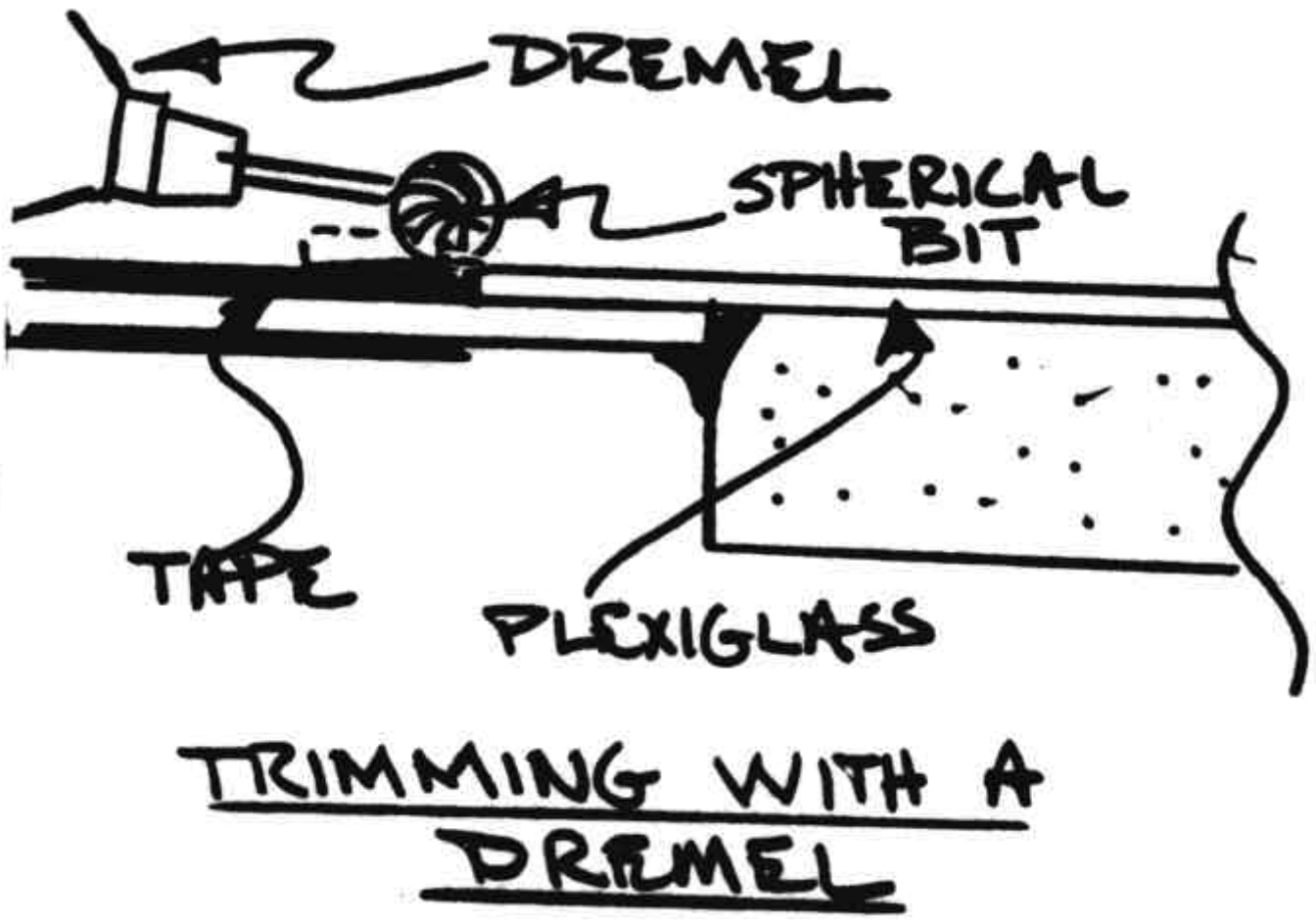

Figure 18-24: Trim glass overlay with dremel

Figure 18-25: ?unknown?

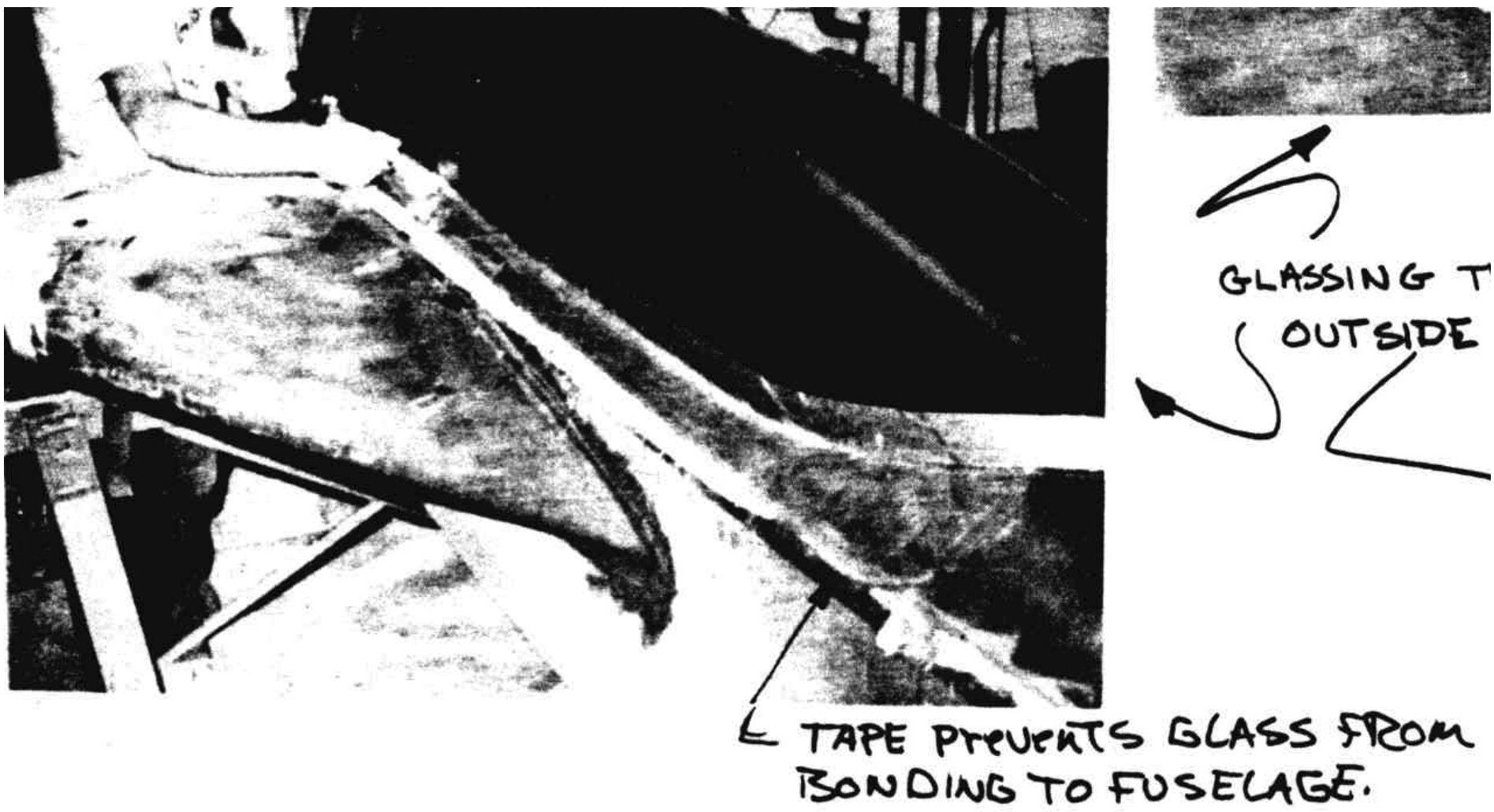

Figure 18-26: Glassing the outside

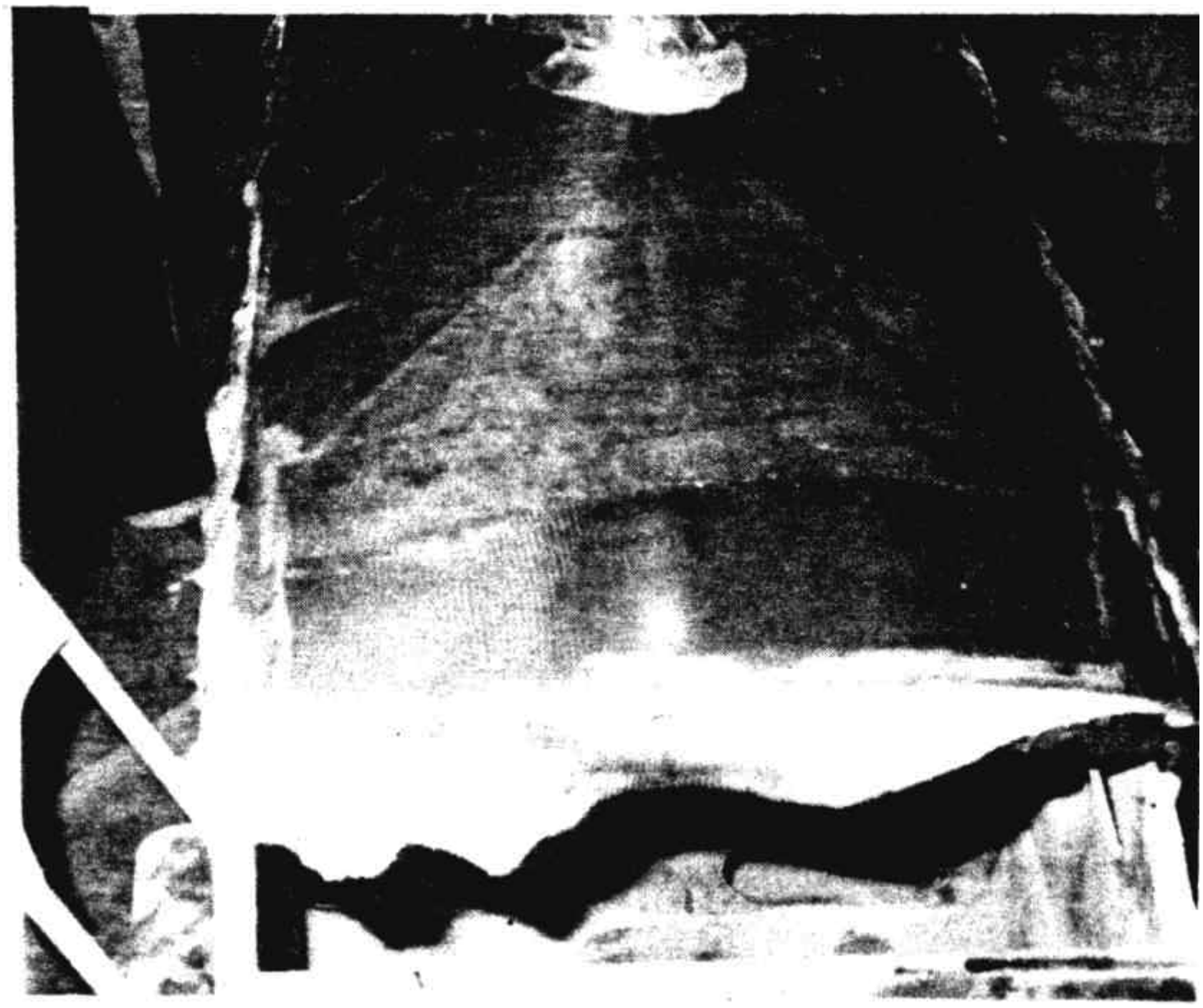

Figure 18-27: Glassing the front?

Step 6 - Trimming, jigging, and removing the canopy

This step should take two hours. Use your hacksaw to cut the canopy front and rear as shown.

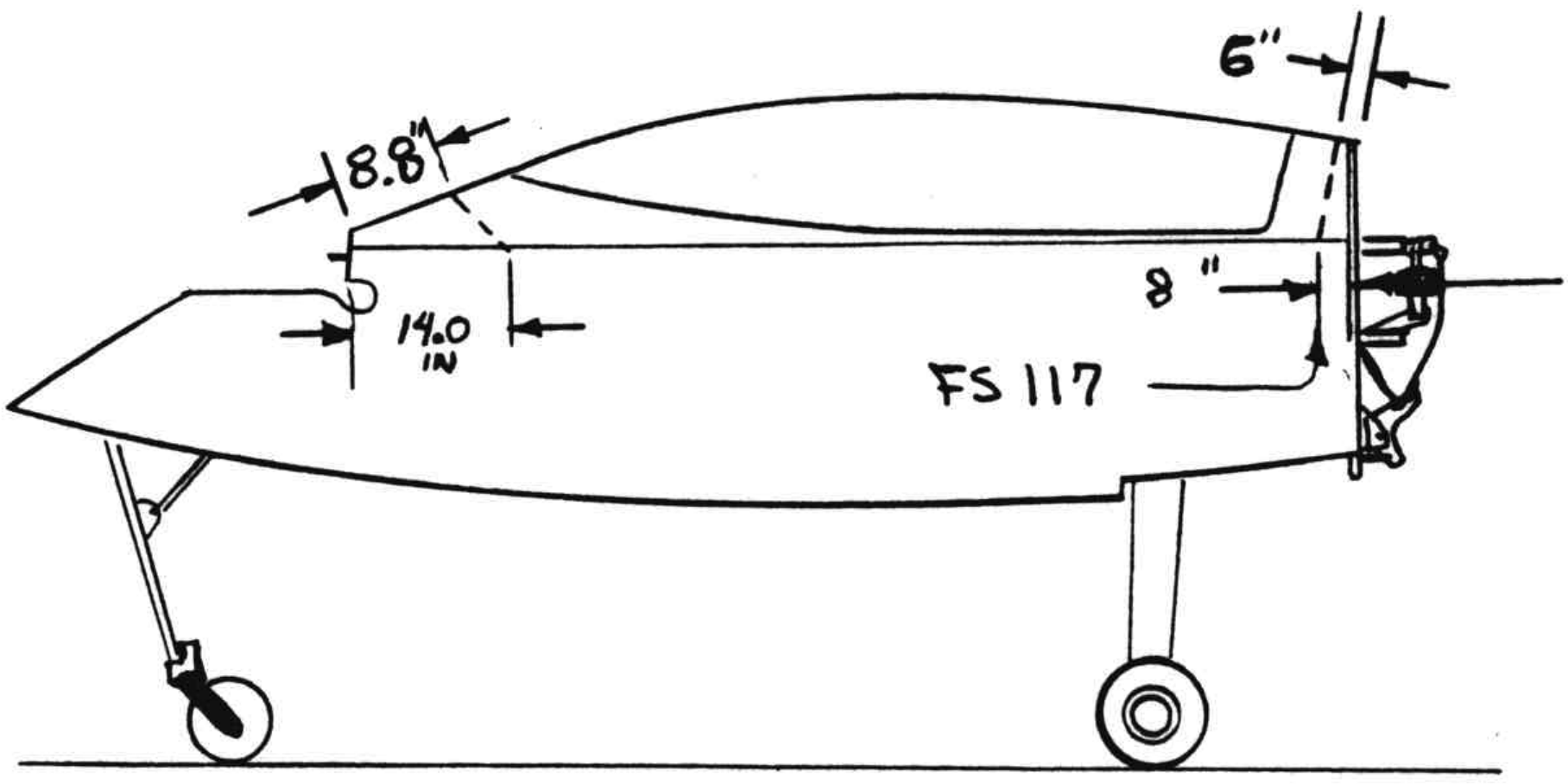

Figure 18-28: Cut canopy out of foam

Don't cut into the longeron or the instrument panel or your finger!

Figure 18-29: Cutting the front of the canopy frame

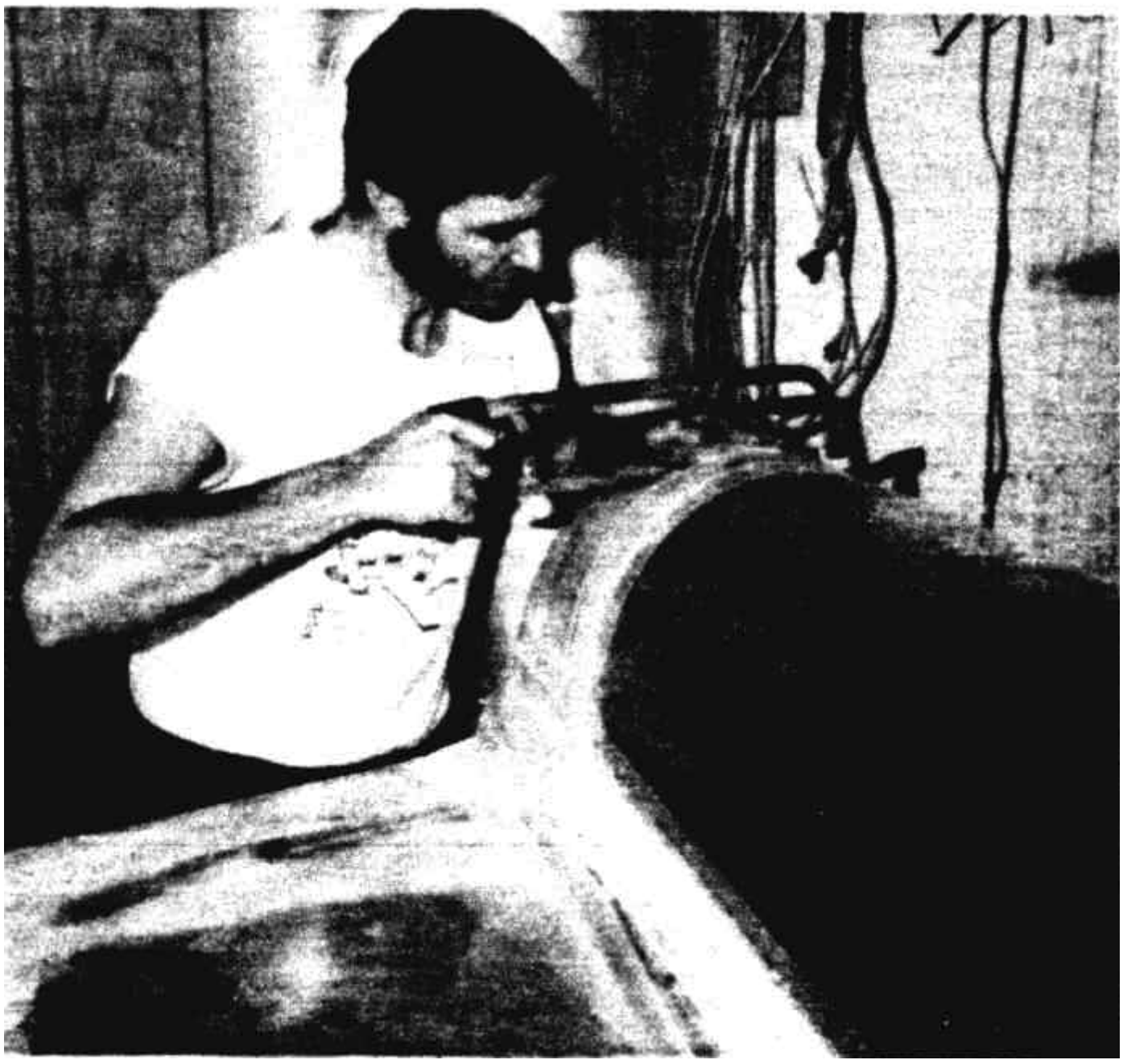

Figure 18-30: Cutting the rear of the canopy frame

When you have the front and rear cuts done, Bondo on a bunch of lumber (front, back and sides like in photo) to keep the canopy frame from warping while working on the inside.

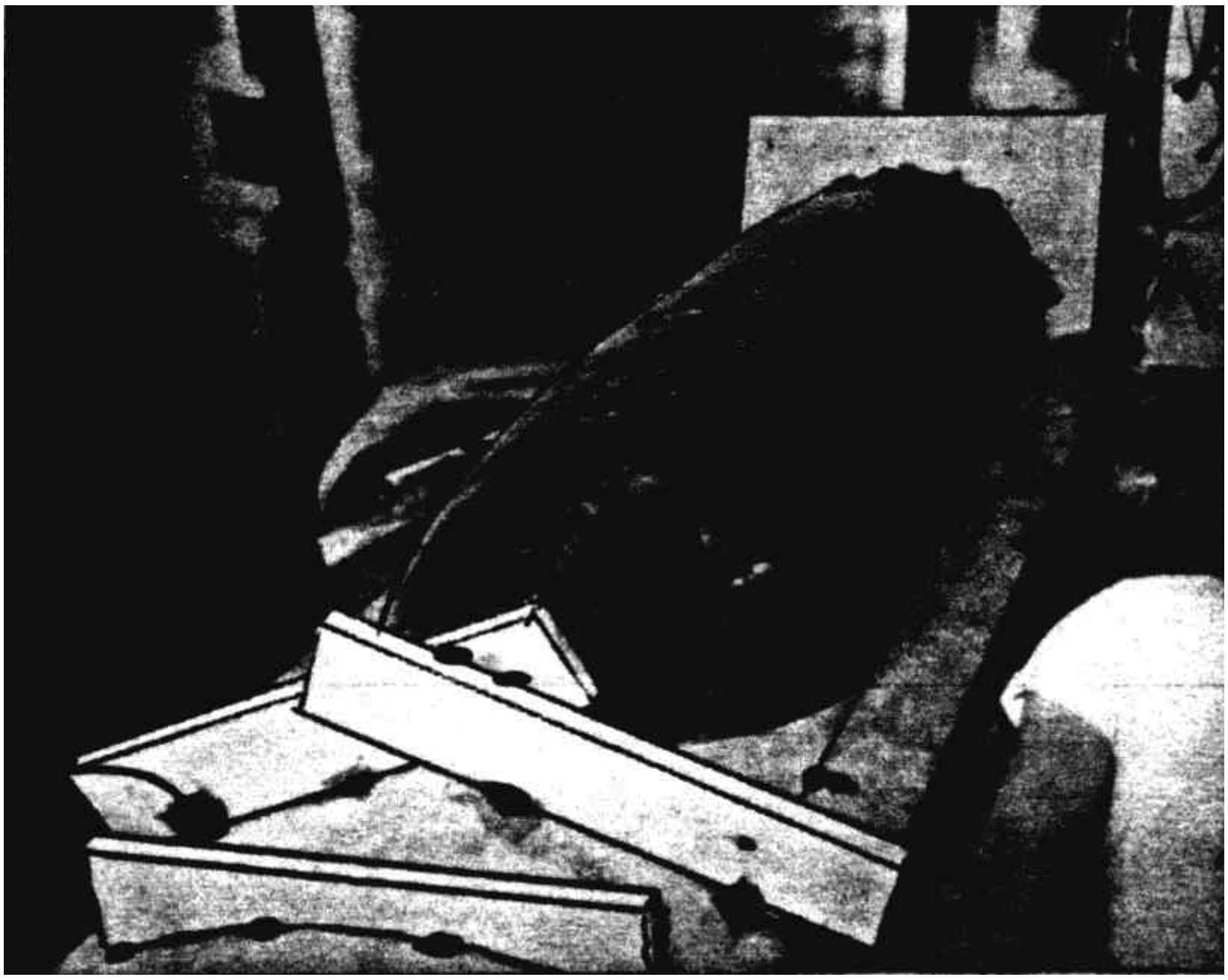

Figure 18-31: Frame stiffiner boards

When the Bondo is hard, use your butcher knife to pop the sides loose from the longerons. Don't just pull or the Bondo blobs on the longerons will break big hunks out of the inside foam. Lift the canopy off of the fuselage and set it upside down on your work bench.

Figure 18-32: Butcher knife to free canopy

Step 7 - Carving the inside foam

This step should take one to two hours. Carve the inside foam surfaces on the fuselage as shown. Carve the inside foam surfaces of the canopy as shown.

Remove all of the foam (down to top skin) in the areas shown for hinge and latch reinforcements.

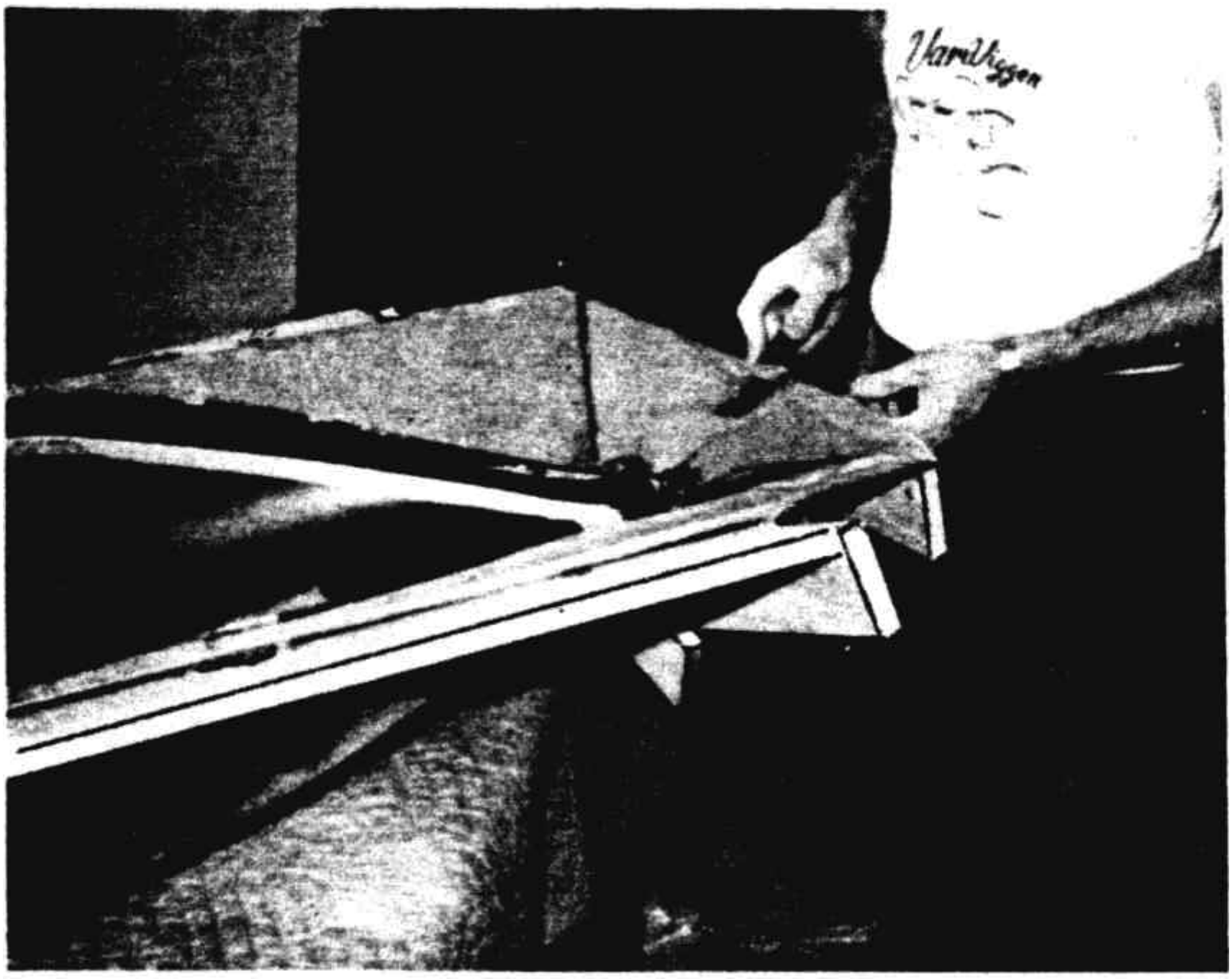

Figure 18-33: Trim inside foam

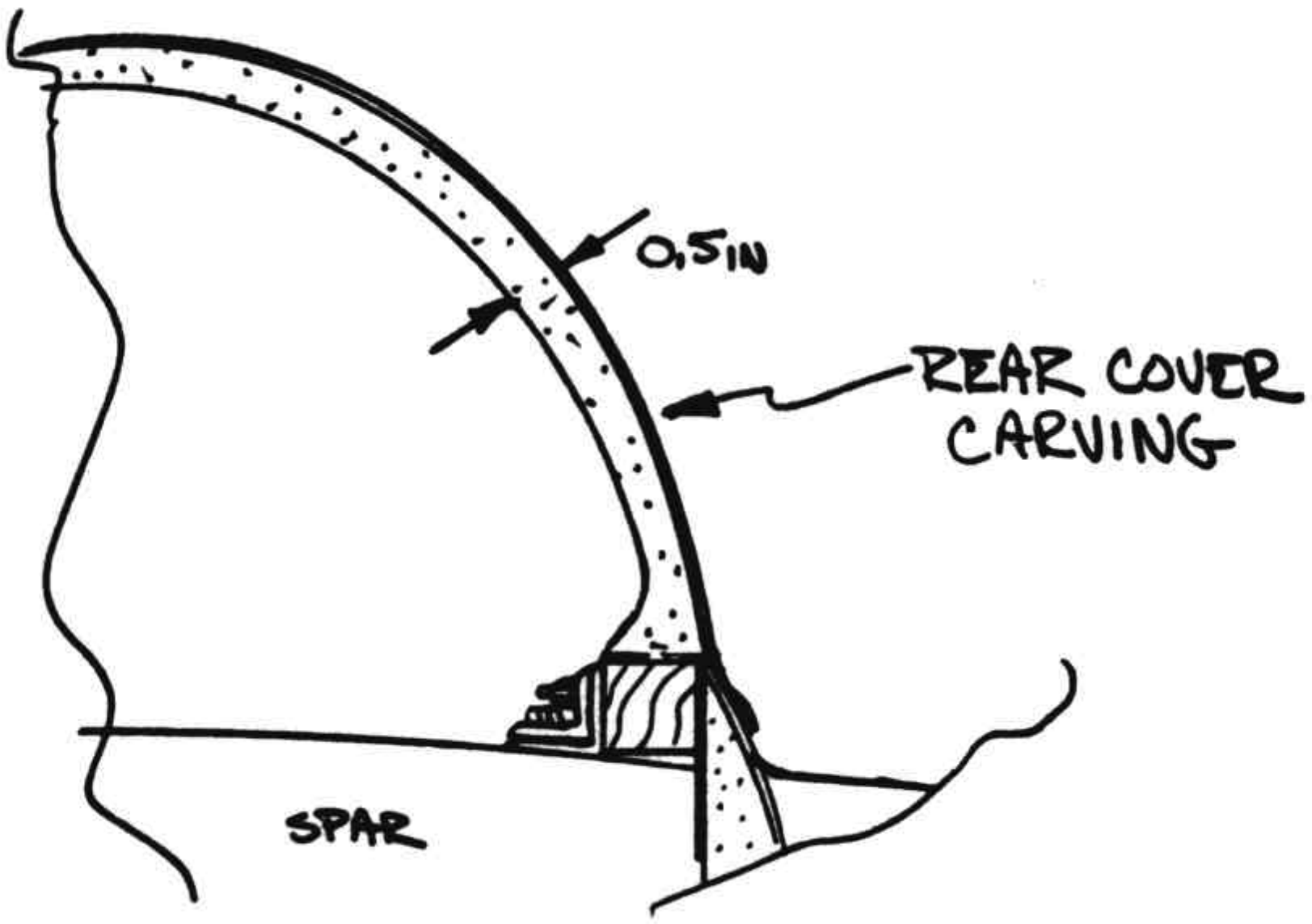

Figure 18-34: Rear foam carving

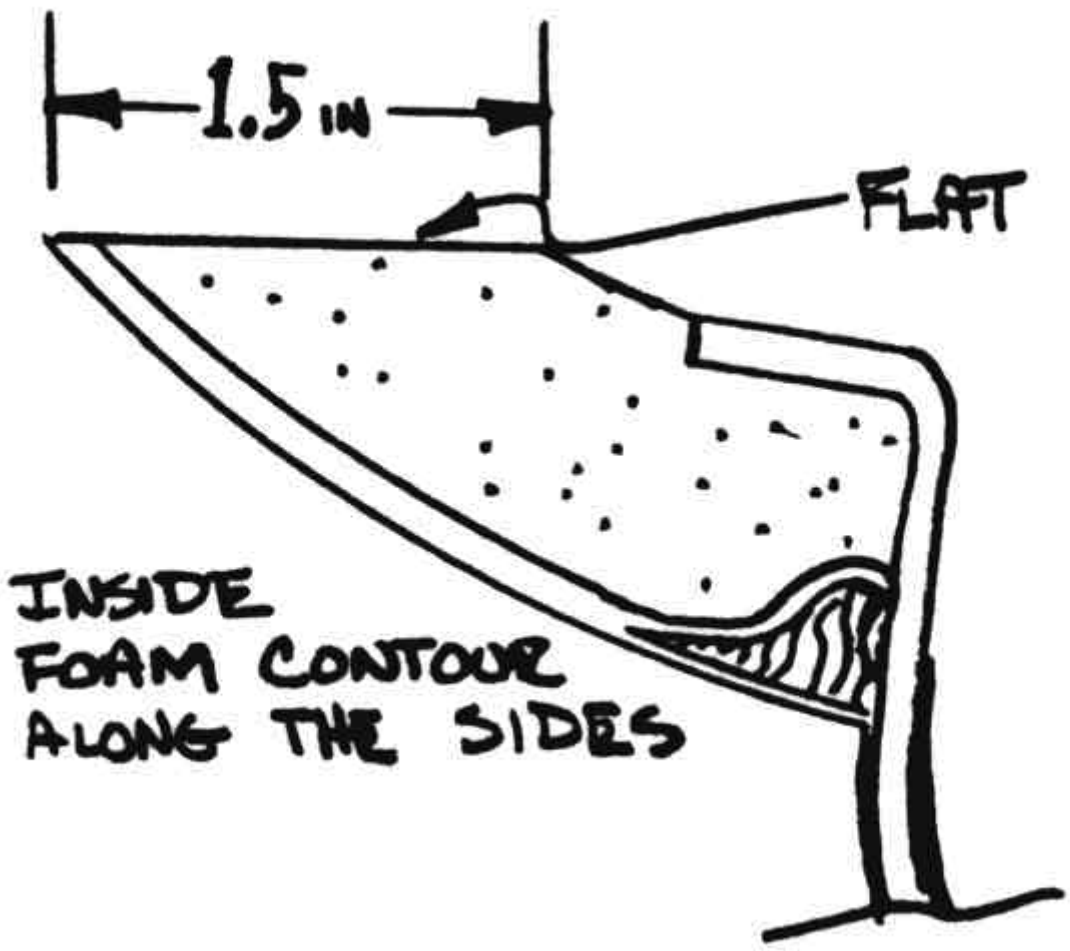

Figure 18-35: Inside foam contour along the sides

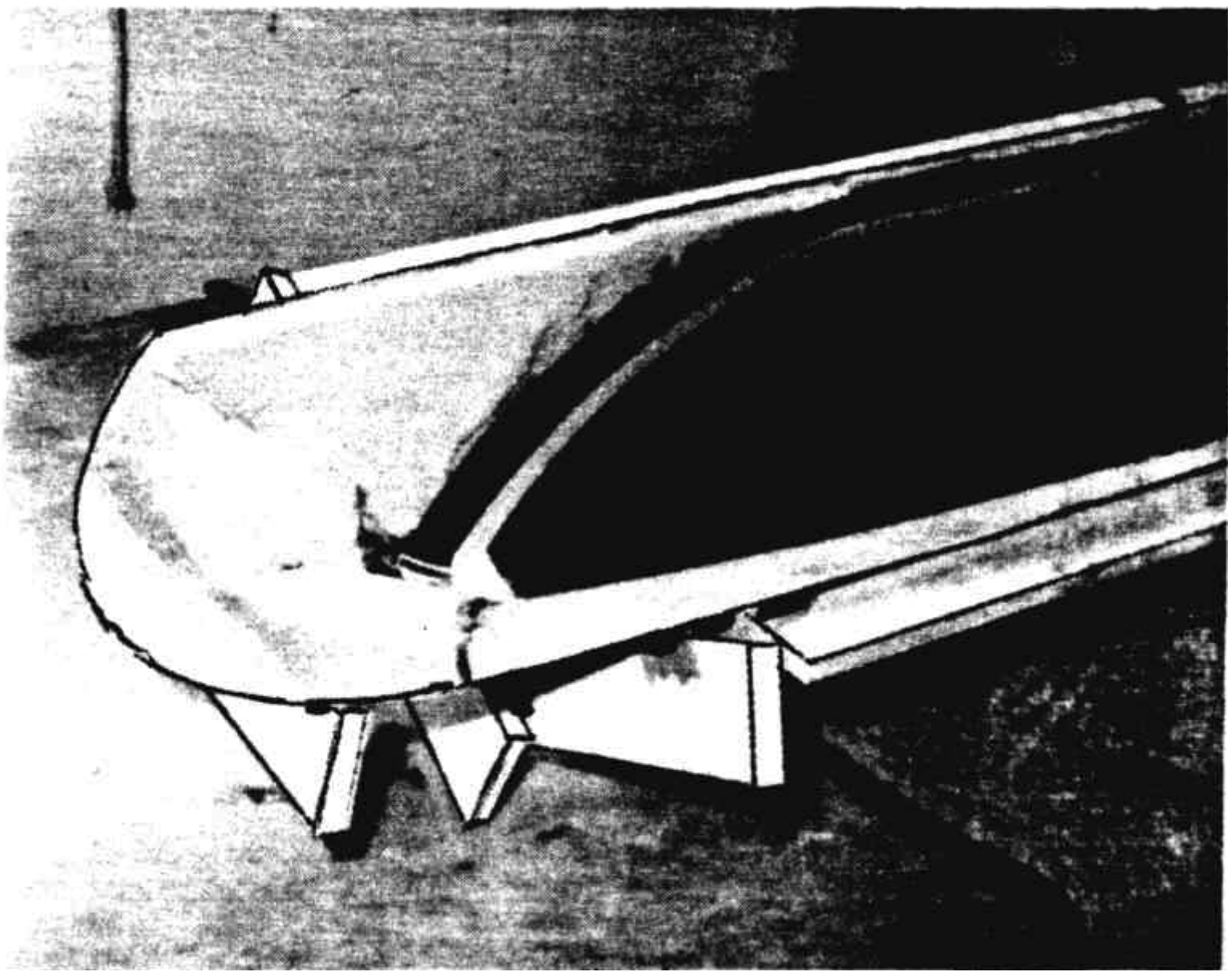

Figure 18-36: Canopy interior foam finished

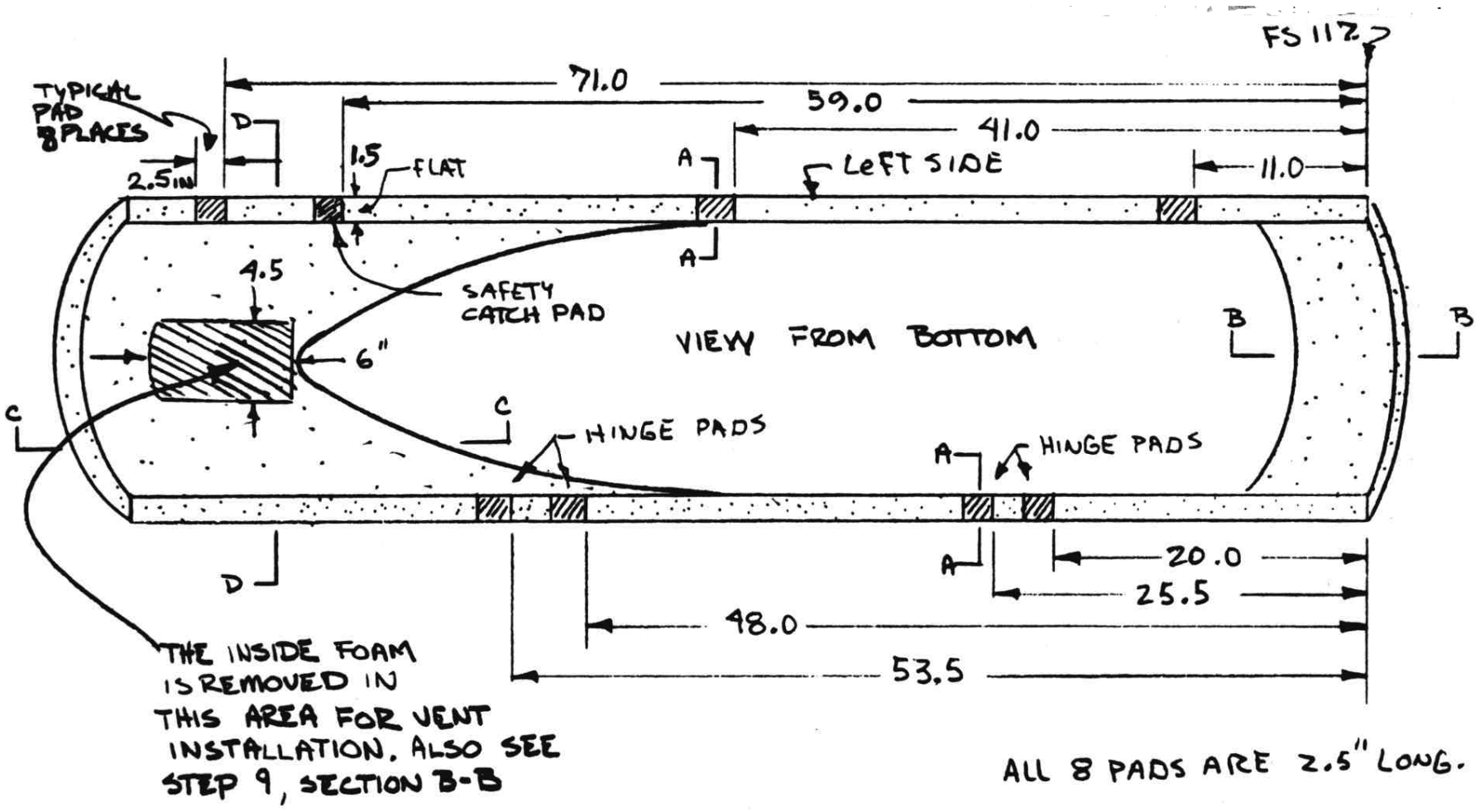

Figure 18-37: Reinforce canopy edges for hinges and vent inlet

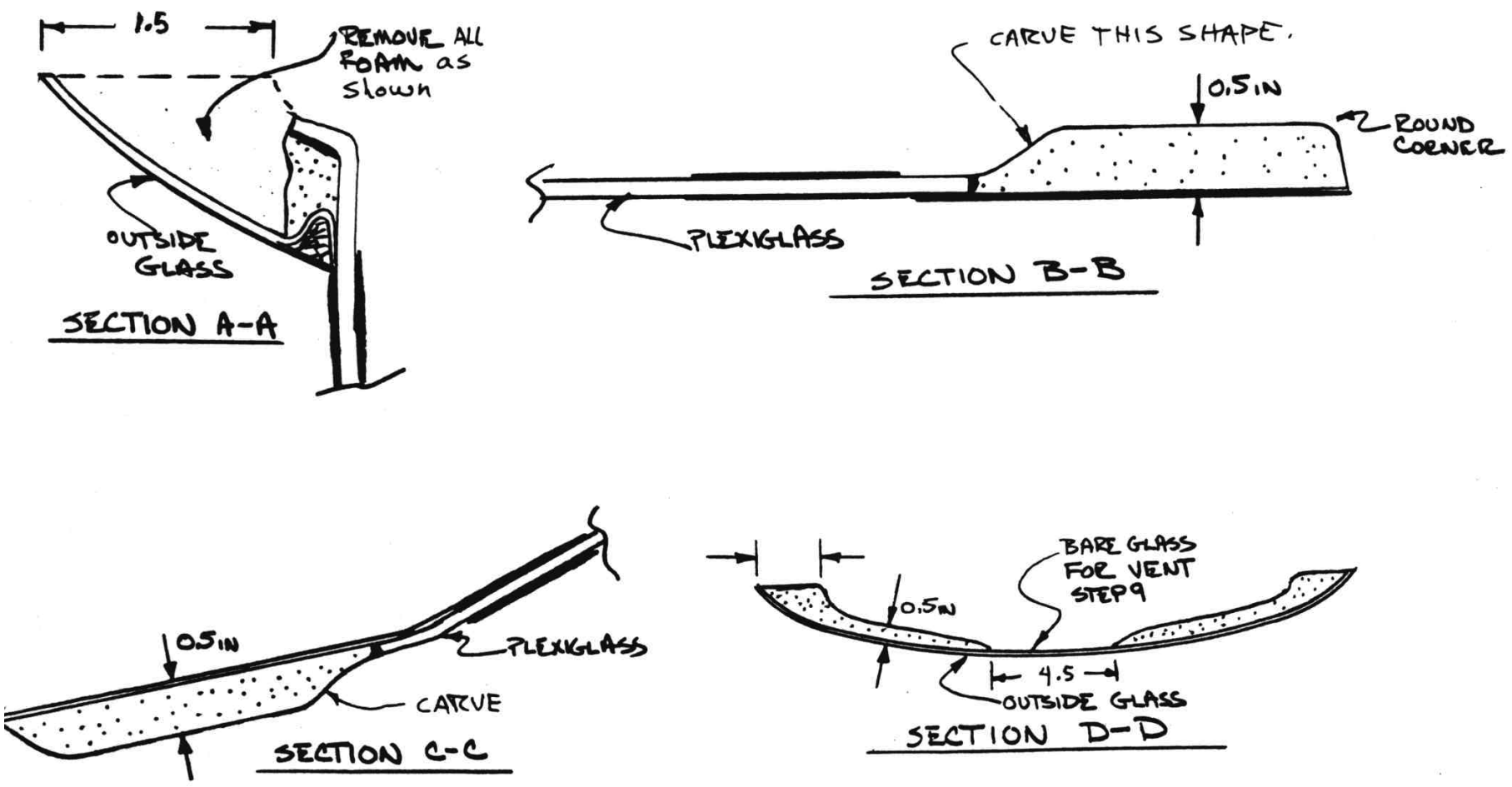

Figure 18-38: Interior foam final shapes

Step 8 - Laying up the hinge and latch reinforcements and the inside glass skins

This step should take about three to four man-hours. Mix a batch of wet flox. Fill the holes carved for latch and hinge reinforcements by alternating layers of flox with BID plies. Overfill the holes slightly so the reinforcements can be sanded flush after they cure. Trial fit the contoured canopy to your fuselage to check its fit. Then take it back to your work bench and lay up the inside glass as shown. Glass the inside surface of the rear cover on the fuselage with one ply BID lapping onto the firewall as shown. This layup is easy if the fuselage is turned over.

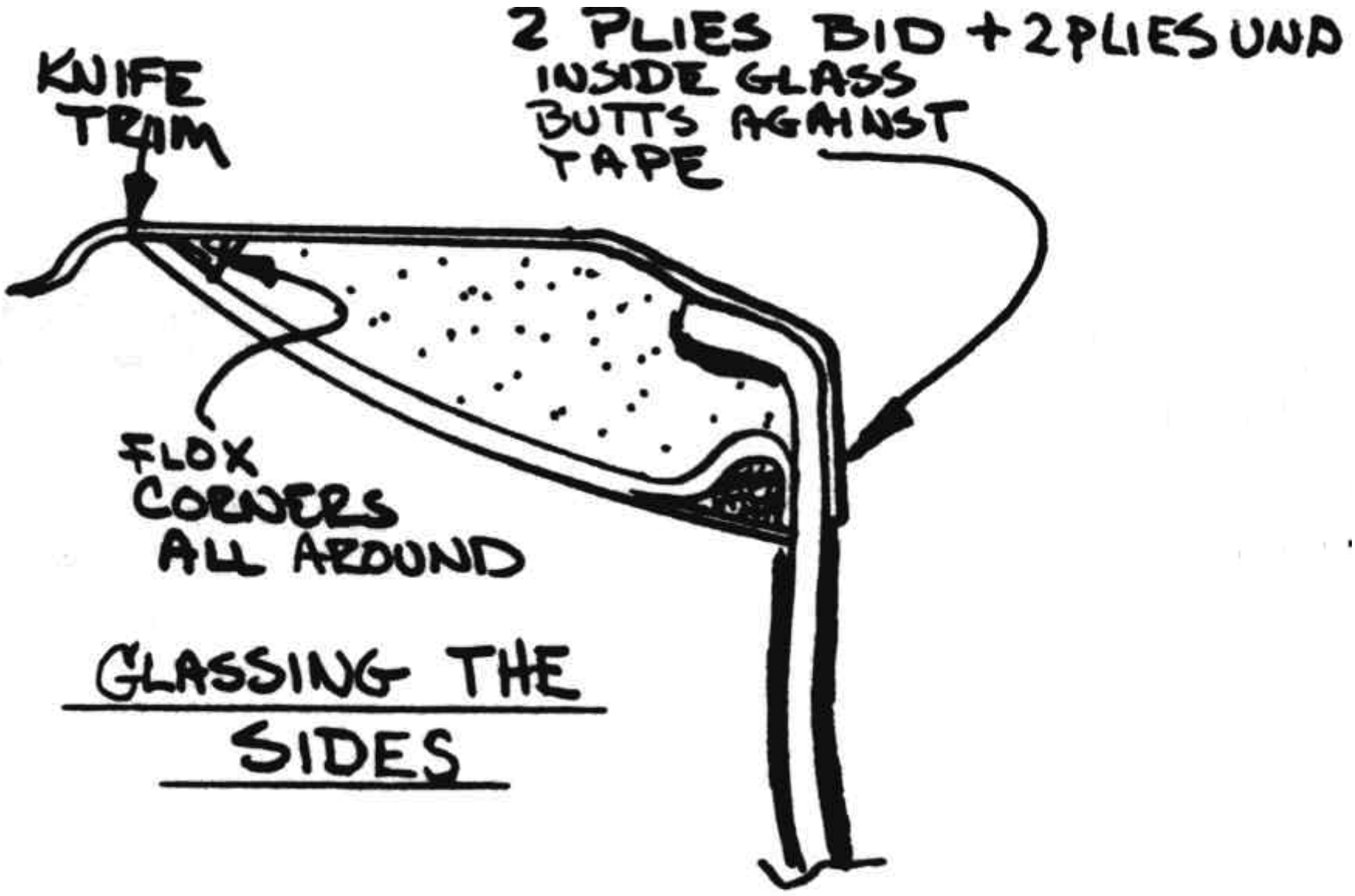

Figure 18-39: Glassing the sides

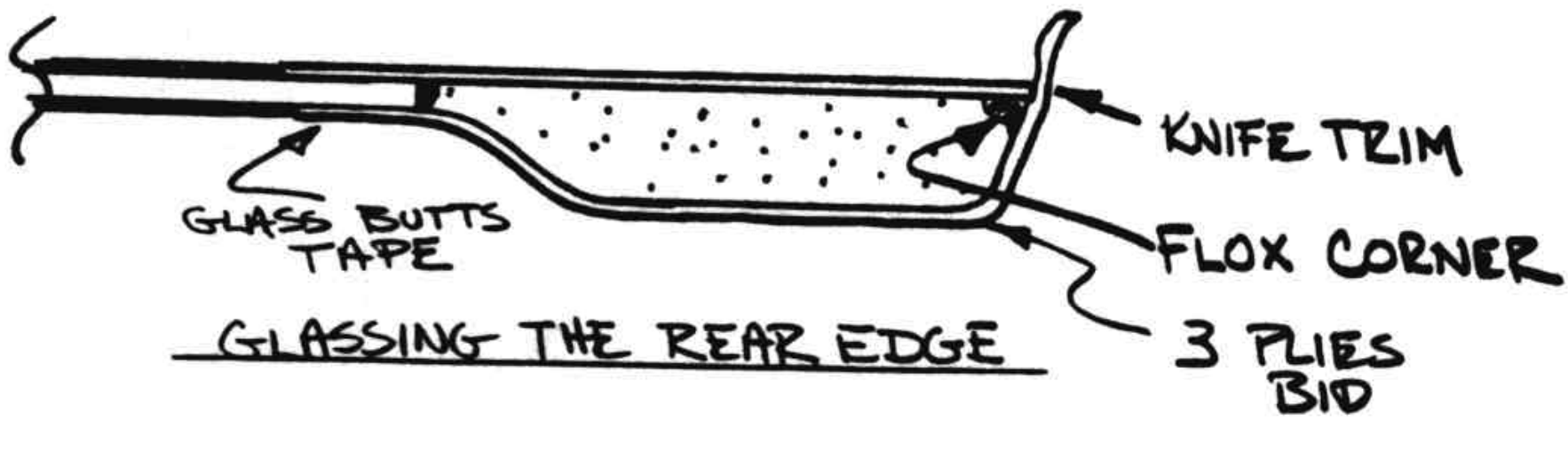

Figure 18-40: Glassing the inside of rear edge

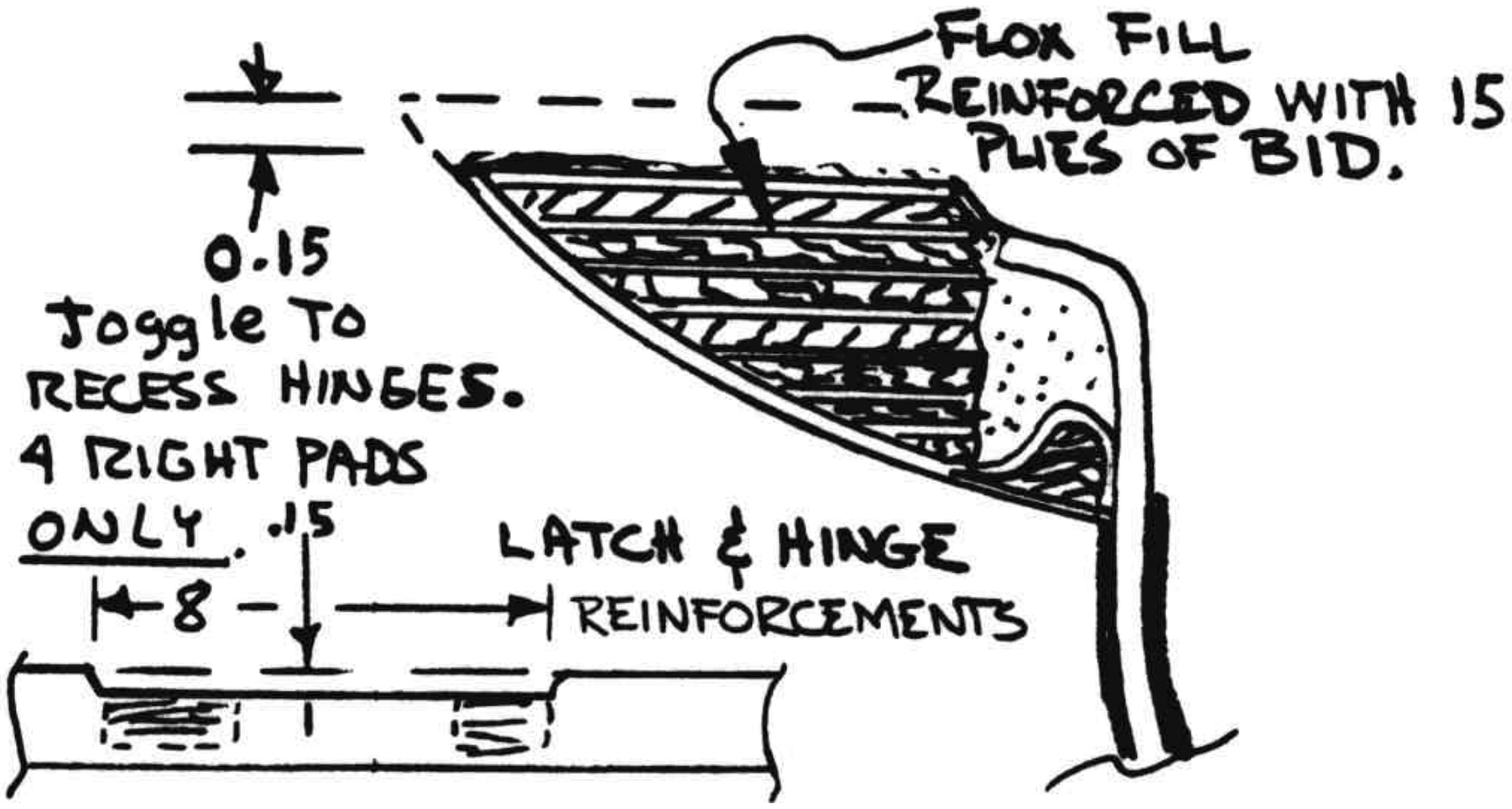

Figure 18-41: Glass the side and Latch and Hinge reinforcement

Figure 18-42: Sanding the reinforcements

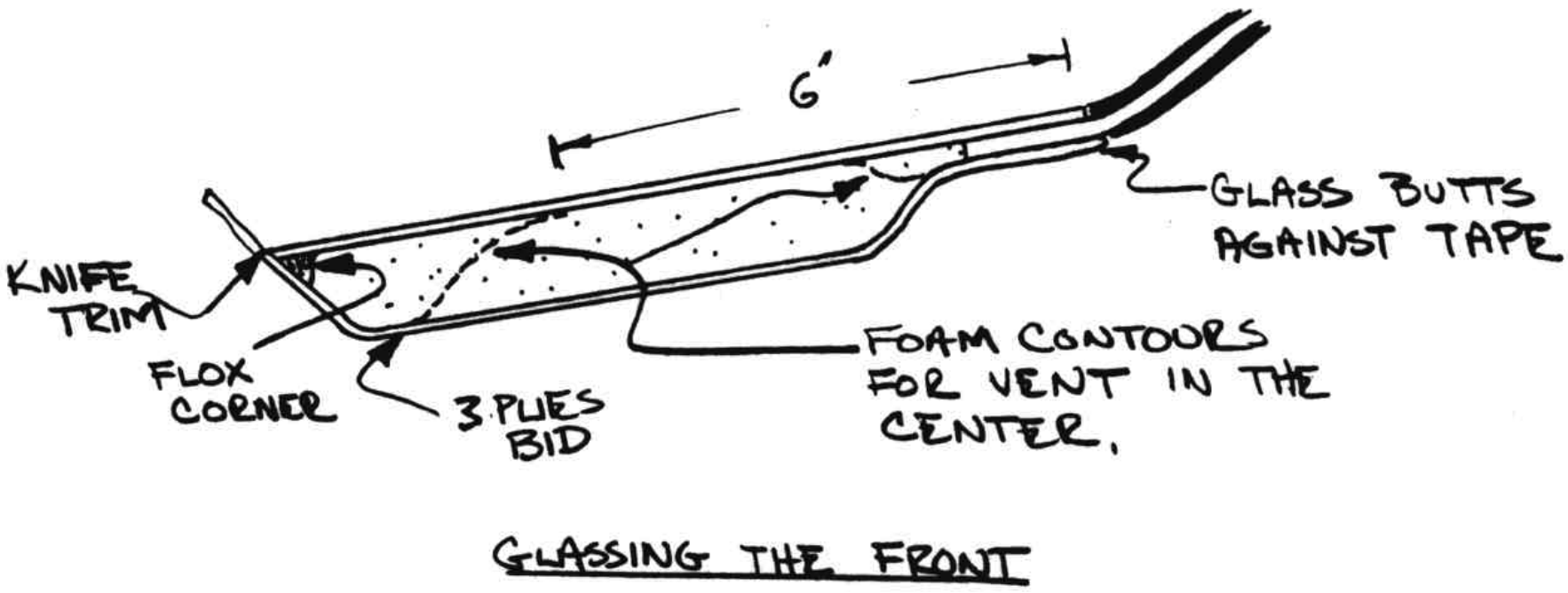

Figure 18-43: Glass the inside of the front

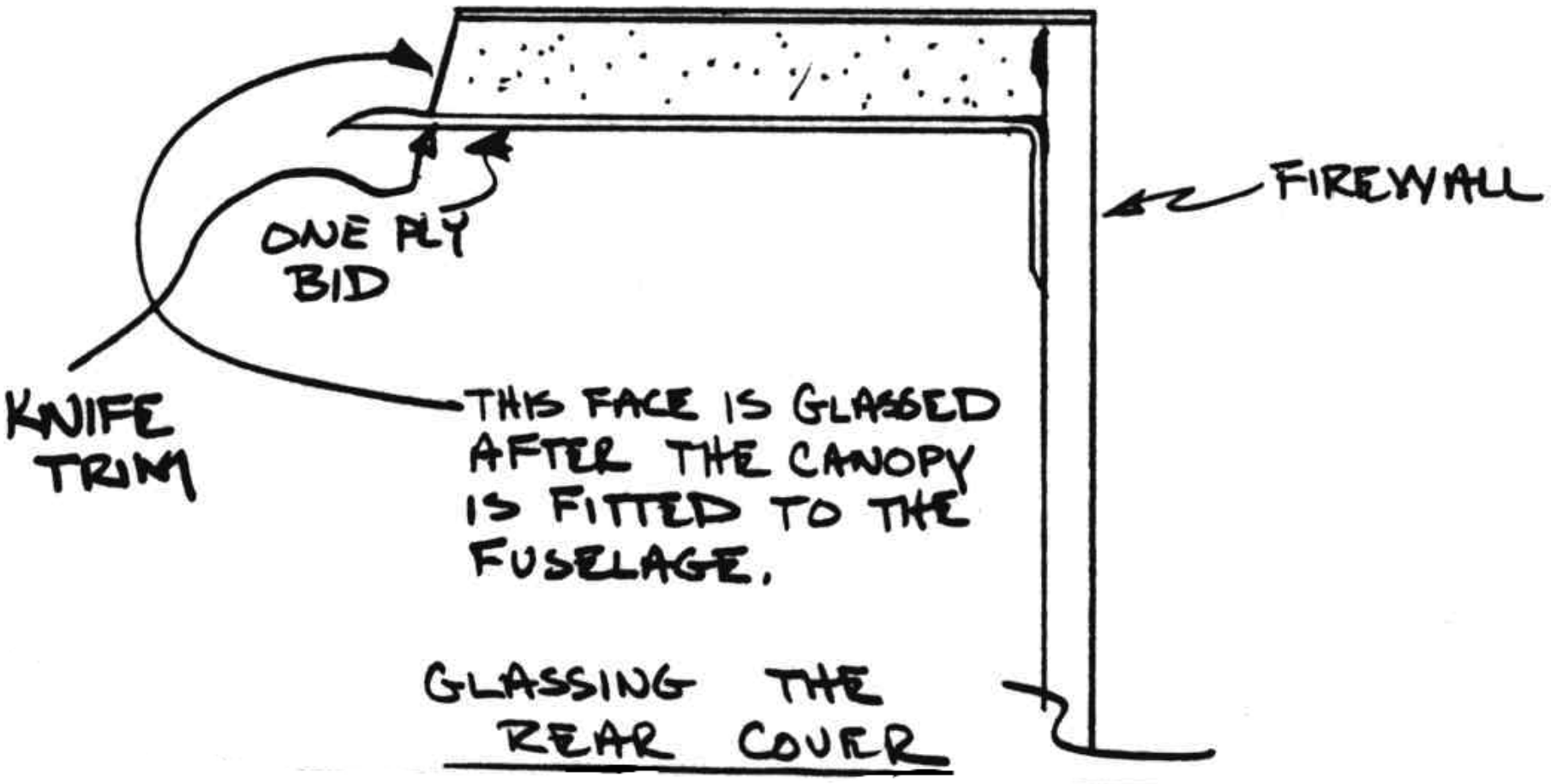

Figure 18-44: Glassing the rear cover

Step 9 - Installing the vent and cross bracing tubes

This step should take you two hours. Carve a green urethane block as shown. Glue it to the inside of the canopy frame as shown with a blob of 5MIN. Glass over the foam block with three plies BID. Lap onto the inside glass of the canopy an inch.

After cure, use the dremel to cut the skin along the pattern shown, and remove the foam. The result is a NACA flush scoop that provides excellent ventilation for both cockpits. The simplest valve for the vent is a plug, carved to fit tight (carve from dark blue PV). The plug stops all flow when fitted straight and allows partial flow when stuck in sideways.

Carve holes through the glass at the canopy frame side in six places, as shown, with your dremel. Cut three lengths of 5/16 OD fiberglass arrow shaft tubing to fit across the canopy. Sand the ends dull for bonding. Install the tubing with flox, filling the holes to flush. The two aft tubes support the aft head rest (see Ch. 26). When this is fully cured, you can knock the Bondo and boards off of the outside.

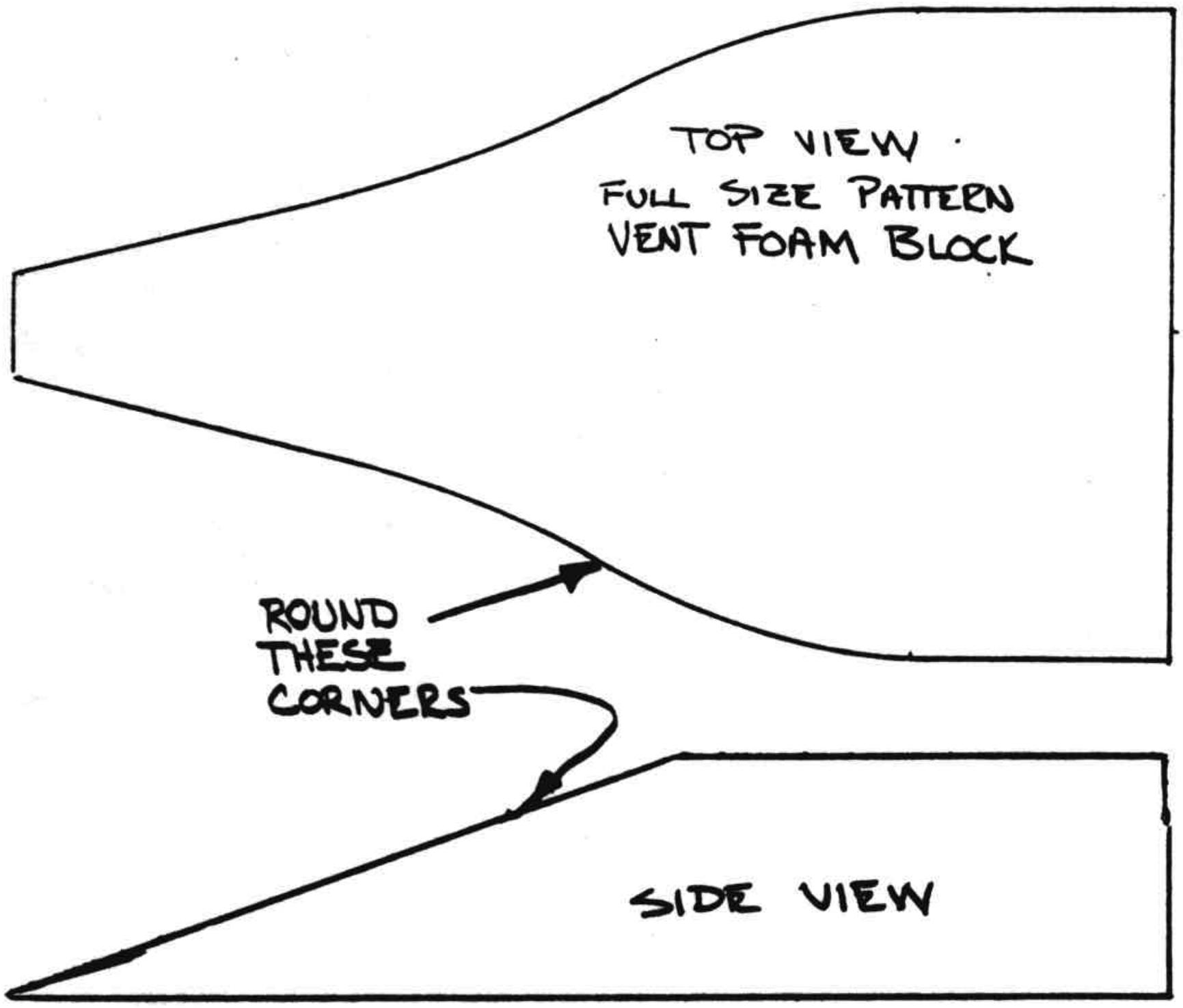

Figure 18-45: Full size pattern for vent foam block

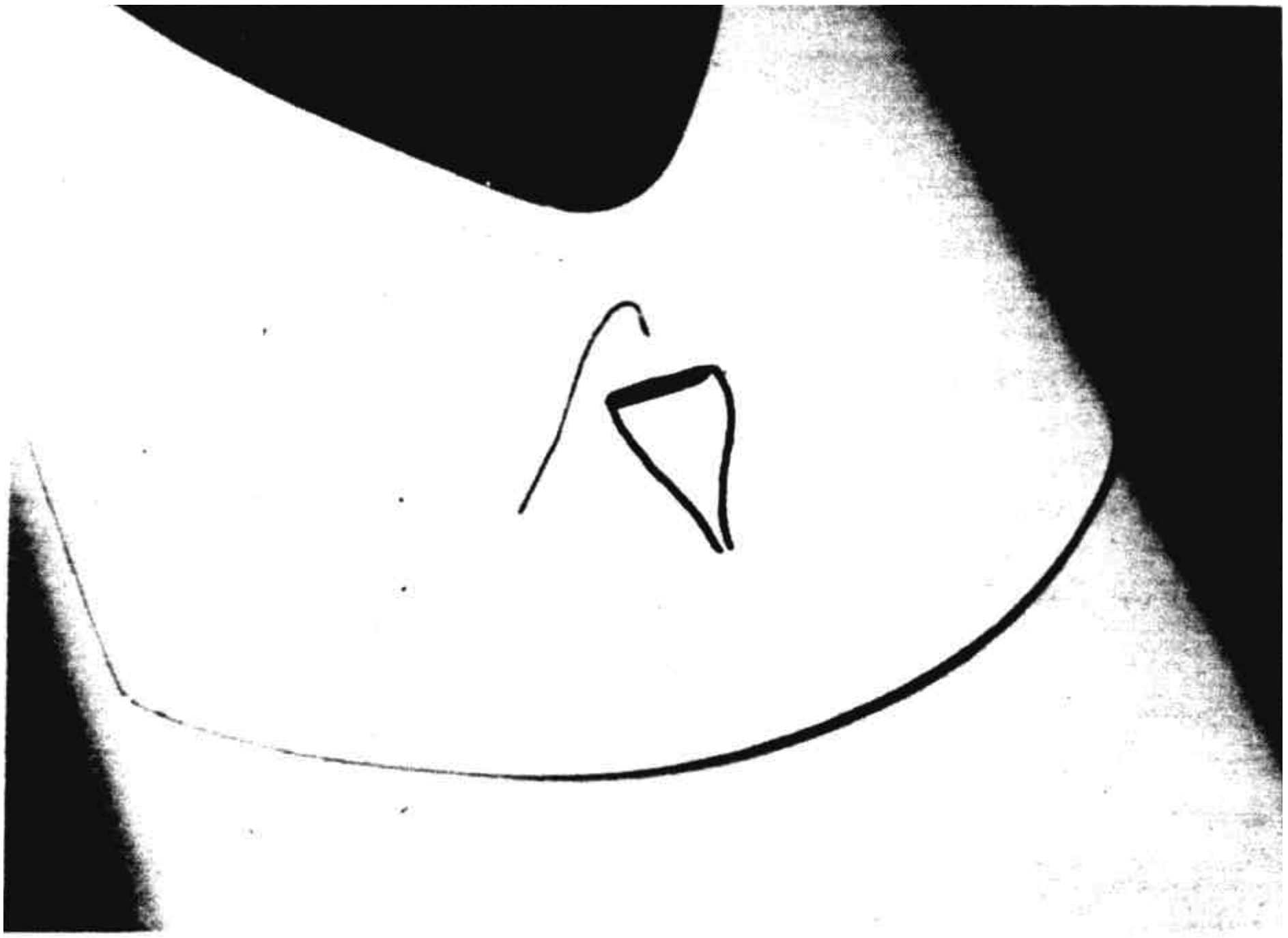

Figure 18-46: Photo of vent location

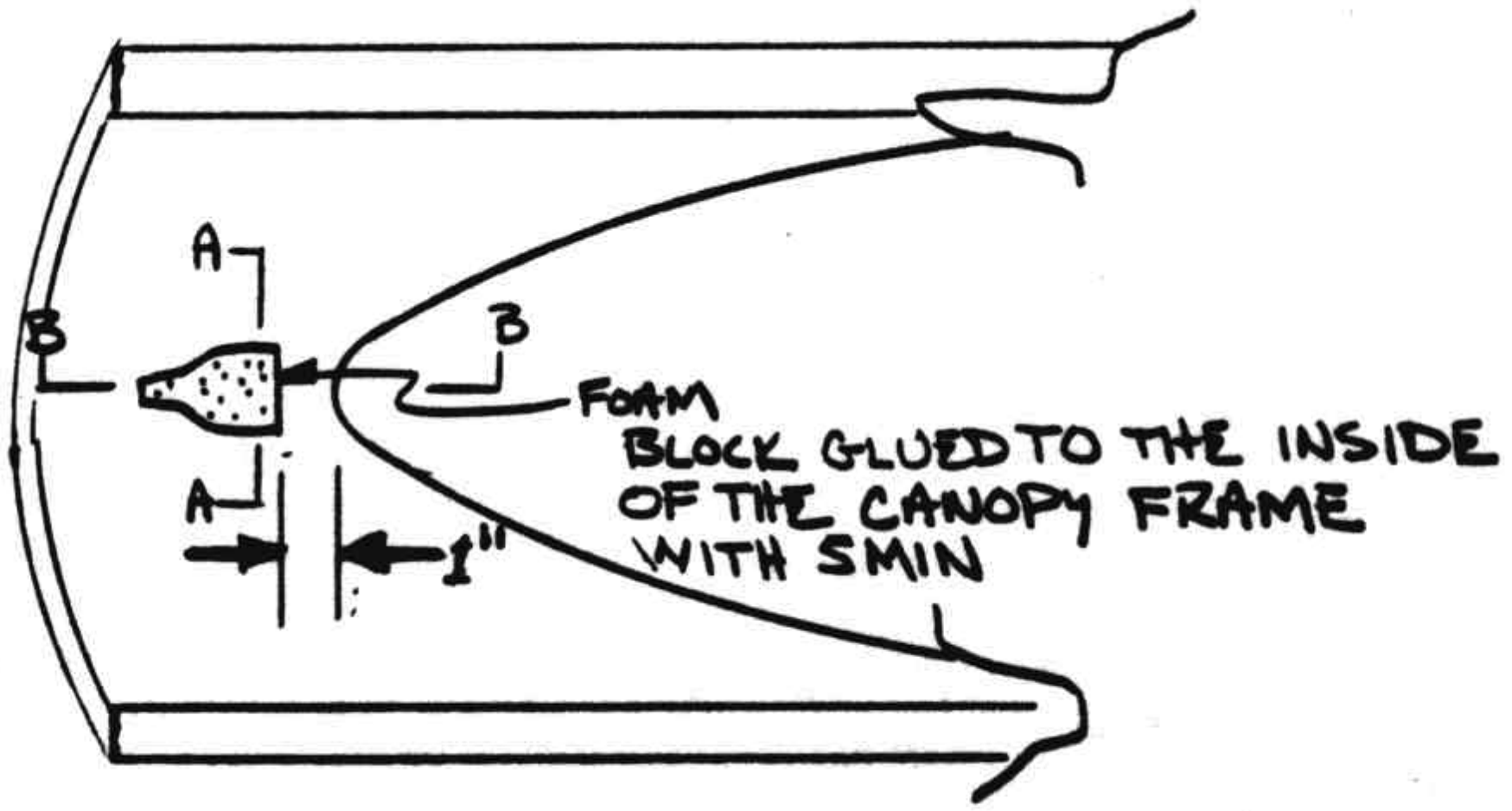

Figure 18-47: Vent foam block placement

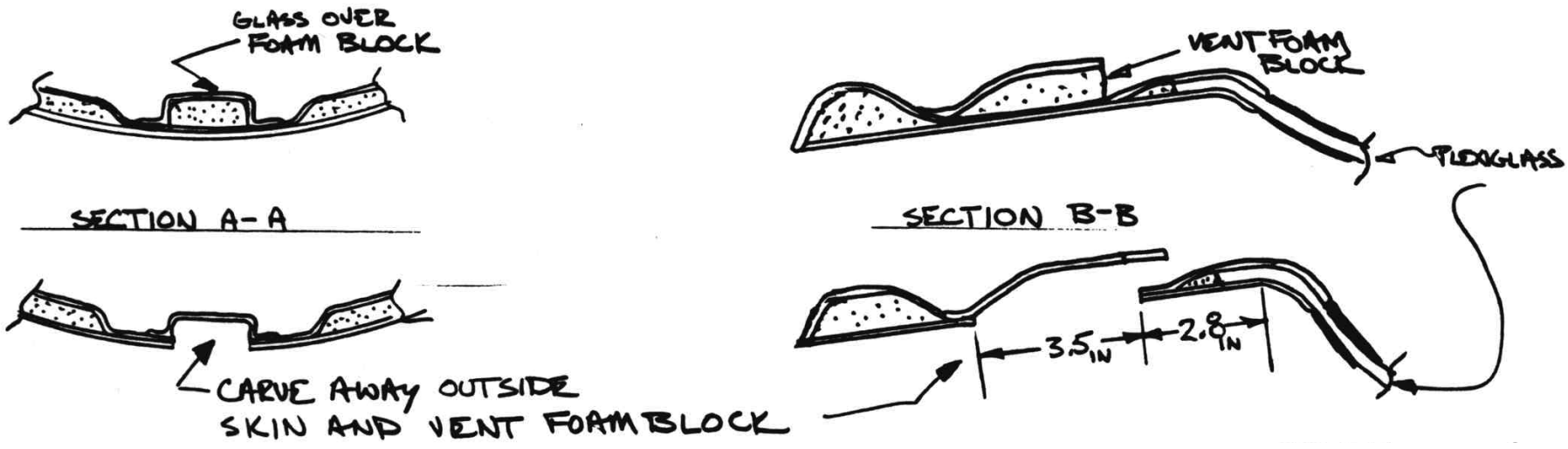

Figure 18-48: Vent passage construction

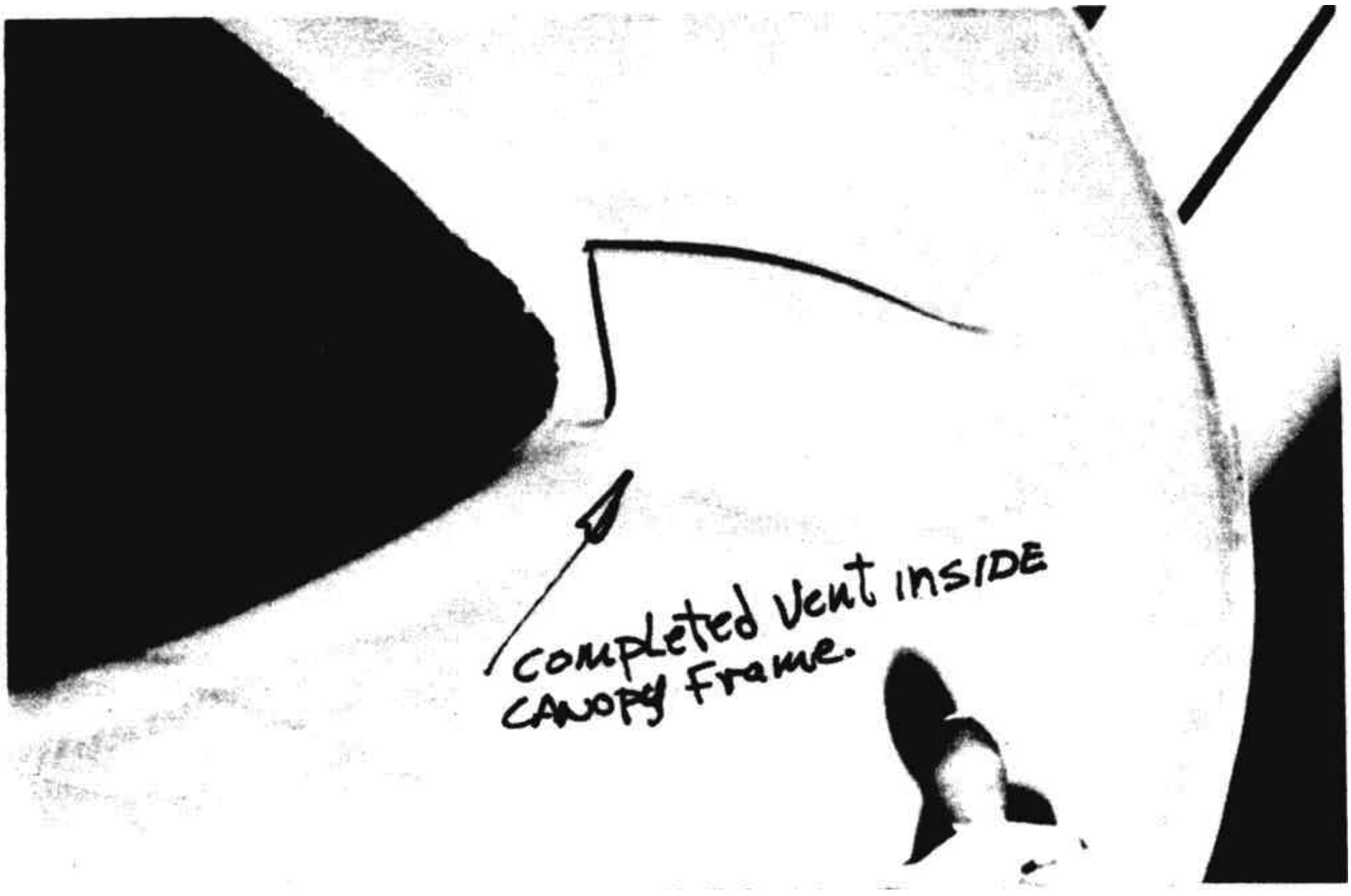

Figure 18-49: Photo of completed vent in canopy

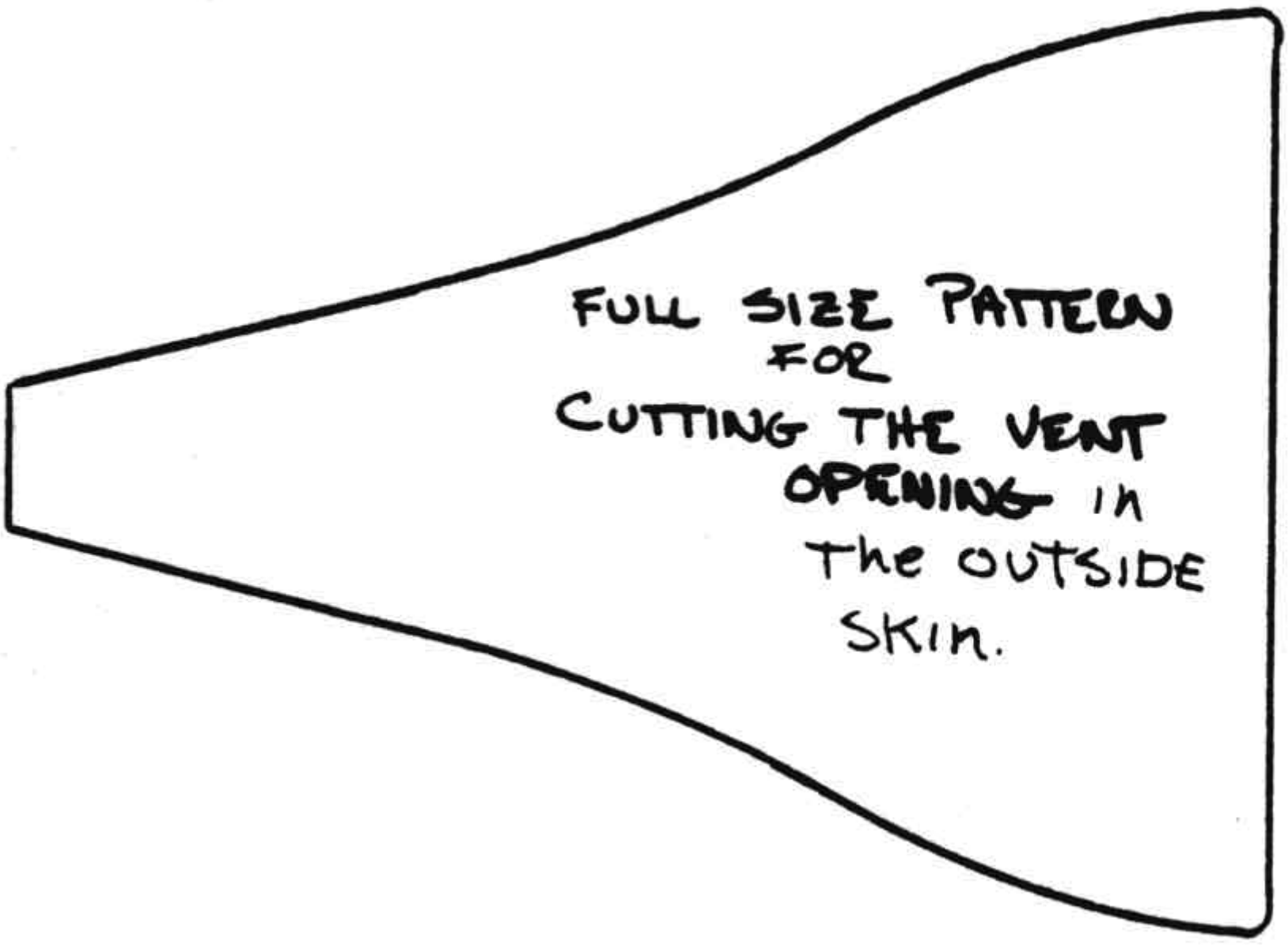

Figure 18-50: Full size vent opening

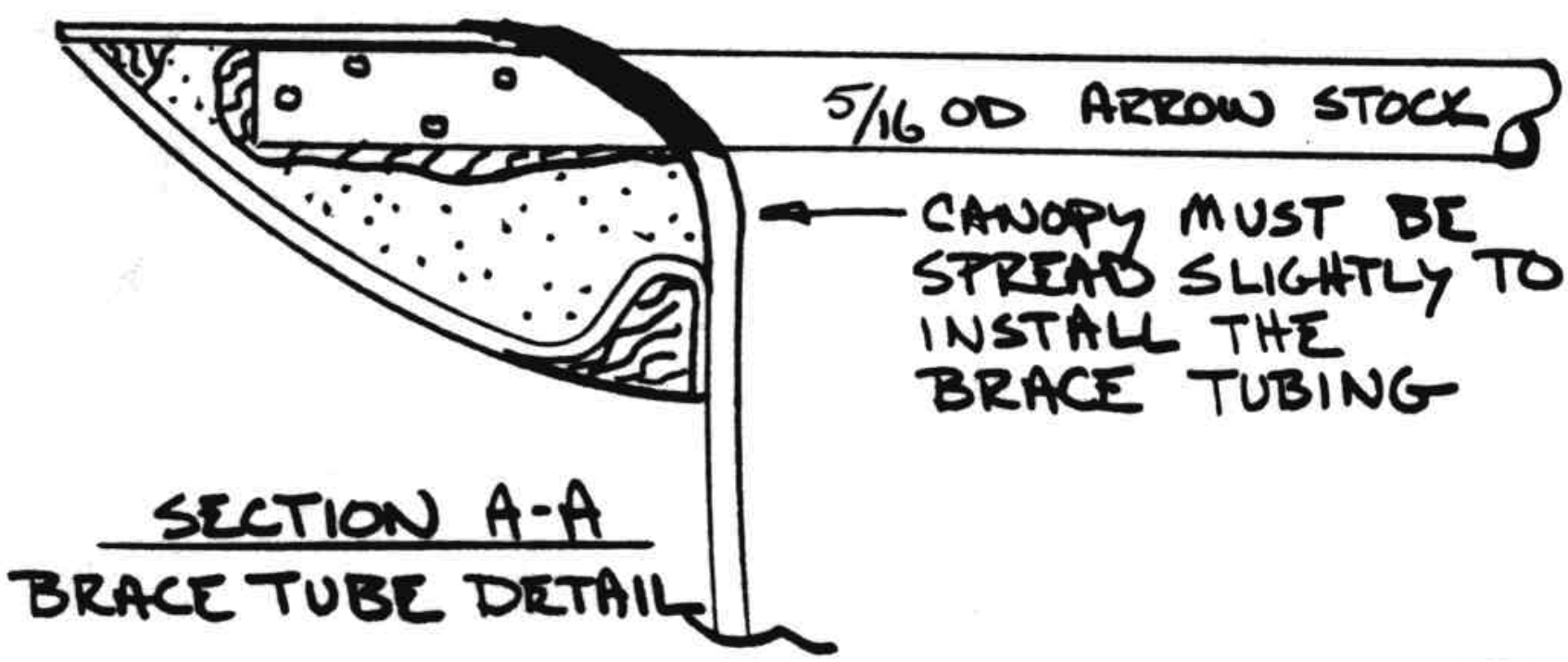

Figure 18-51: Install brace tube into canopy

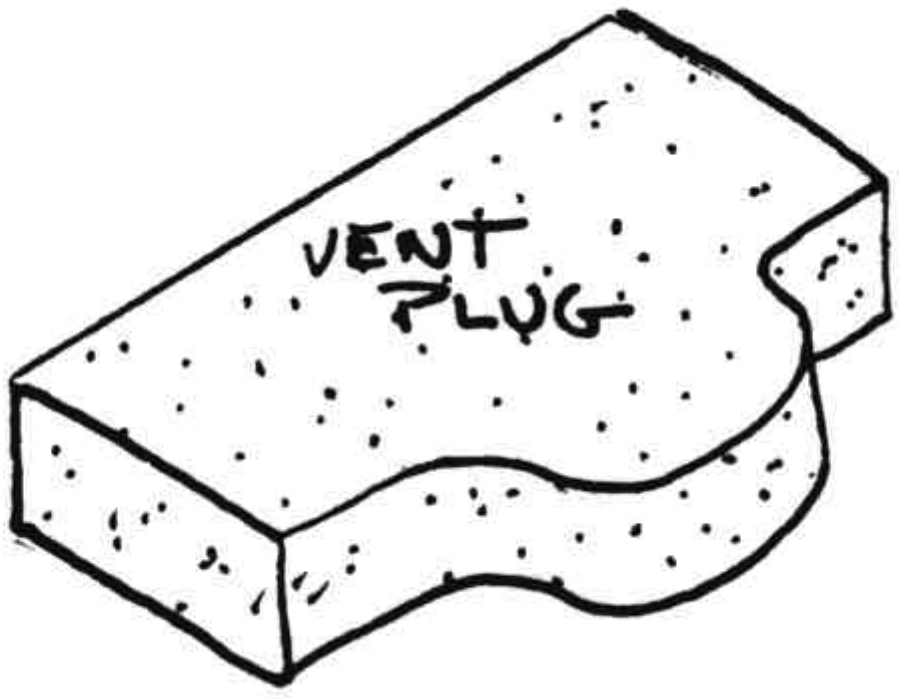

Figure 18-52: Vent plug foam

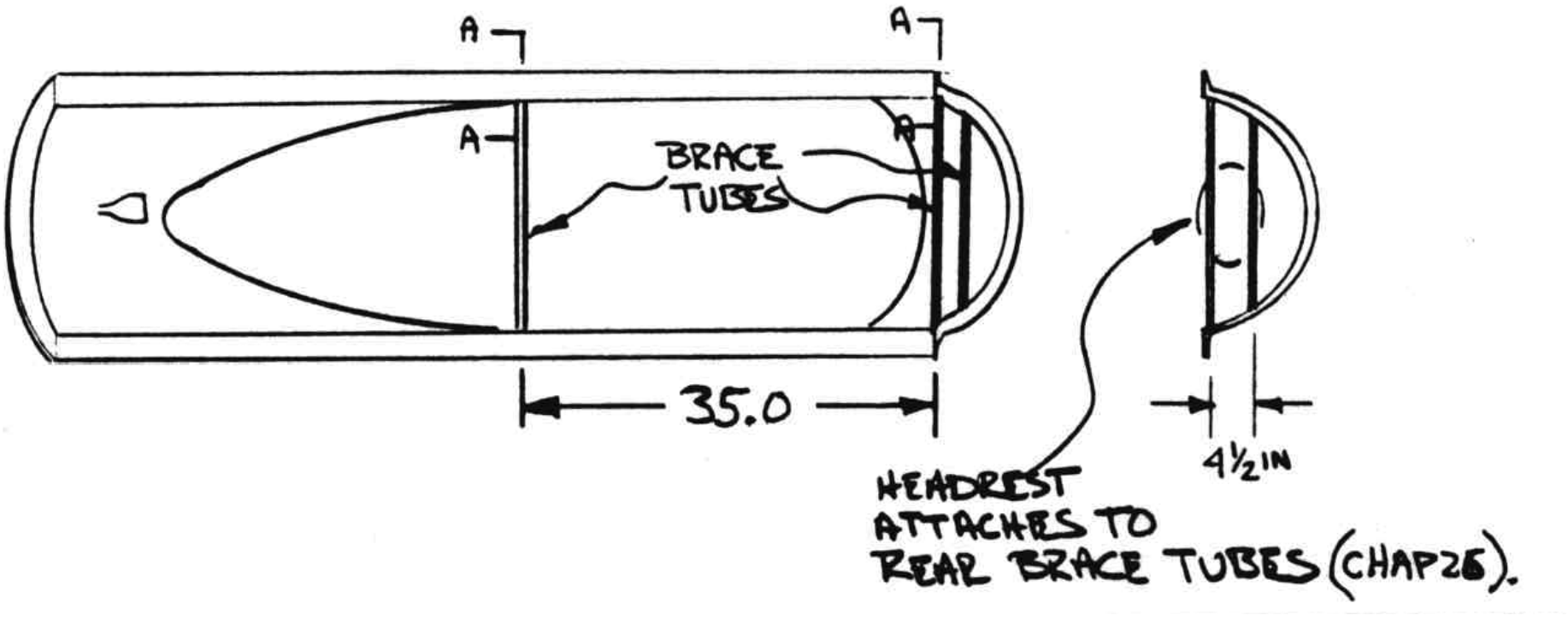

Figure 18-53: Brace tube placement on canopy

Step 10 - Installing the canopy hinges

This step should take an hour. Locate the canopy hinges (MS20001-P6) as shown, opposite the recesses, carved during step 8. Drill four #10 holes vertically through the longerons in each hinge. Countersink (100º) the hinges for AN509-19R-30 screws and install as shown.

Now with the hinges bolted in place on the fuselage, put a blob of Bondo (or 5MIN) on the canopy side of the hinge, locate the canopy on the fuselage and let the Bondo harden. Flip the canopy open and drill through the hinge, as shown, with a #12 drill bit in eight places. Be sure these holes go through the reinforcement pads of the canopy (two holes per pad). Counter-bore the top of the frame for an MS21042-3 nut to sit below contour. Install as shown. Don't be upset if you can't get the canopy to fit perfectly. The frame or fuselage can be filled with dry micro and sanded to fair in.

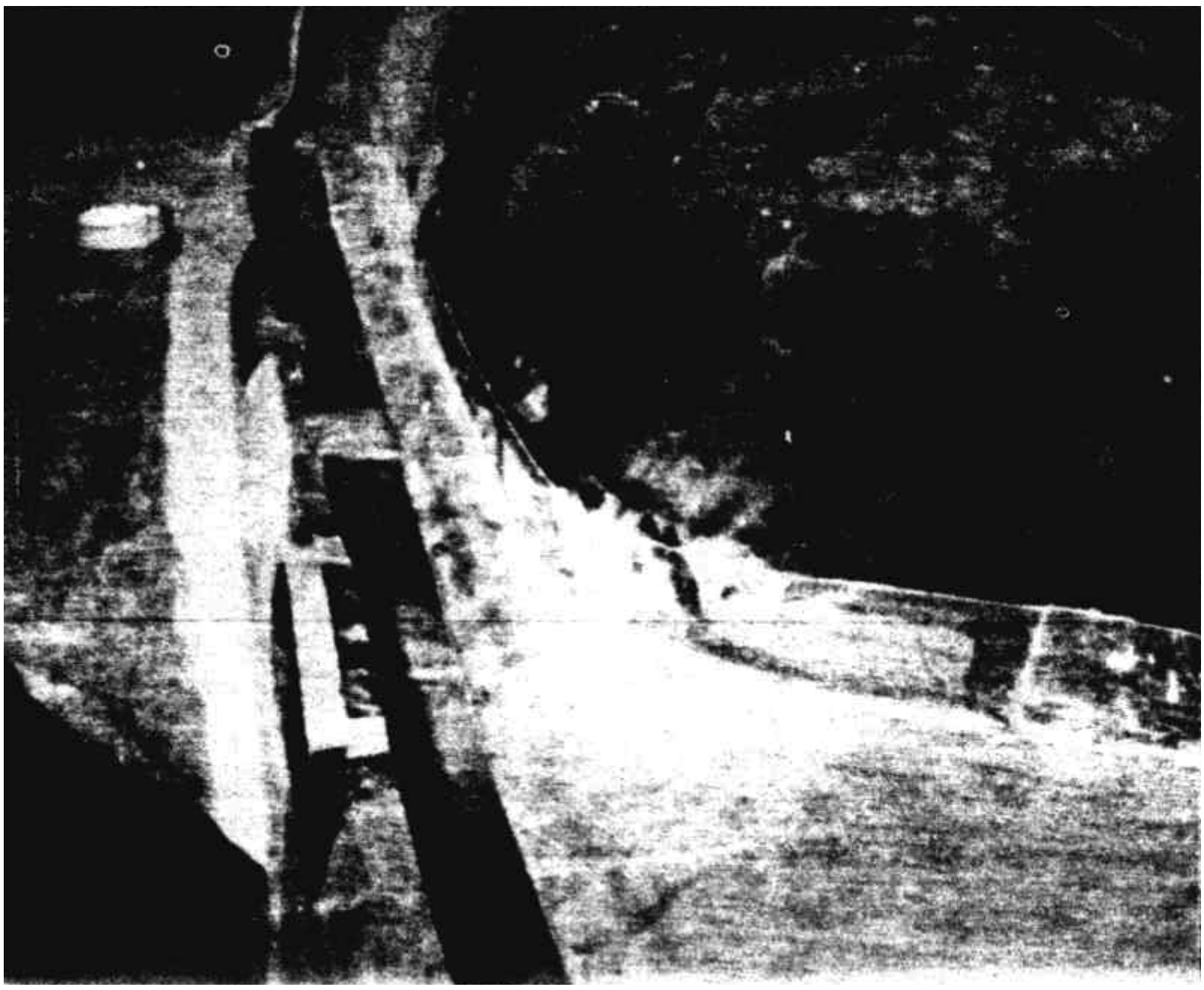

Figure 18-54:Right side of fuselage

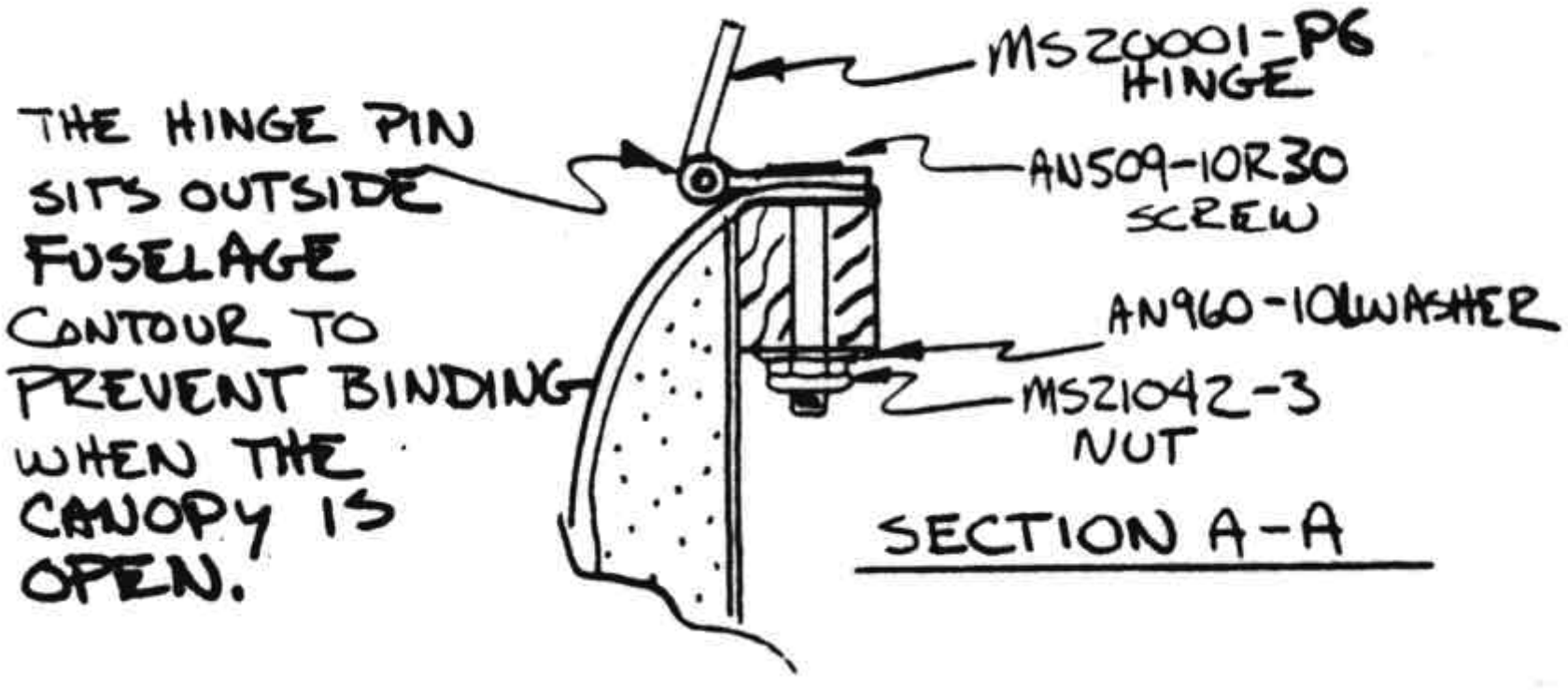

Figure 18-55: Hinge placement on side of fuselage

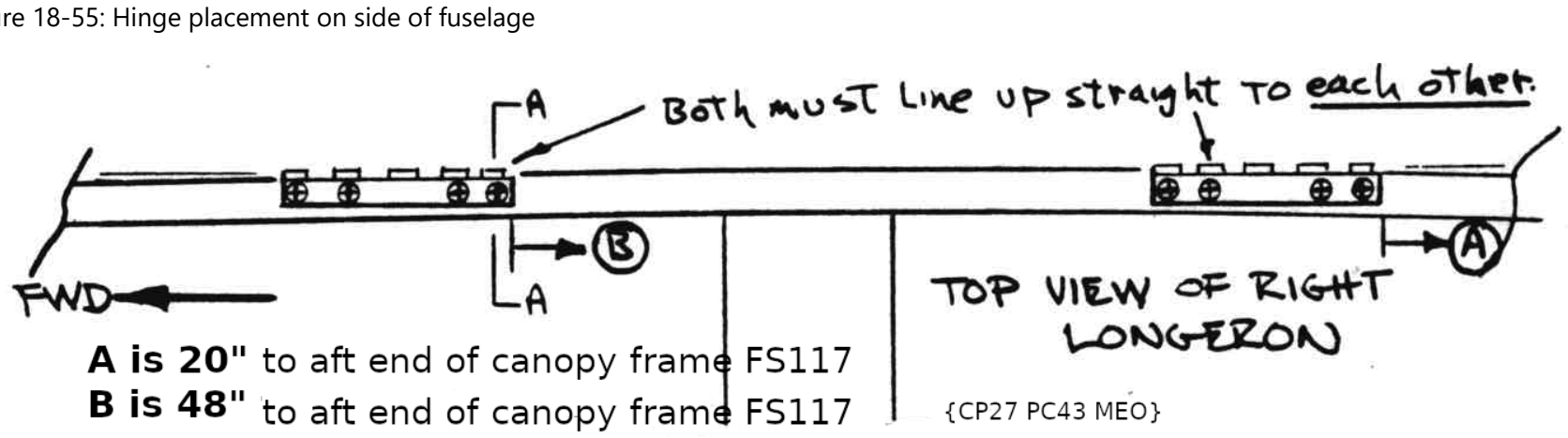

Figure 18-56: Hinge mount section A-A

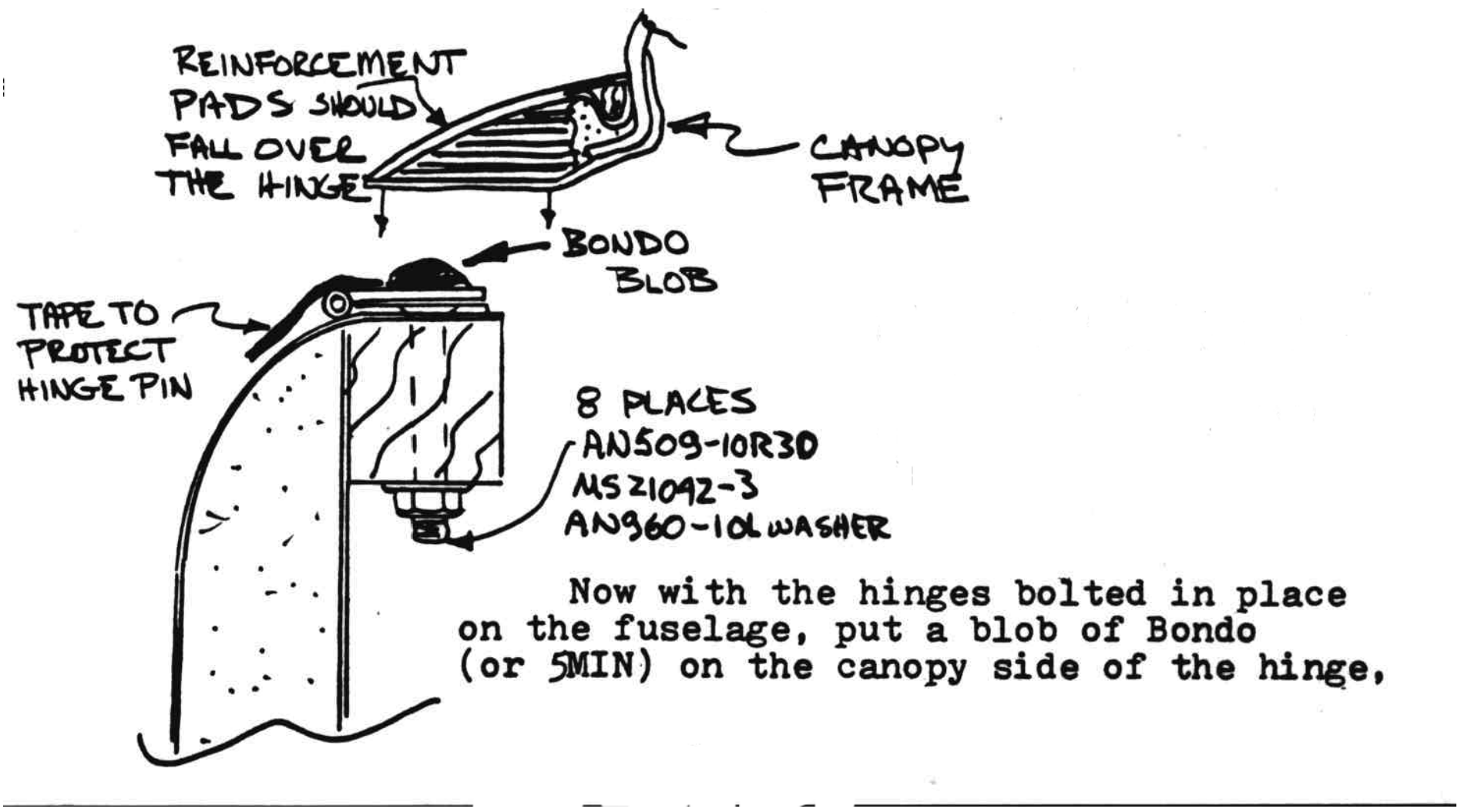

Figure 18-57: Bondo hinge to canopy

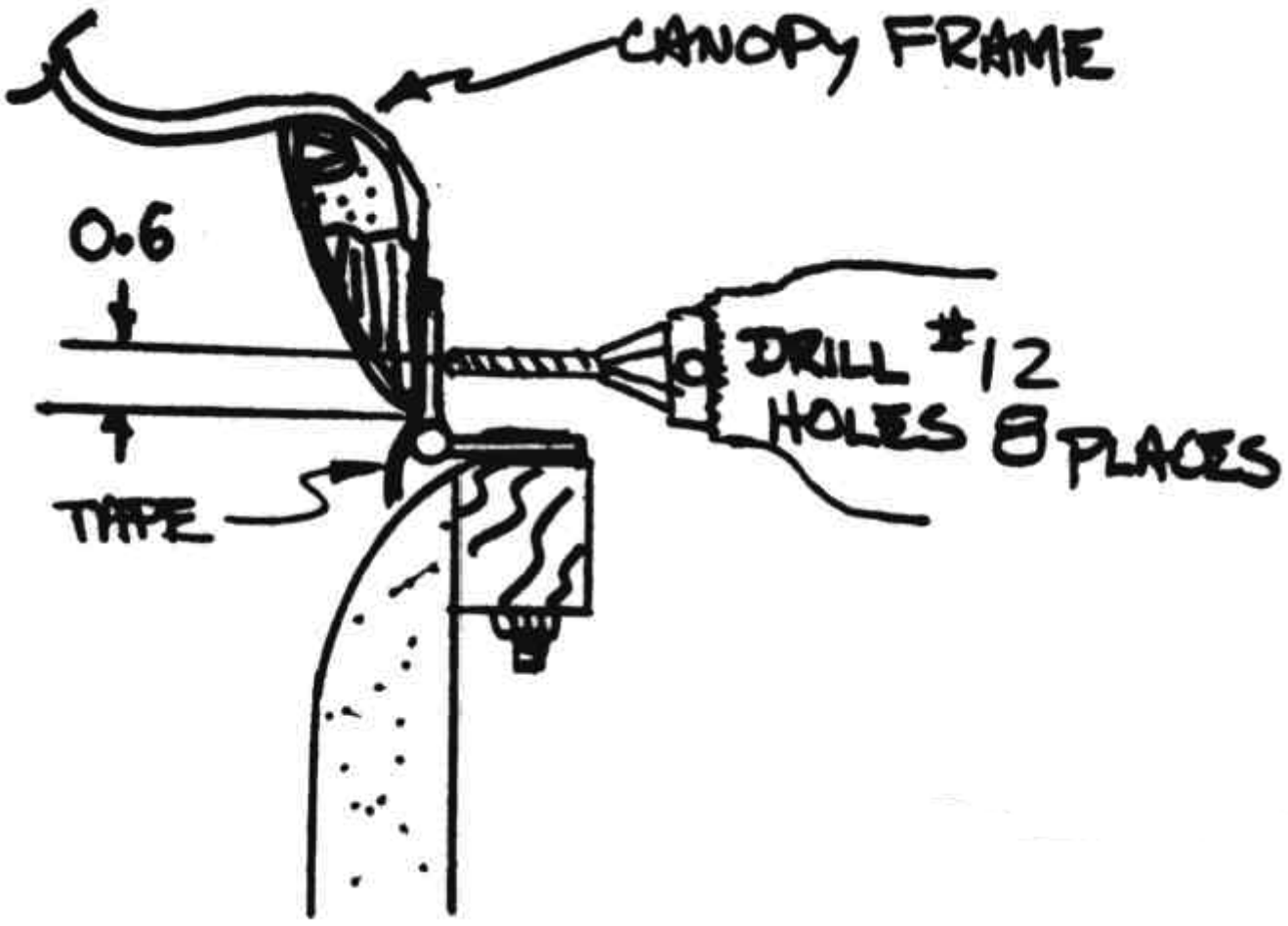

Figure 18-58: Drill canopy side hinge

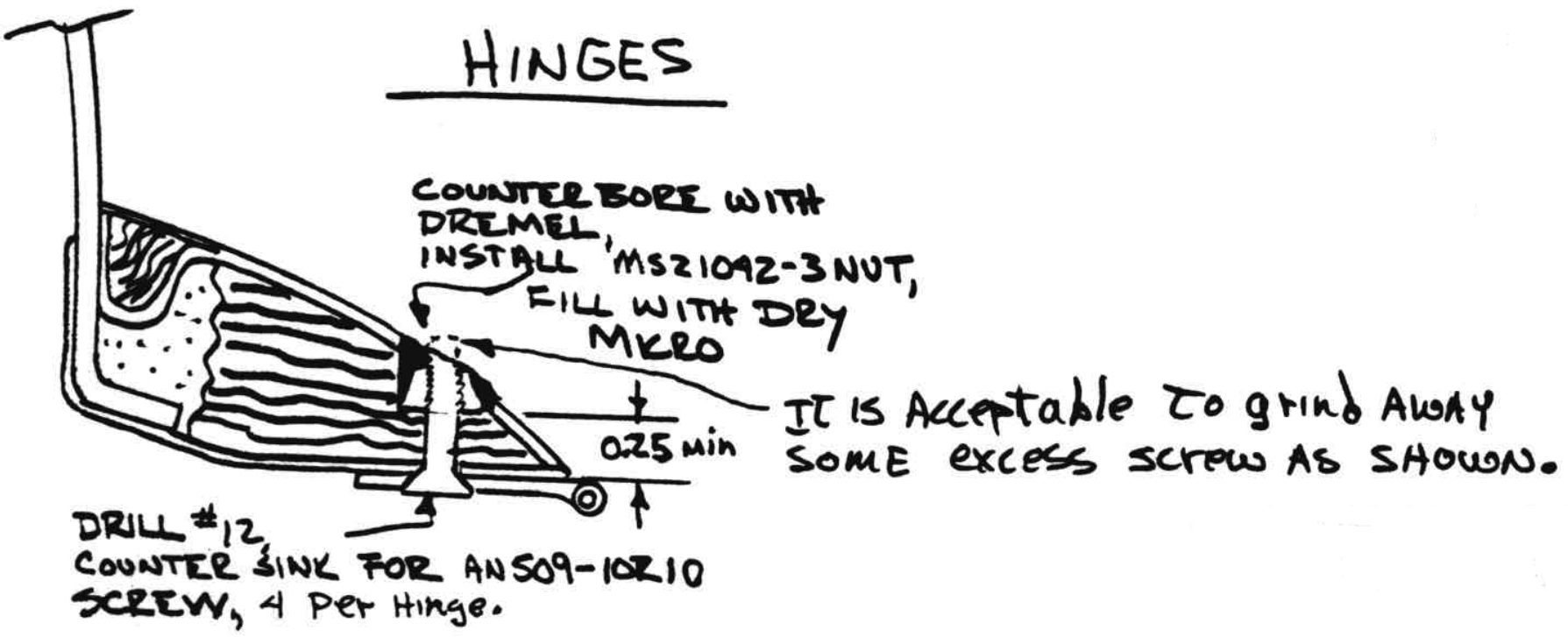

Figure 18-59: Bolt canopy hinge to canopy

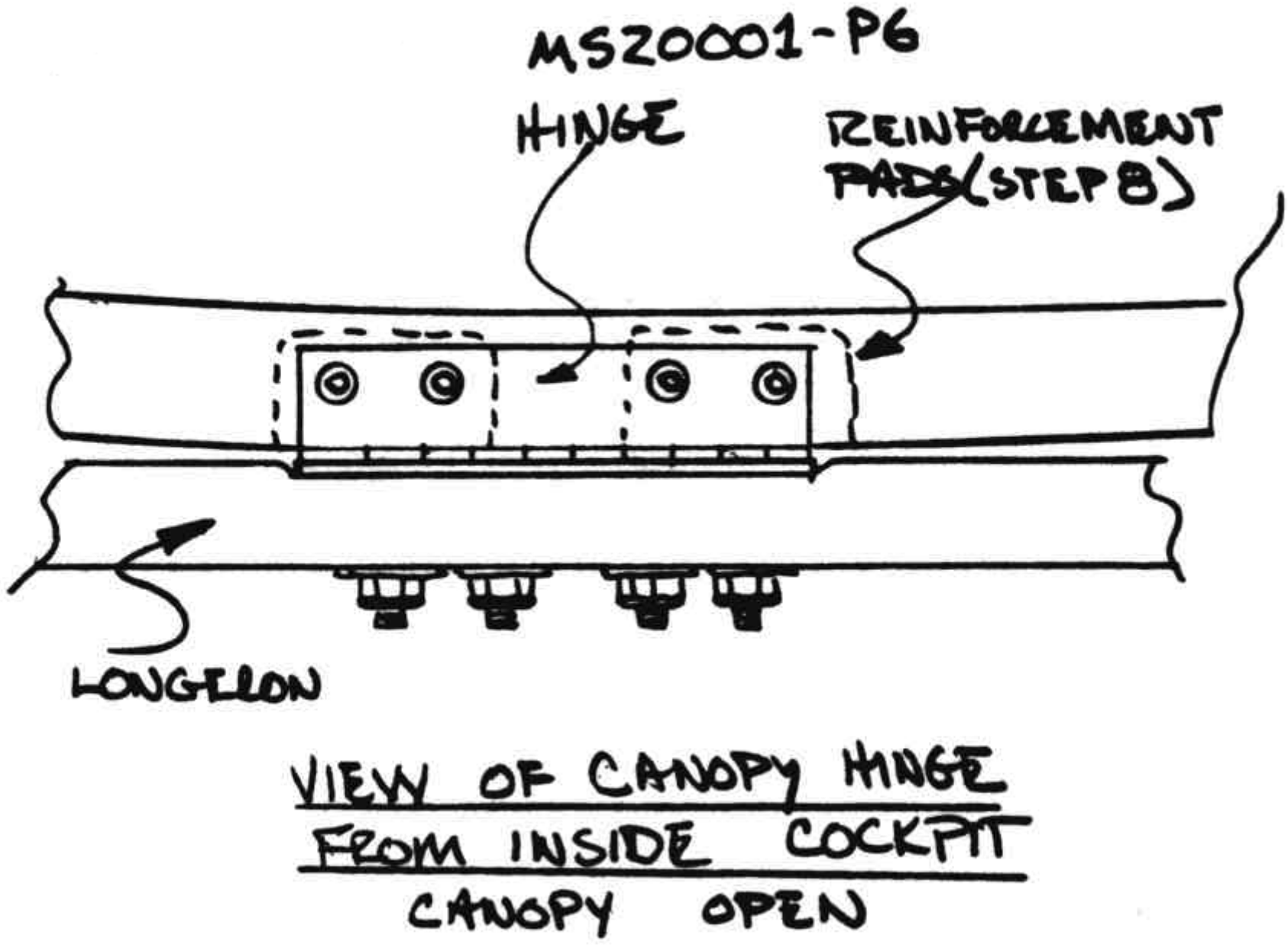

Figure 18-60: View of canopy hinge from inside

Step 11 - Installing the canopy latches

This step should take from one to four hours, depending on how well everything fits! Refer to the full-size drawing on 18-9 and 18-10 for the details of the canopy latch locations and hardware. Make all of the metal parts shown, and install the three pivot bolts, C1L and C2 arms, and pushrods (C3, C4, C5, and C6) on the longerons. With these items installed, take your C7 and C8 extrusions and a batch of Bondo, climb into the cockpit, close the canopy, and (one at a time) position the C7 and C8's on the canopy frame to match the pivots and arms. Hold the C7 and C8's in position while the Bondo hardens, then open the canopy gently and drill in as shown. Install all latches with AN525-10R12 screws (install wet with flox, wipe excess). File away the exposed threads on the front screw of each latch to avoid interference with the C2/C1 arms.

Adjust C4 so that all three latches seat evenly. For a good seal, contact cement a thin, **soft**,foam rubber strip to the canopy frame where it mates the fuselage. Adjust the lock plates (C9) slotted holes, so the canopy closes **snugly** when the handle is pulled **firmly** forward and into the C9 holes.

CAUTION: Good workmanship and fit up of the canopy latches is important for flight safety. Poor canopy retention on your airplane can ruin your whole day.

The C9 plate and bolt head on C1-L engage in such a fashion that you have to move C1-L. forward **and** pull it inboard to unlock the canopy. This prevents it from being bumped open inadvertently. To keep your canopy from banging on the fuel tank when open and to provide some shock absorbsion if a strong wind gust blows the canopy open, a cable retainer with a shock cord is mounted as shown. This can be made from a motorcycle or bicycle-type bungee strap.

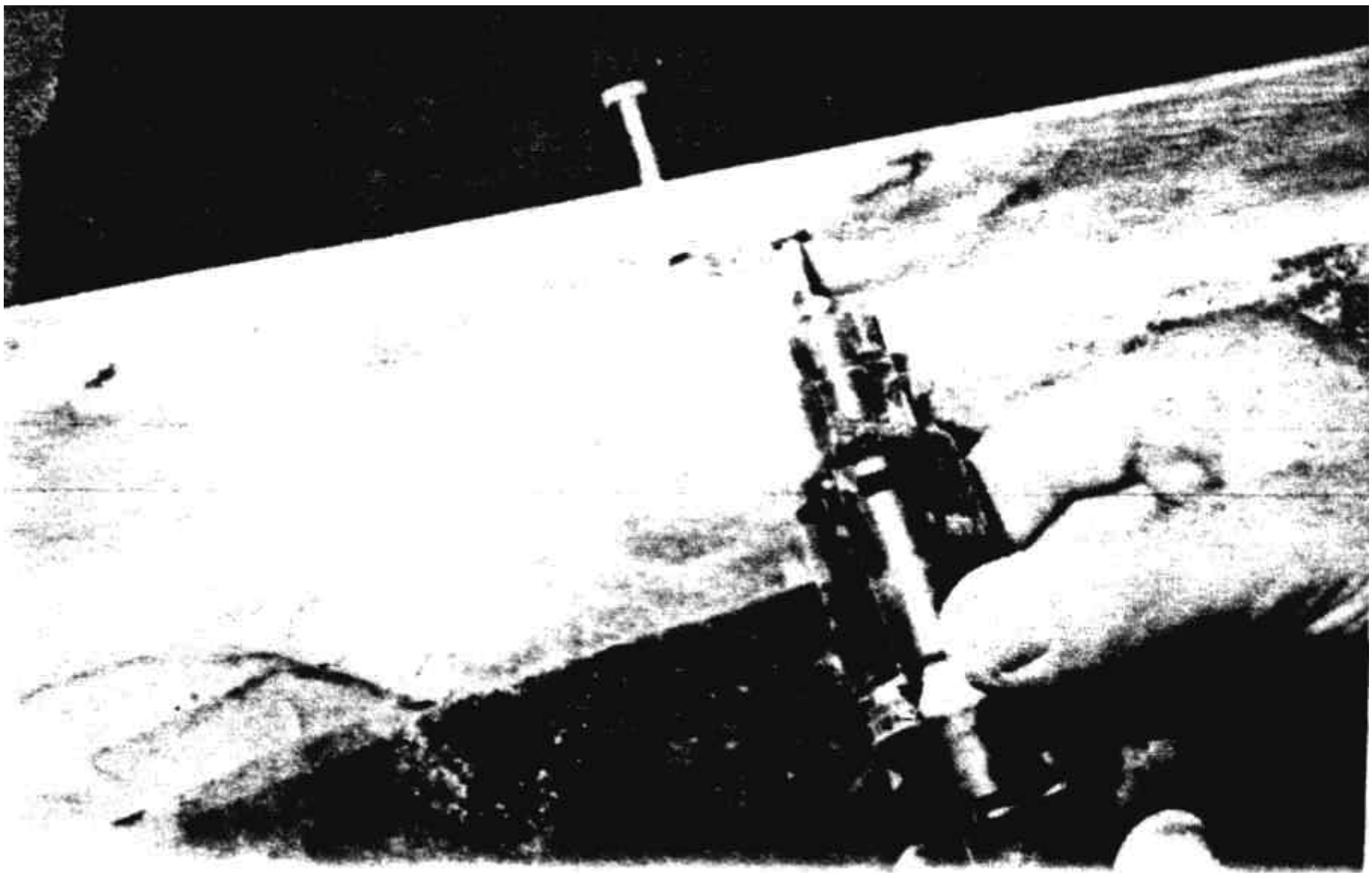

Figure 18-61: Counter bore for AN-525

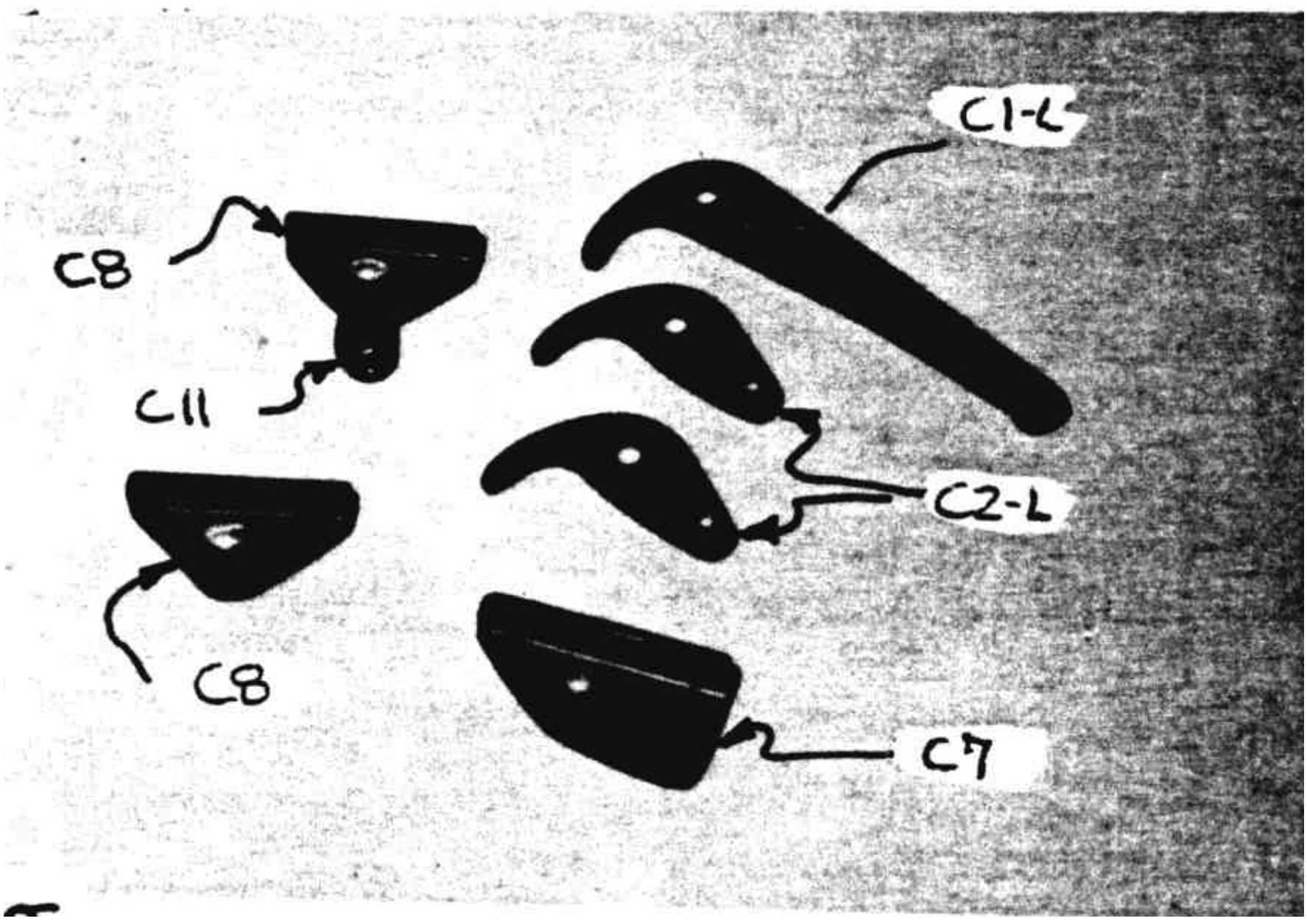

Figure 18-62: Canopy latch parts

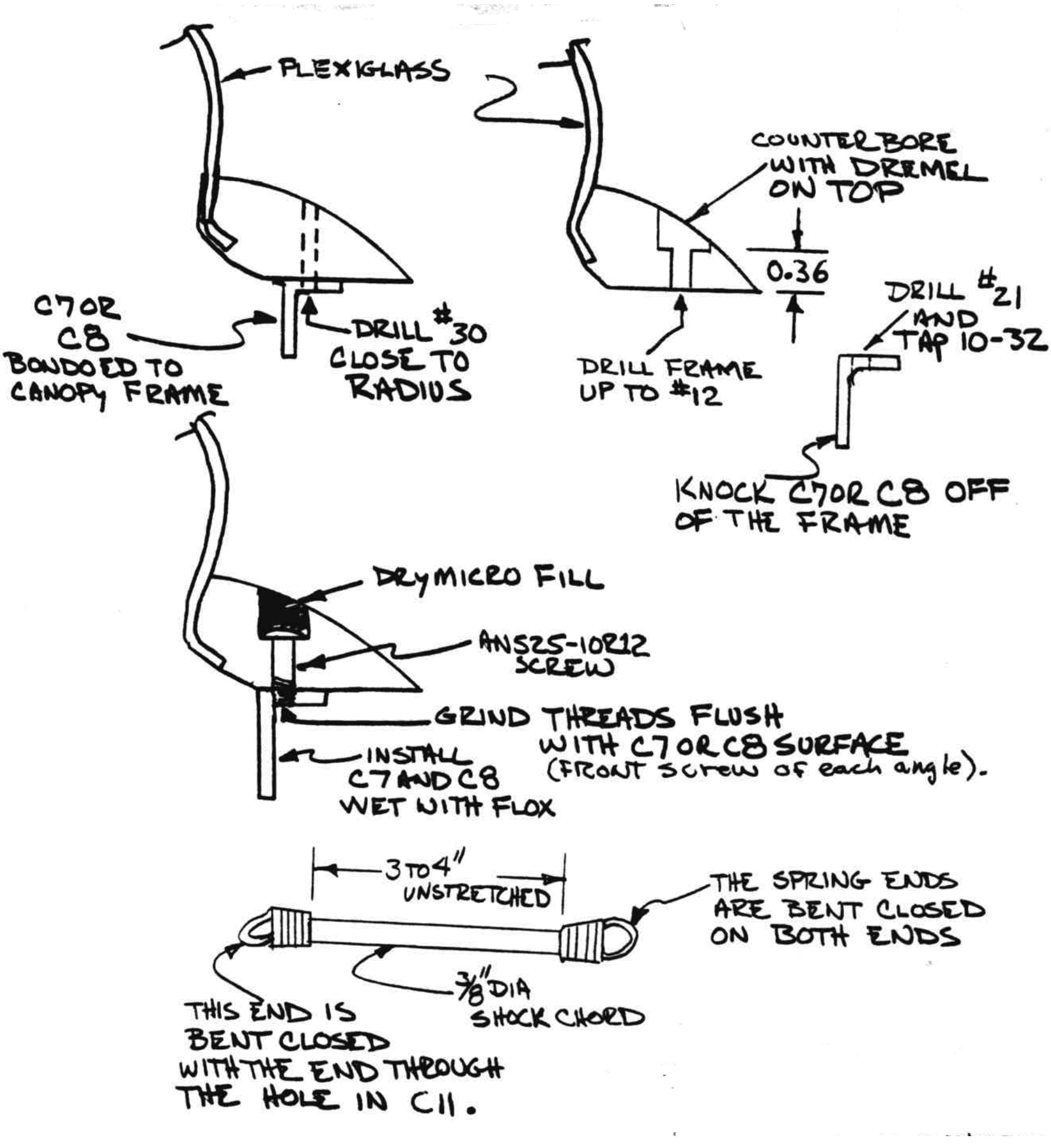

Figure 18-63: Mount C7 and C8

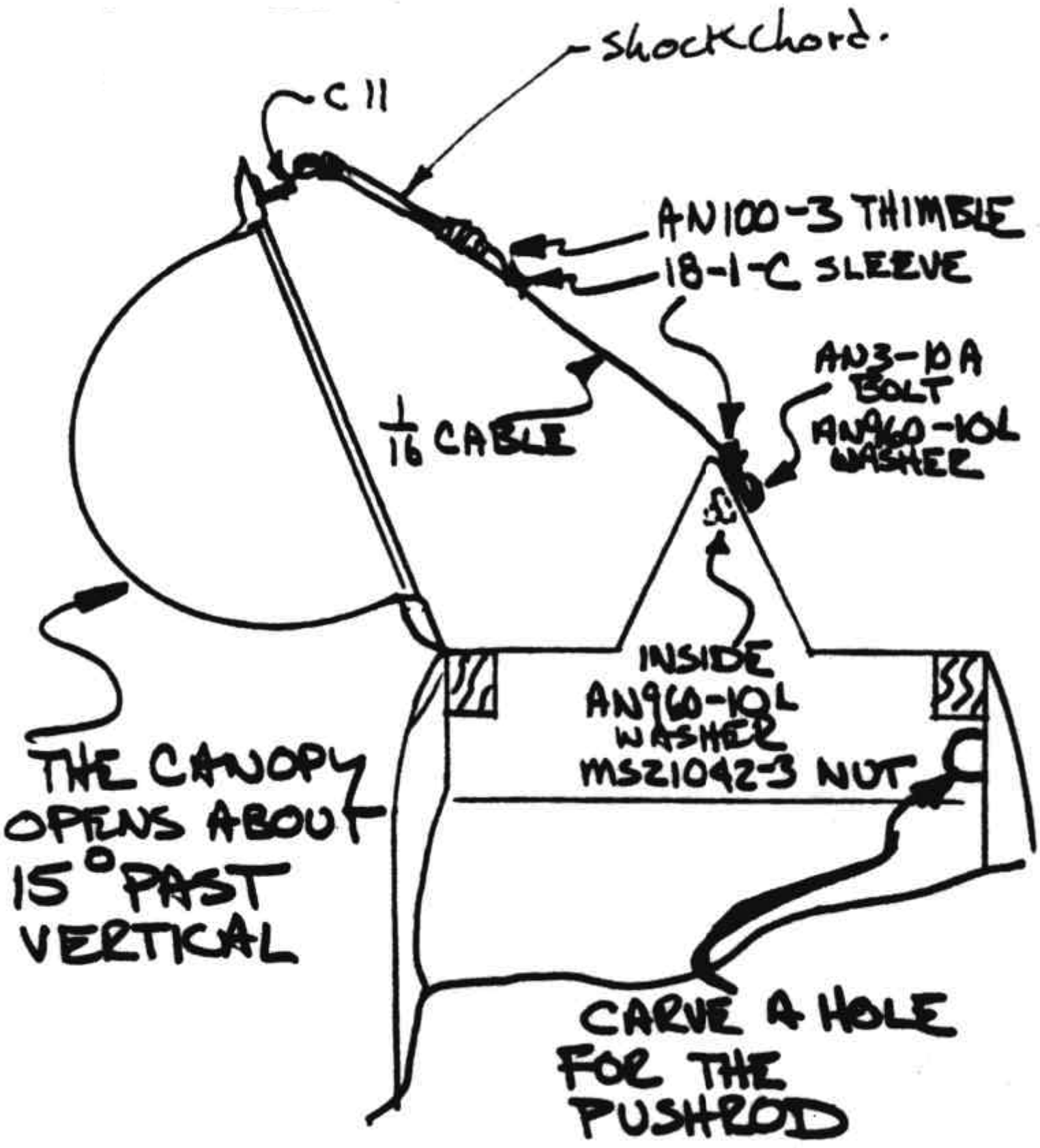

Figure 18-64: Install shock cord to canopy

Step 12 - Glassing and installing the front top fuselage cover

This step should take about two hours. The front cover is the hunk of glass and foam, forward of the canopy that was left in place on the fuselage, way back in step 6. Pop the forward cover free of the front bulkhead and longerons. Remove the tape and take the cover to your work bench. Contour the inside foam surface so that the foam is about 1/2" thick.

Glass the inside foam surfaces with one ply BID, allow to cure an hour or two, then flip the cover over and install on the fuselage with flox. Layup a BID tape over the outside as shown, to join the outside skin to the fuselage skin, and to F28.

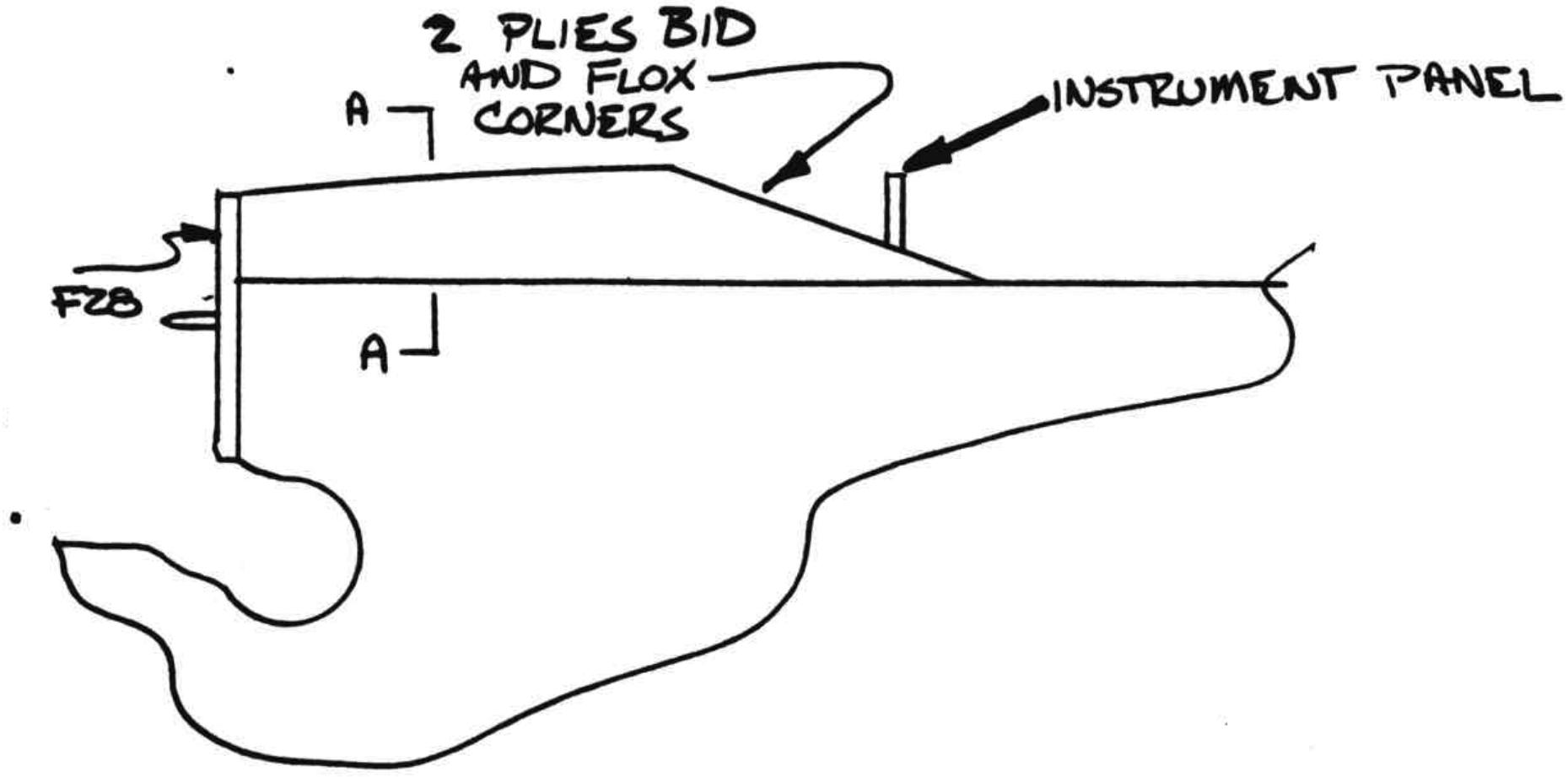

Figure 18-65: Side view front top fuselage cover

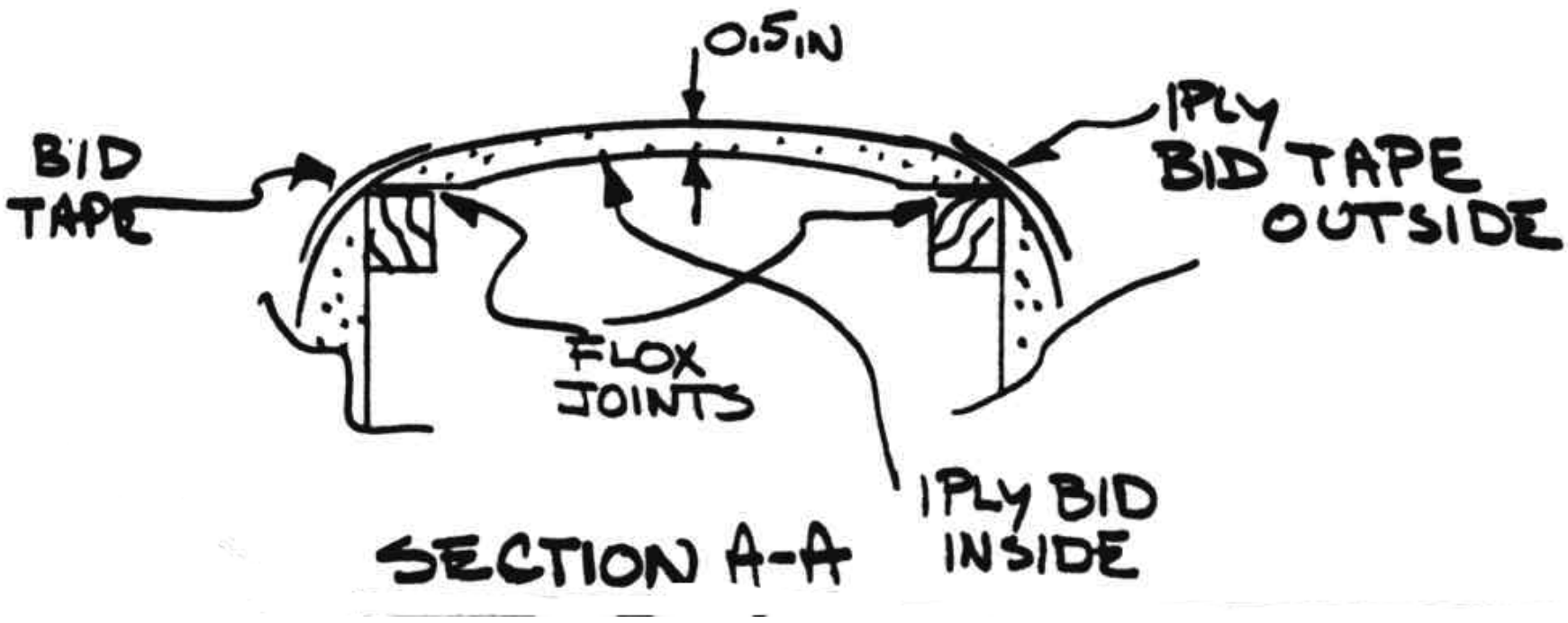

Figure 18-66: Front top fuselage cover

Step 13 - Safety Catch

Refer to the drawing for the SC-1 canopy safety catch. This catch keeps the canopy from opening more than 1" if the pilot forgets to lock it for takeoff. Do not skip this installation thinking you will never forget. Experience has shown that the most proficient pilots forget if the conditions are unusual. All of us at RAF have forgotten on at least one occasion.

Canopy up 1" is easily handled in any flight situation; however, canopy fully open is an extremly dangerous flight condition requiring good pilot ability to maintain aircraft control. Several pilots of VariEzes have handled this successfully, but in at least two cases it has resulted in an accident. The SC-1 automatically engages the AN525/CS13 bolt when the canopy is closed (locked or not). To open normally, you lift the canopy up about 1", then push inward on SC-1 to disengage (similar to safty catch on a car hood).

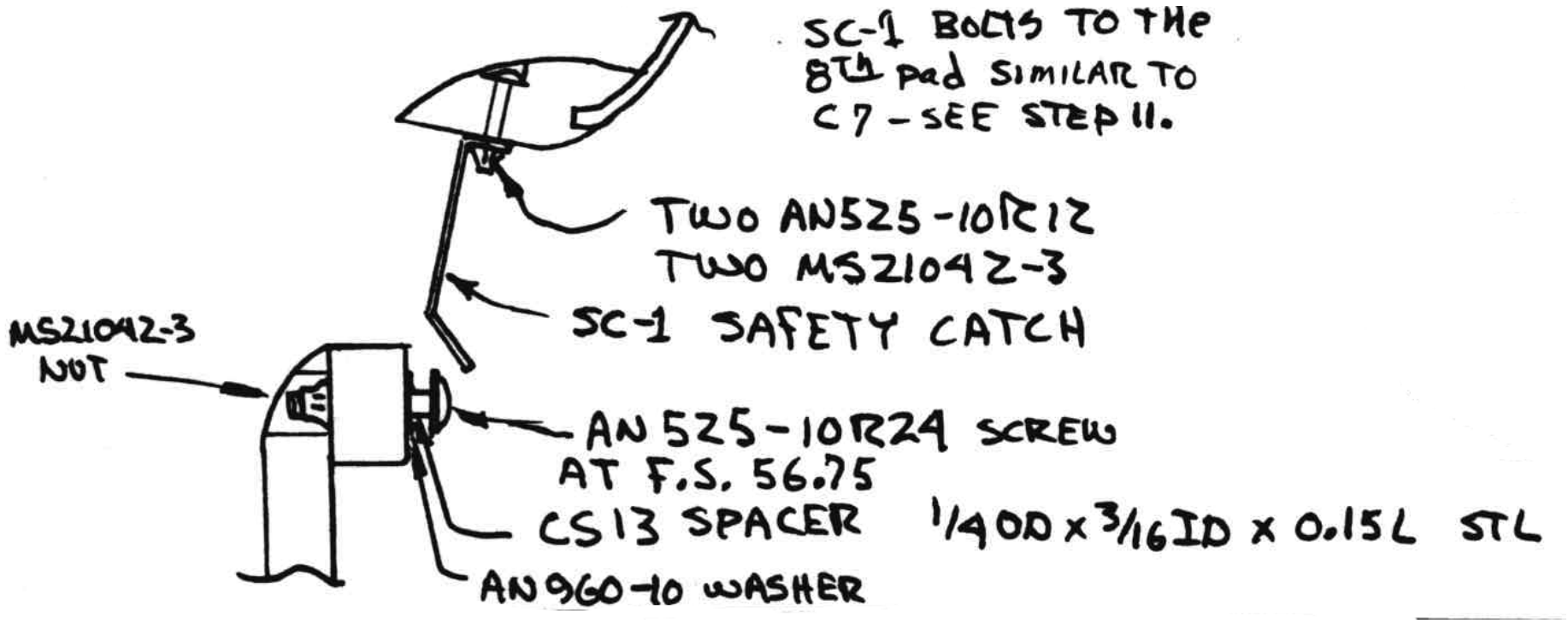

Figure 18-67:SC-1 mounting

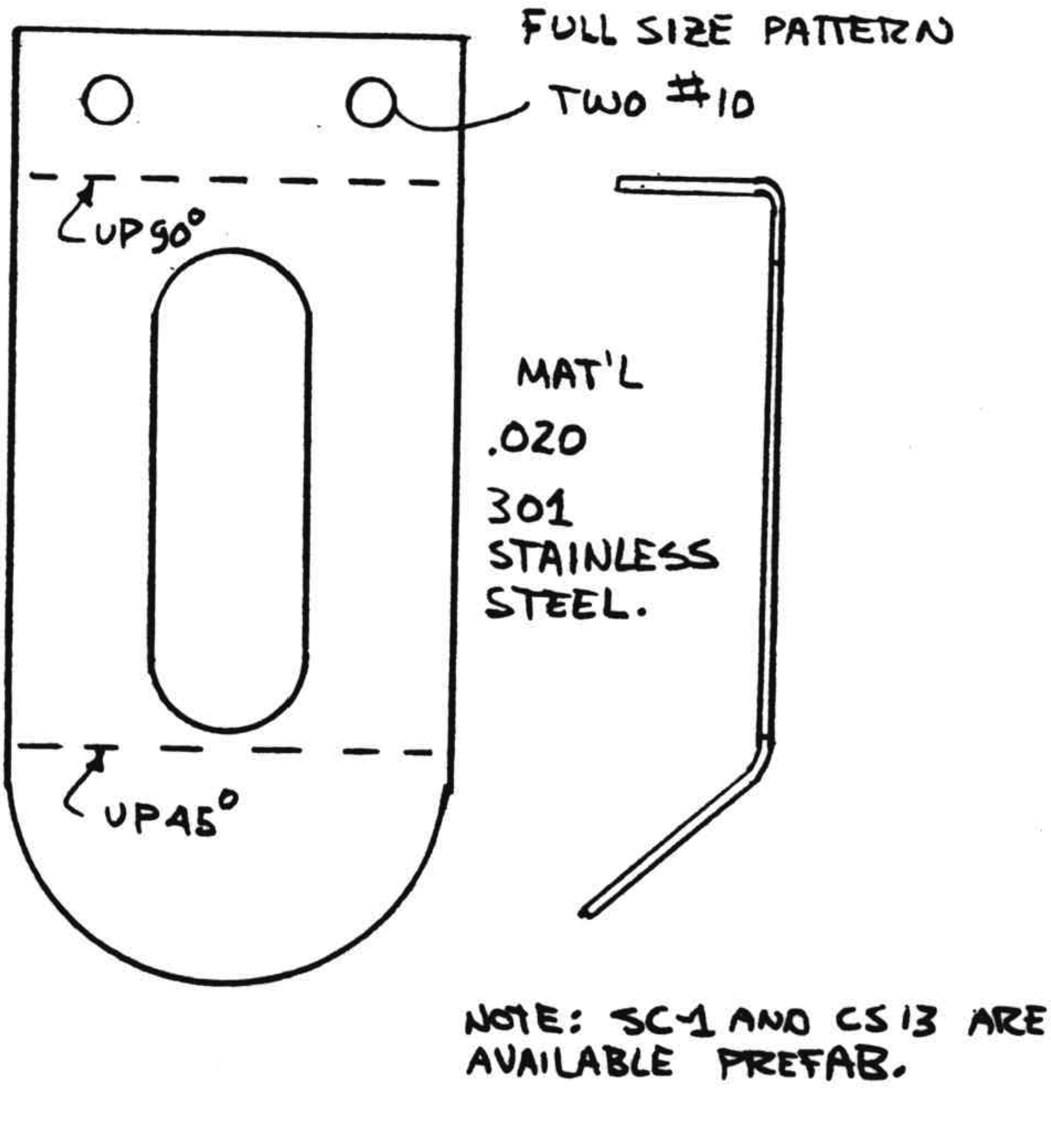

Figure 18-68: SC-1 Safety catch full size

Do not omit the knob on C7 – it is required to close the canopy in high winds.

Step 14 - Door

The door shown provides a hole to reach through, allowing you to fully lock the C-1L handle when you are outside your aircraft. The door also allows emergency canopy opening from the outside. Print the letters "EMERGENCY CANOPY OPENING" on the outside of the door. Apply the lable shown on the inside of the door. If you desire to install a key lock to secure your aircraft from radio theft, install a small drawer type key lock (available from hardware stores).

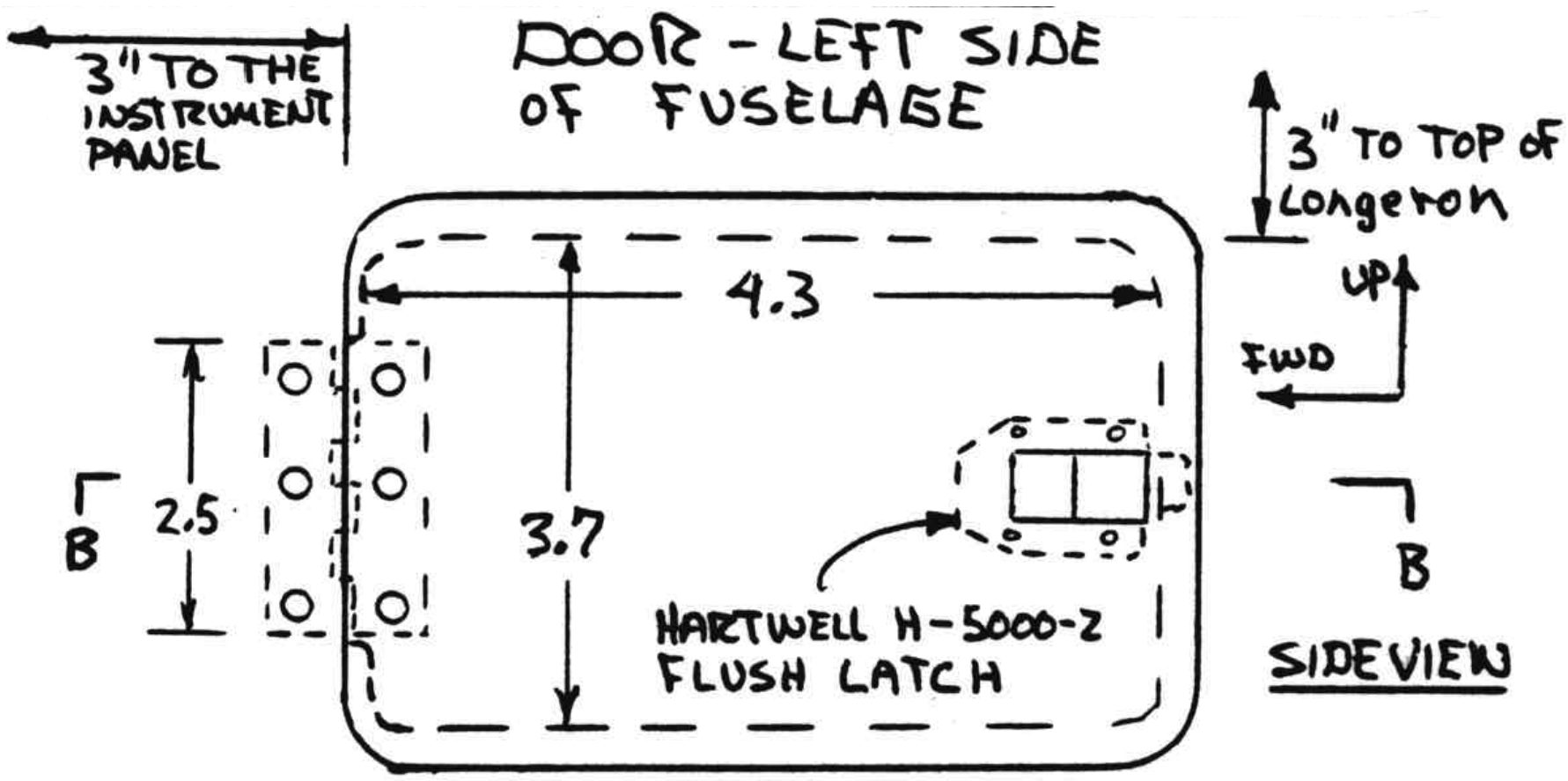

Figure 18-69:Exterior door

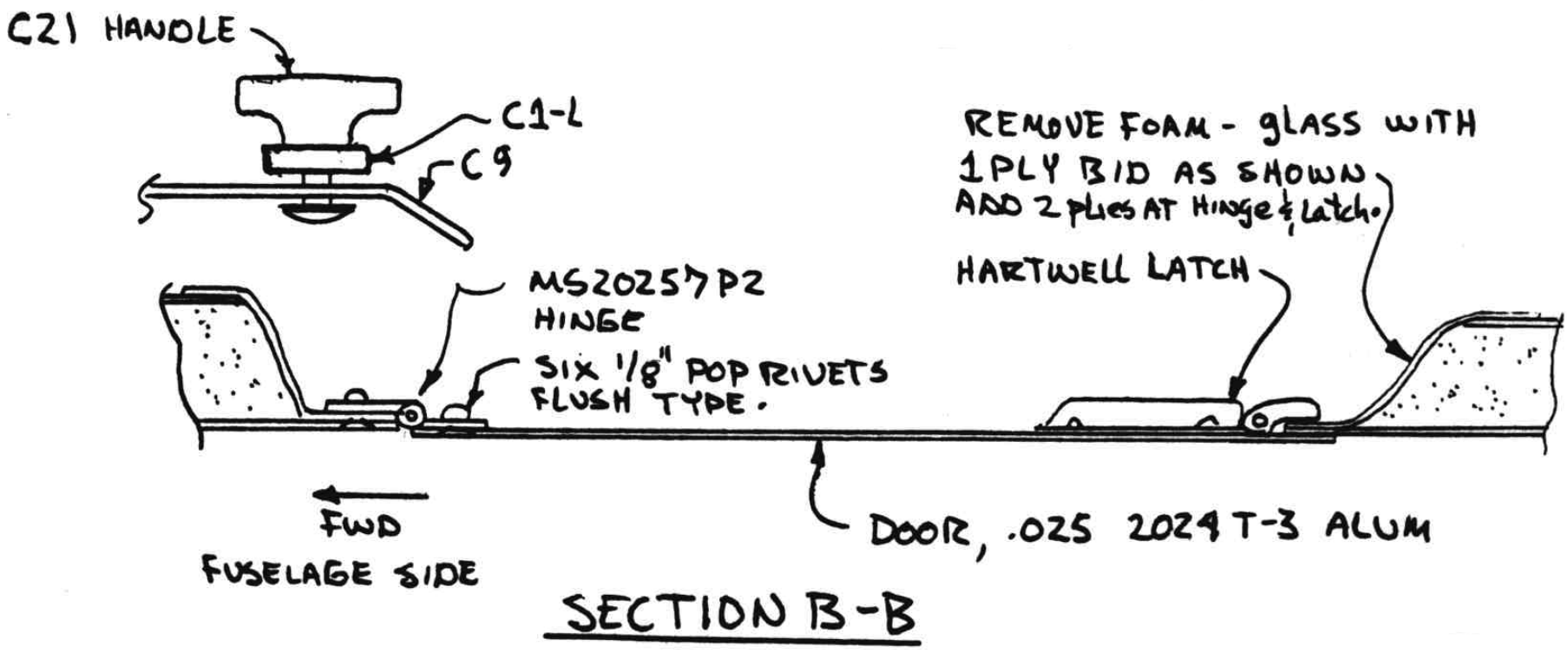

Figure 18-70: Side door assembly

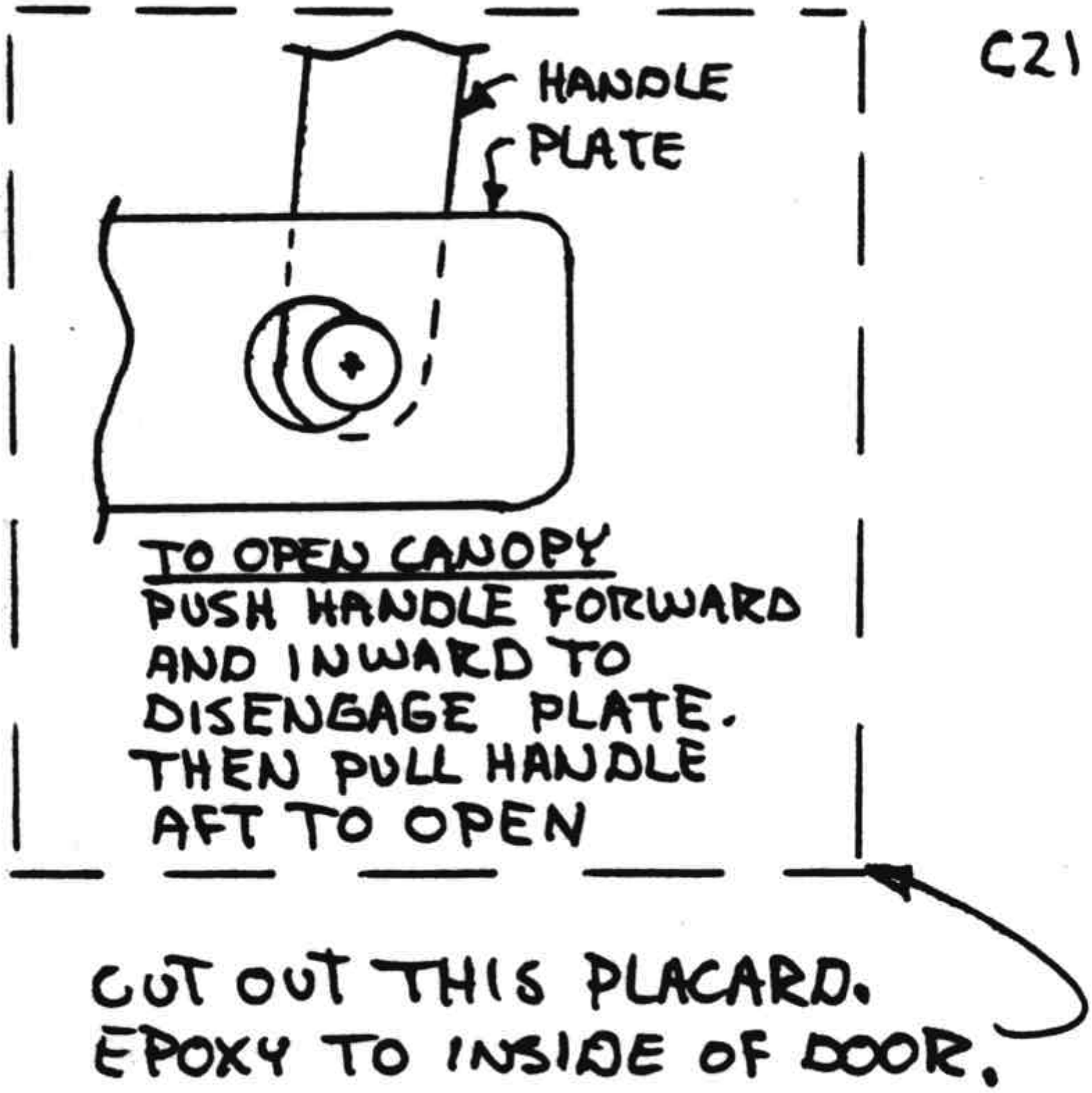

Figure 18-71:

Canopy handle placard

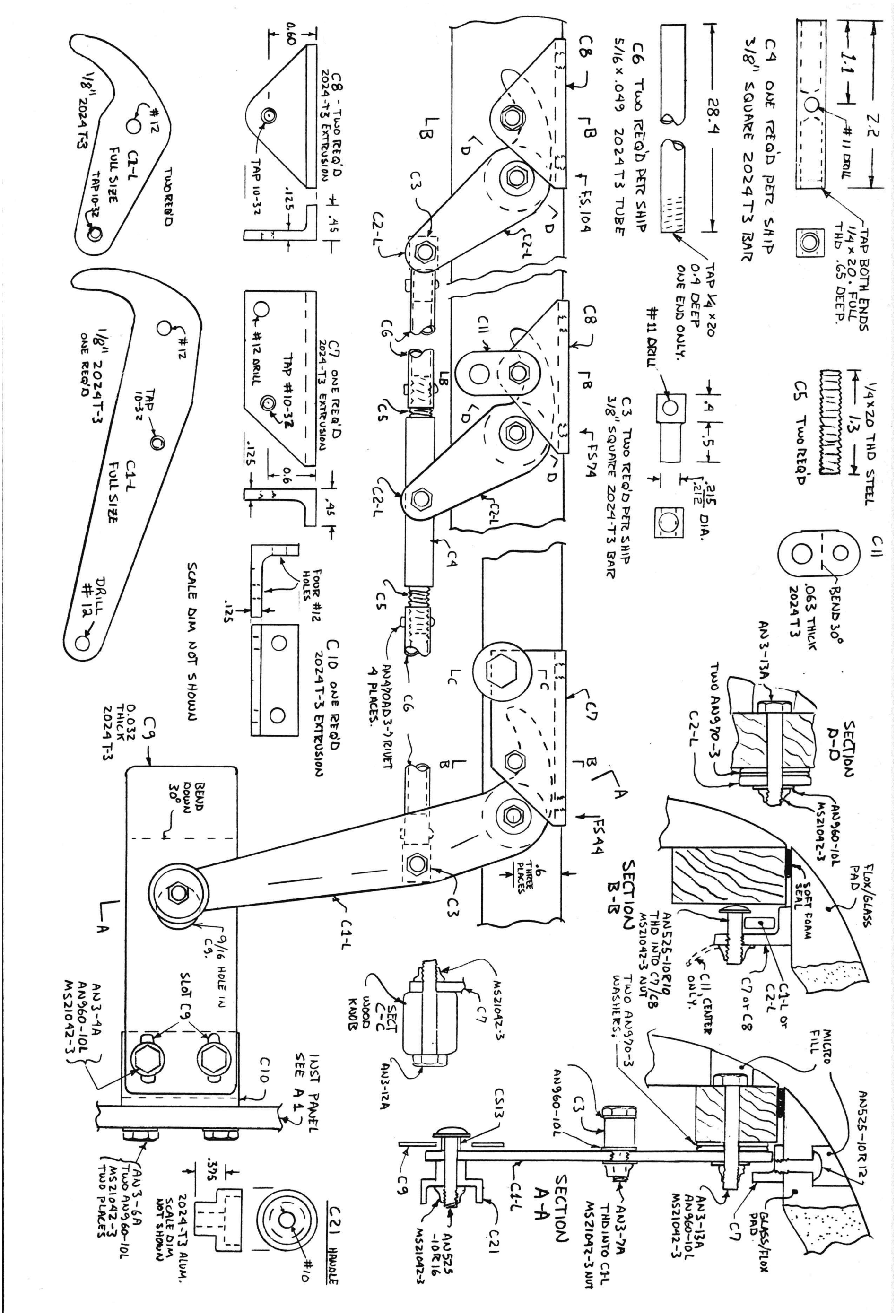

Figure 18-72: Canopy latch assembly