Section 8
Body Details

Procedures covered in this section:
Install main rotor shaft and foot pedal cross tube; fit and install tub, seat bulkhead, floor pan, body panels, windscreen, doghouse, seat back access panels, cyclic inspection panels; install cabin comfort system; construct and install doors, install front inspection panel.

Cards used in this section:

HARDWARE CARD	E25 CARD 4	E32 CARD 3	E49 CARD 1
E16 CARD 1	E32 CARD 1	E32 CARD 4	E49 CARD 2
E16 CARD 2	E32 CARD 2	E41 CARD 1	E54 CARD 1

Prints used in this section:

E16-2000	E41-2000
E32-2000	E49-2001

Templates used in this section:

E25-2	E32-2	E41-2
E32-1	E41-1	

Tools required for this section:

Air grinder	Countersink	Hammer	Scissors
Air or electric drill	Dzus tool	Needlepoint pliers	Screwdriver
Band saw	Files	Nut driver	Tape measure
Cleco	Framing square	Pop rivet gun	Vise
Cleco Pliers	Grease pencil or marker	Protractor level	

Drill bits of the following sizes: 1/16", 1/8", 5/32", 3/16", 1/4", 5/16", 3/8", #53, #40, #19, Uni-bit or step drill
Ratchet with sockets of the following sizes: 1/2", 9/16"
Wrenches of the following sizes: 1/2", 9/16"

Notes:
1. MAIN ROTOR SHAFT: The rotor system must be temporarily installed at this point to help position the body and doghouse for assembly. Refer to Section 11 for installation instructions.

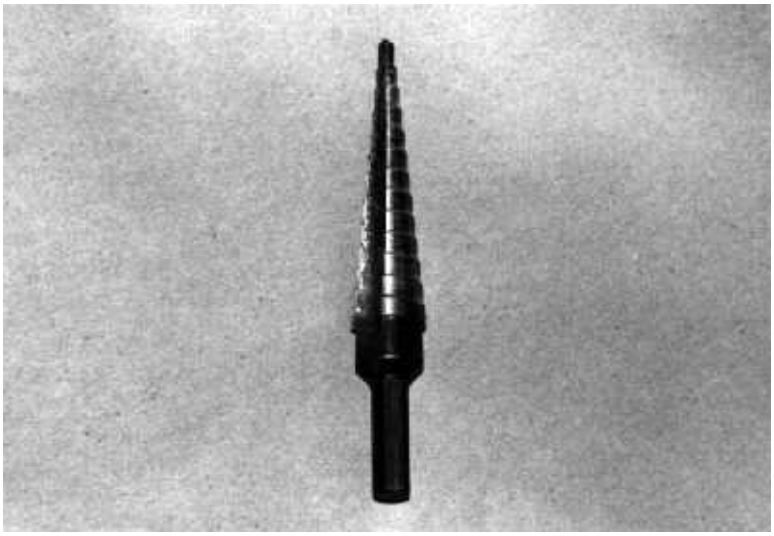
2. FOOT PEDAL TUBE: Install the foot pedal cross tube when fitting the floor pan. Adjust the body support pads so that the pan does not rest on the cross tube.

PREFACE

Many of the body panels have pre-drilled master cleco holes. These holes are for initial alignment only, and may not necessarily be in the right position to be used for fasteners after all panels are fitted.

Pre-assemble the entire body with clecos before attaching any nut plates or Dzus fasteners. This gives you the opportunity to shift or relocate components somewhat if there is any unacceptable mismatch. Any unused alignment holes may be filled with fiberglass.

To get accurate hole alignment in the body panels, hold the body together initially with as few cleco fasteners as necessary to maintain alignment. When an acceptable fit has been achieved, lay out and drill the remaining cleco holes. Then enlarge the holes in the fiberglass according to the type of fastener being used. Try using a uni-bit or step drill (see photo below). These types of drills are less likely to wander.



Many of the fiberglass pieces have pre-scribed marks that appear as slightly raised lines on the surface of the gel coat. These are approximate areas to be cut out and are not necessarily in the exact location. When trial fitting, cut out only as much as necessary. Open the cut outs to their finished size after the body is completely fitted.

IT IS EXTREMELY IMPORTANT THAT YOU READ THE ENTIRE SECTION OF BODY CONSTRUCTION PROCEDURES BEFORE BEGINNING THE ACTUAL FITTING AND ASSEMBLY, SO THAT YOU HAVE A PROPER OVERVIEW OF THE ENTIRE PROCESS.

Overview of how the body will look when clecoed in place:

Photo A

Photo B

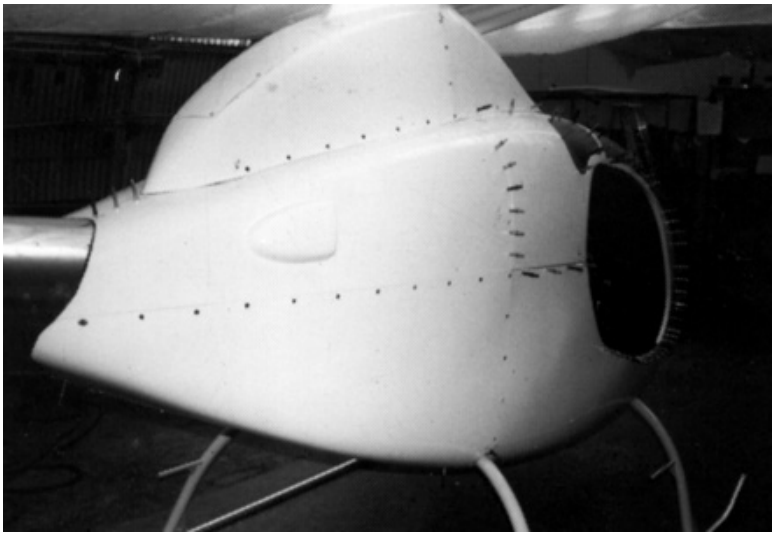
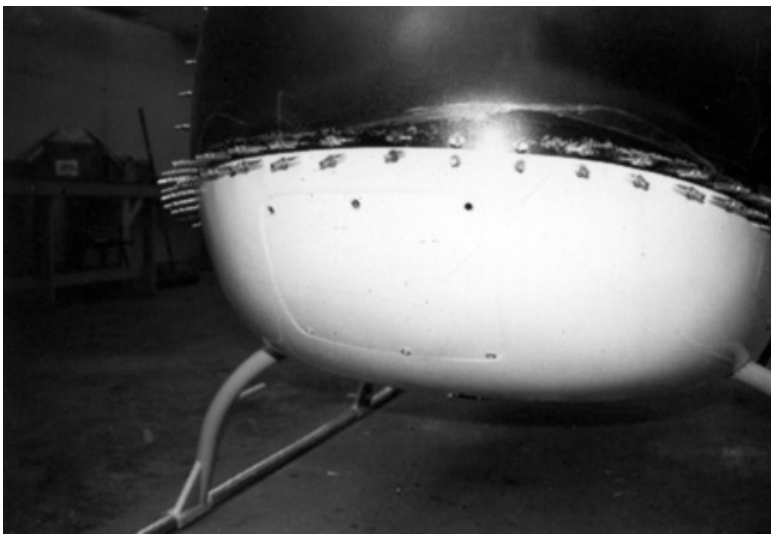
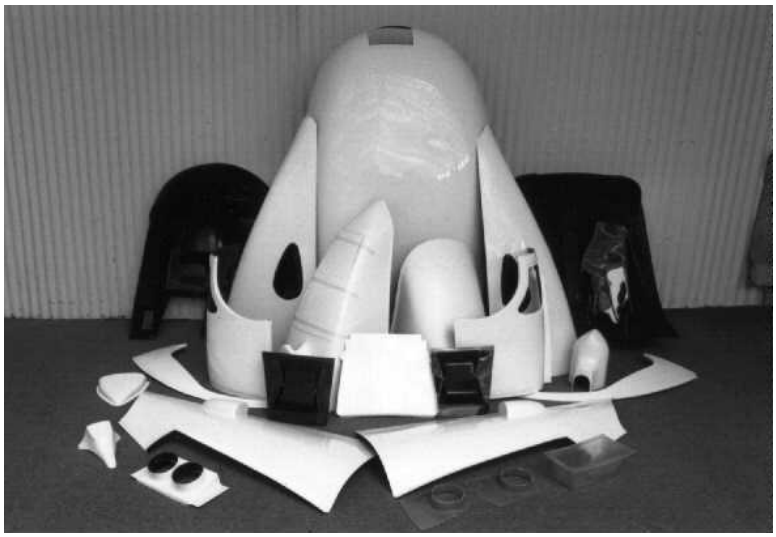


Photo C





BODY

Photo #1

Use print E32-2000 when assembling the body. Parts as received from RotorWay International.

Photo #2

Cut out areas scribed for holes in the tub, as shown by the arrows.

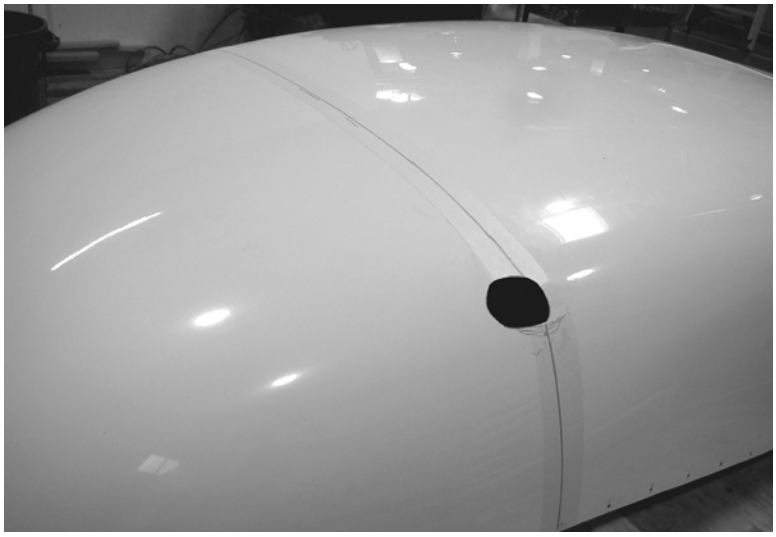


Photo #3

The tub must be split at the front landing gear holes to install the gear. Mark the split line on the tub to the rear of the the holes. Cut the tub into two pieces using a saw or abrasive disc. File or sand the cut edges for a smooth, straight seam.

Photo #4

Fit the fiberglass doubler, making clearance for the reinforcement strips on the bottom of the tub, and cut reference holes for the front landing gear.

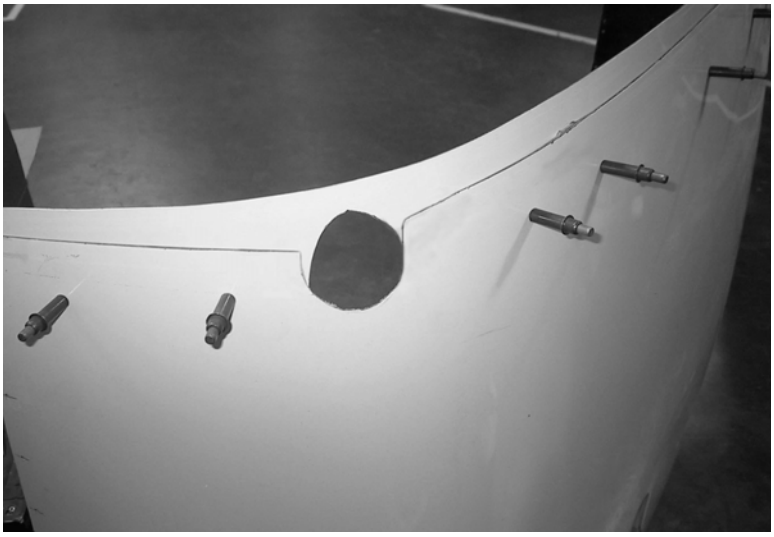


Photo #5

Attach the doubler to the back part of the tub using fiberglass mat and resin. Hold in place with clecos while the resin cures. When bonded, cut the landing gear holes so that they open towards the front.

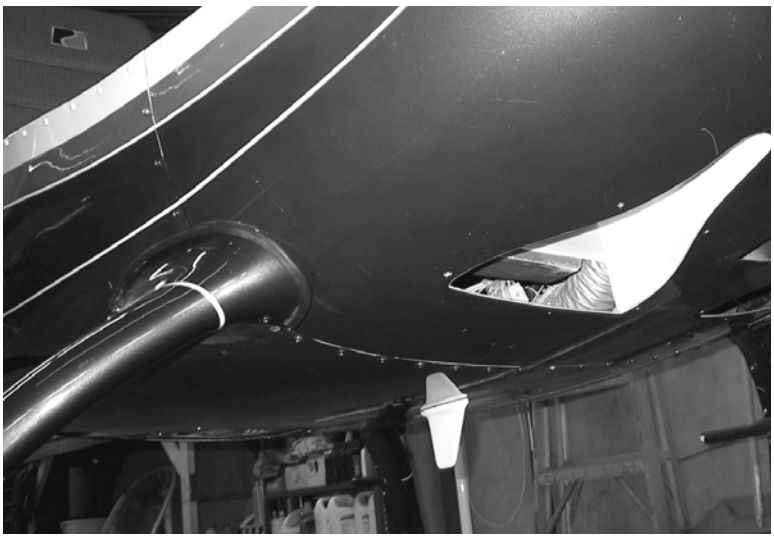


Photo #6

Install 8-32 nut plates and screws to hold the tub together. This photo shows the split tub on a completed aircraft.

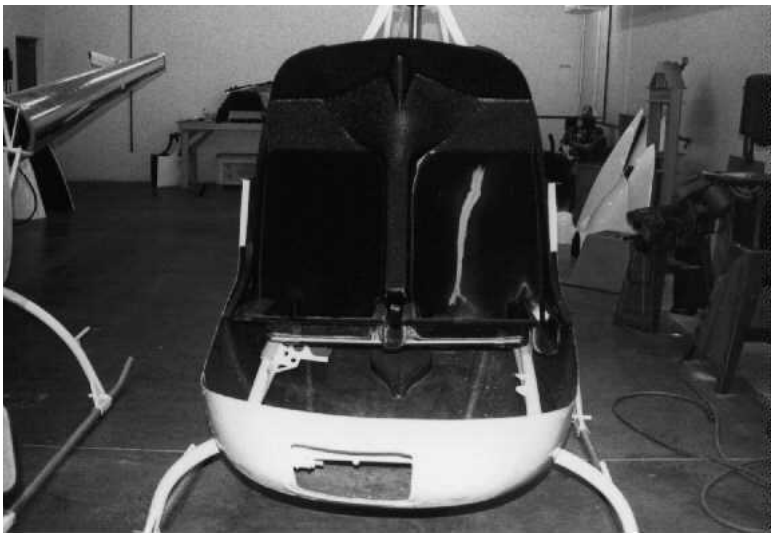


Photo #7

With the help of an assistant, install the seat bulkhead on the airframe. Push it to the rear and to the pilot's side as far as it will go. Hold this position.

Photo # 8

The seat should sit on the curved airframe tubes. Later it may be necessary to add shims in this area for body alignment.

Photo #9

These arrows indicate where to drill the seat for clecos.
Note: The seat bulkhead is the only part of the fiberglass body that is securely bolted to the airframe. The fit of all other panels is determined by the location of the seat on the airframe. Once the body is completed, it can be shifted slightly on the airframe for a better fit. The initial cleco holes in the seat do not have to be the final bolt holes.

Photo #10

Drill the seat and airframe tubes for clecos.

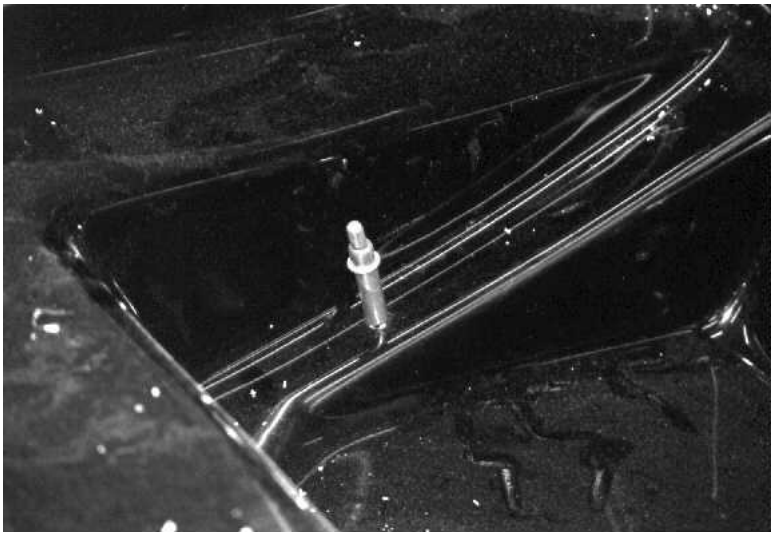


Photo #11

Install clecos to hold the seat in position.

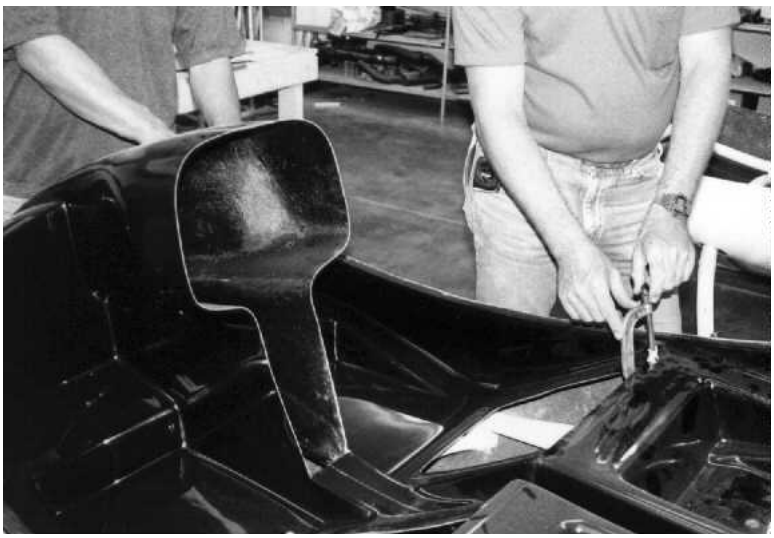


Photo #12

The foot pedal cross tube should be installed before fitting the floor pan (see Section 10). Install the floor pan and adjust the body support pads so that the pan does not rest on the cross tube. Pull forward and clamp the rear as shown. Secure the front of the floor pan to the tub with clecos in the master holes.
Note: Check alignment by comparing the distance from the front corners of the airframe to the tub on each side. The tub should be centered. Adjust the body support pads as needed to raise the pan up off of the pedal cross tube.

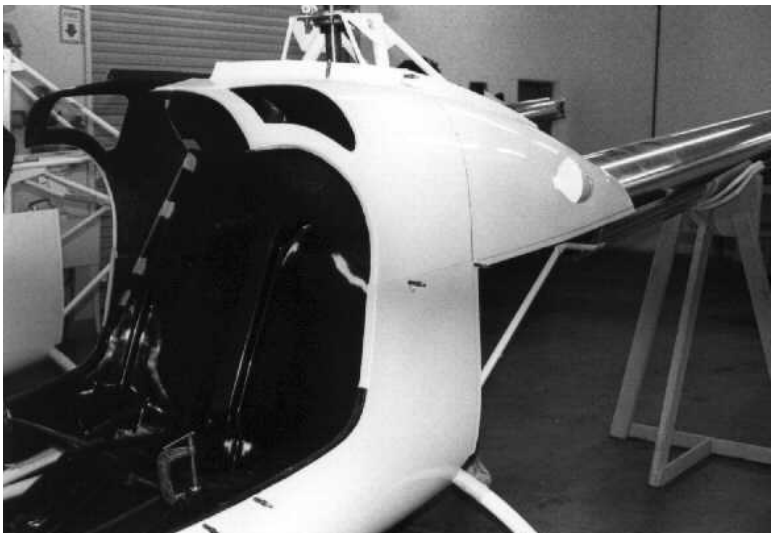


Photo #13

Begin hanging the remaining body panels. Install the upper front and rear panels first. As panels are added, use only as many clecos as necessary to hold them in place and maintain their shape. Since the fit of each panel affects another, gradual trimming and fitting is necessary as the body goes together. Final fitting and hole drilling can be done when all panels are in place.

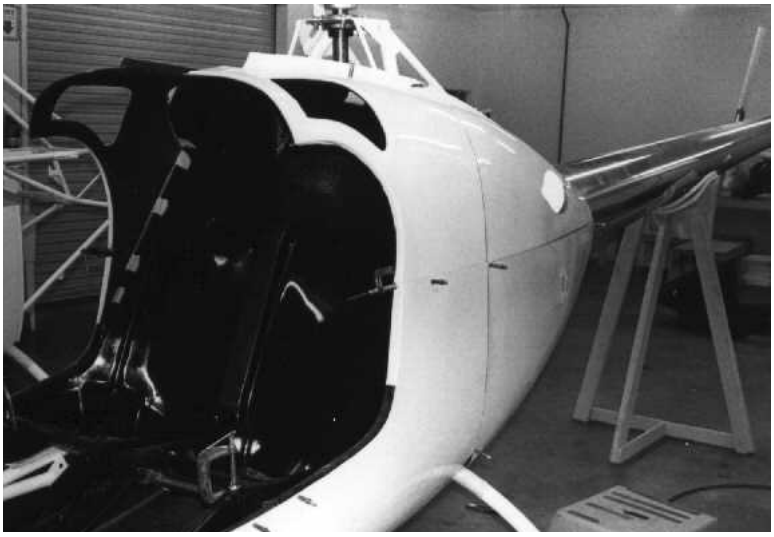


Photo #14

Install the lower rear body panels. Open the cut-outs for the landing gear only as much as necessary.

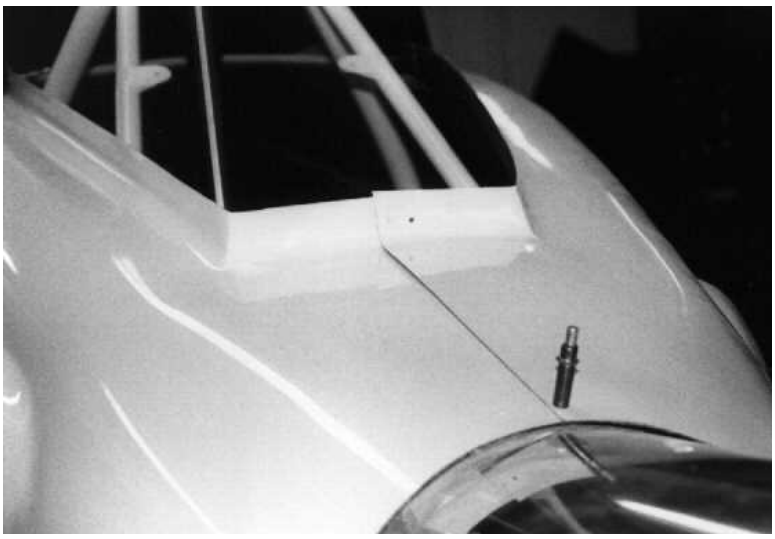


Photo #15

Check the fit of the top rear panels. They may be overlapped to reduce the opening around the tail boom. Shims may be added between the seat and the curved airframe tubes to achieve a better fit and to level the body.

Photo #16

The panels should fit evenly all around the tail boom. When the body has been final fitted, there should be enough clearance around the tail boom for the weather stripping that will be glued in place. Do not fasten the bottom overlap yet. This will be trimmed later when the radiator is installed.

Photo #17

Stretch a tape measure around the upper rear curve of the windscreen. Use the same measurement to install the cabin roof panel. This will ensure that the body is the correct width in that area.

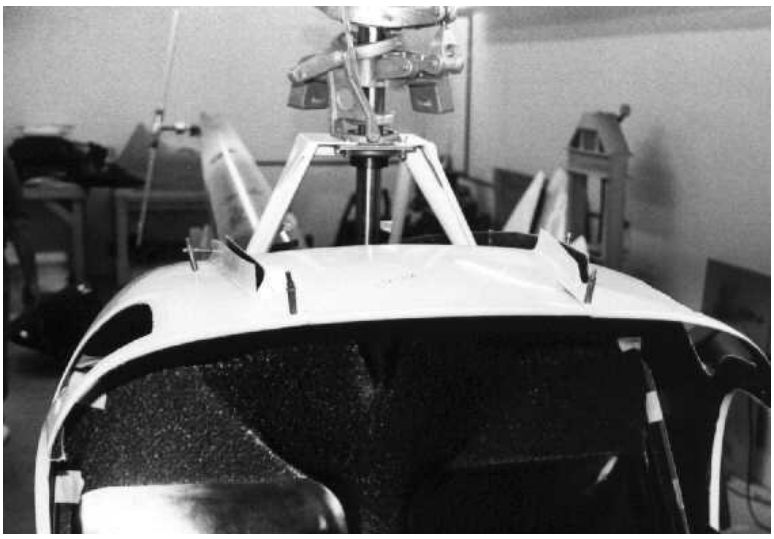


Photo #18

Insert cleco in the two front locations of the roof panel as shown. Do not fasten the back of the panel yet. This will help when fitting the windscreen.

Photo #19

Before installing the windscreen, review “Working With Plexiglass” in Section 1.
Place the windscreen on the body and position it for best fit. It should be allowed to fit naturally without being forced into position. Check the alignment and curvature of the top of the windscreen with the body. Find an area where the windscreen fits well and hold it in place at that point with clecos.

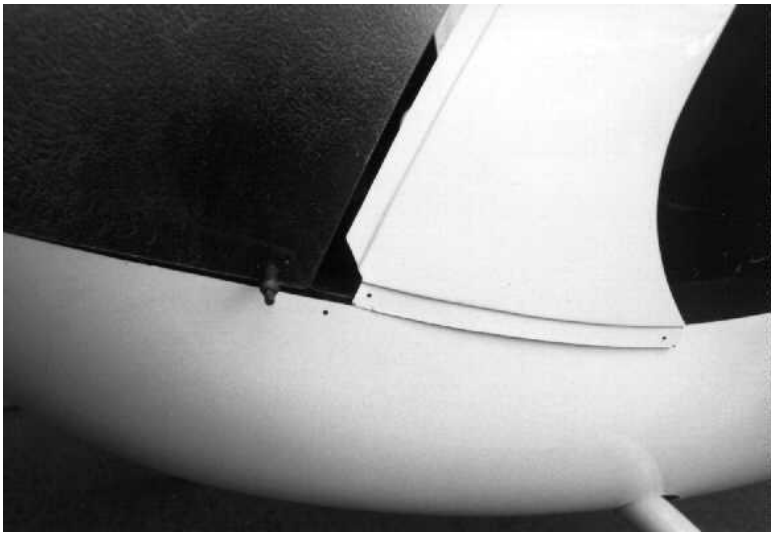


Photo #20

Trim the front part of the door posts (also called windscreen bracing panels). Attach them to the tub with cleco. The upper rear part of the posts will be fitted later.

Photo #21

Check all around for fit. The windscreen in this photo is slightly short on the upper rear passenger side. Body panels can be shifted and adjusted slightly to reduce some of this mismatch.
Note: This is shown as an example only. Trimming and fitting of your windscreen may vary.

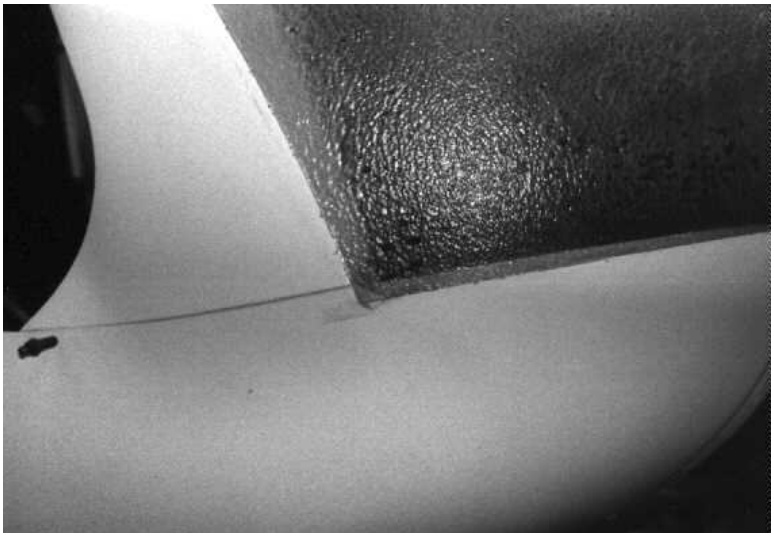


Photo #22

The windscreen in this photo is also slightly long on the lower passenger side. This will be trimmed off for a better fit. The windscreen when fitted properly should fit naturally without binding or stress.

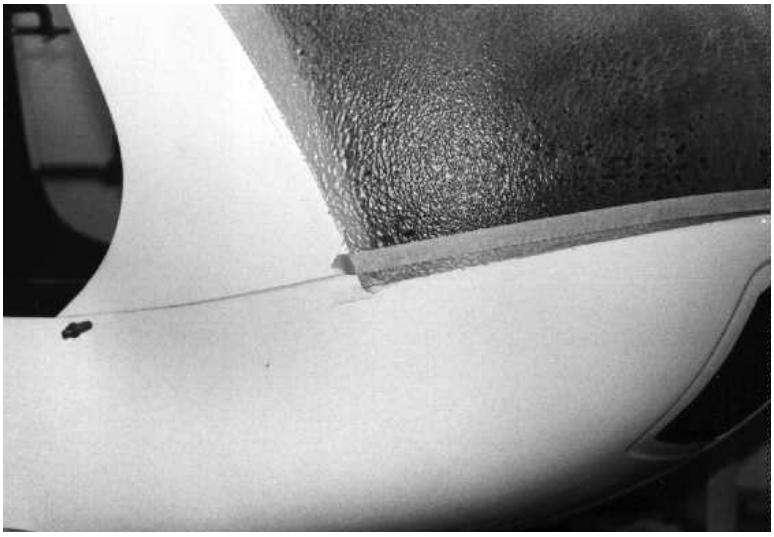


Photo #23

Mark the area to be trimmed with masking tape.

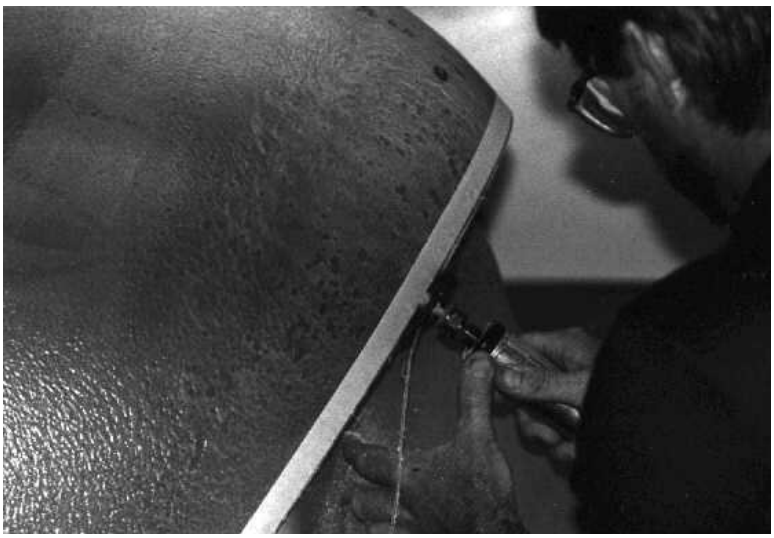


Photo #24

Remove the windscreen and trim. An air grinder with a 2 to 3 inch abrasive wheel works well for this.

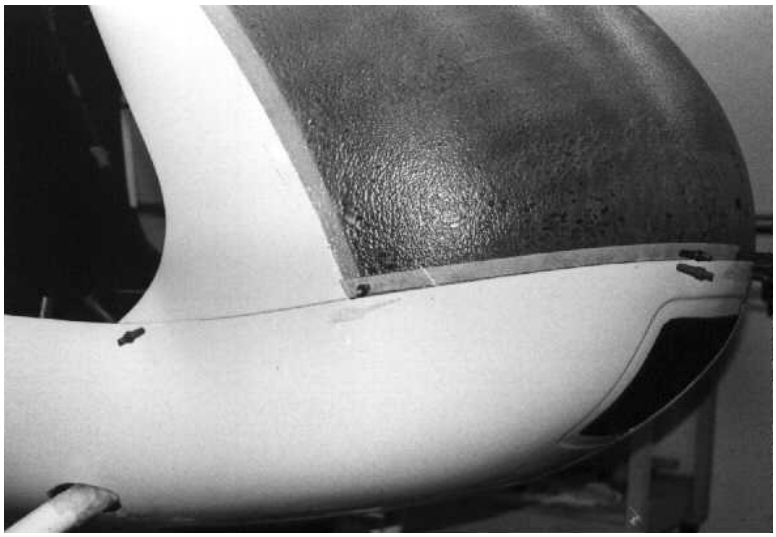


Photo #25

When the windscreen fits properly, secure it with a cleco in that area.

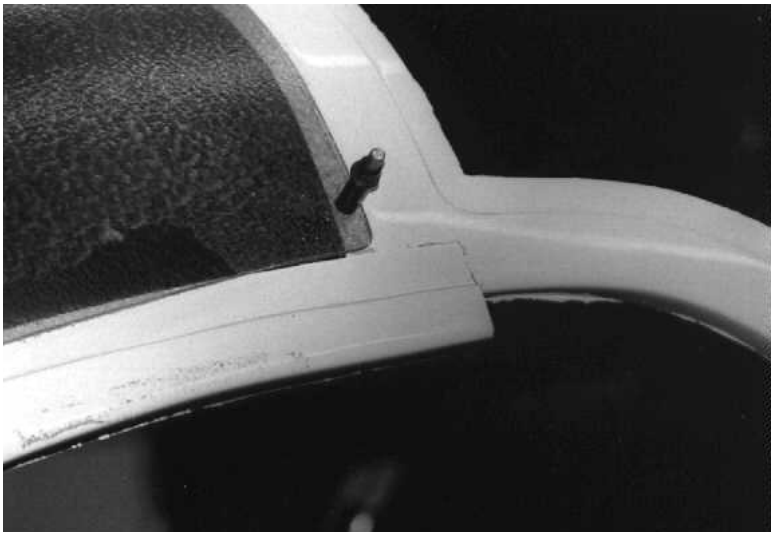


Photo #26

The door posts are supplied longer than needed. Trim off a little at a time and fit them carefully to avoid cutting them too short.

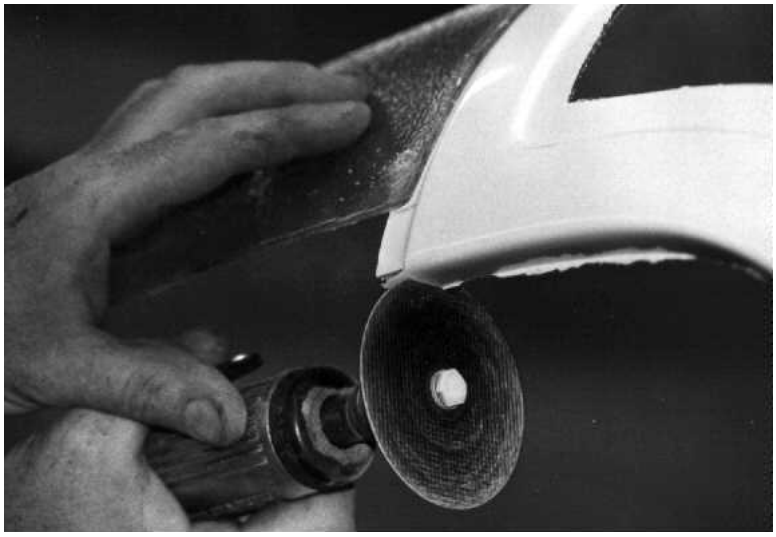


Photo #27

Cut out the area in the upper body panel where the door post will fit.

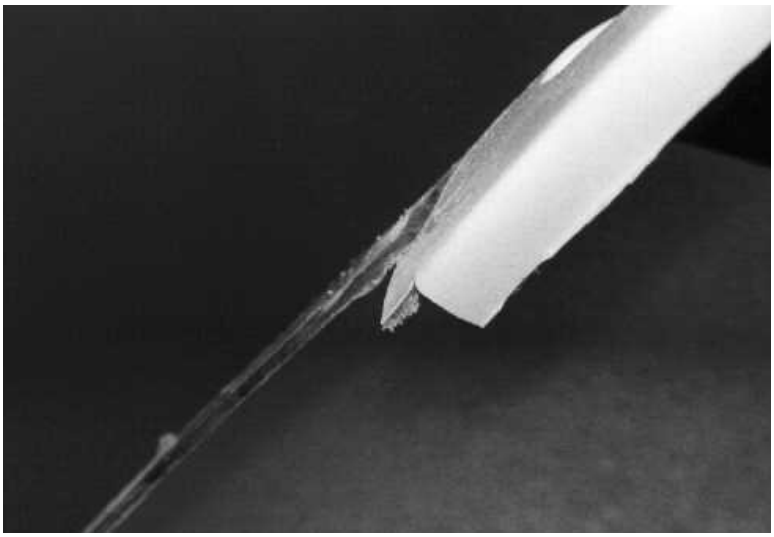


Photo #28

Gradually enlarge the cut out as necessary for best fit.

Photo #29

Secure the door post with a cleco when the desired fit is achieved.

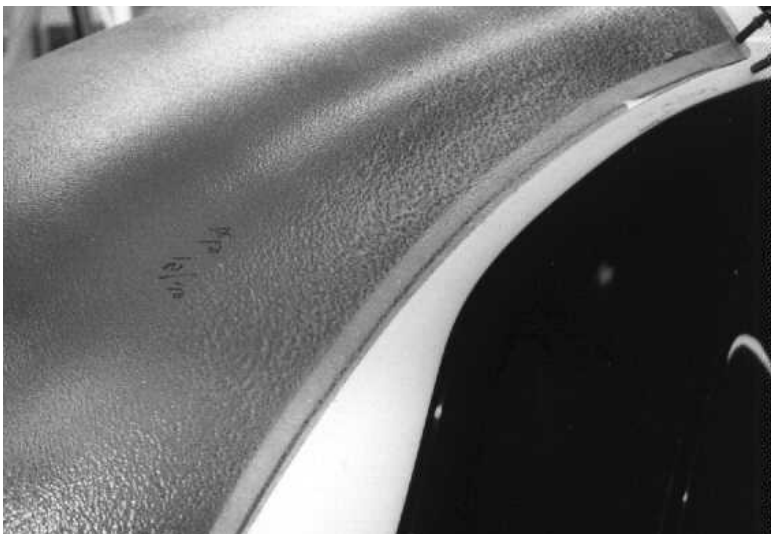


Photo #30

The edge of the windscreen should fit into the recess in the door post. Trim the edge as necessary.

Photo #31

A simple tool can be made to transfer the location of the seat back to the outside body panels.

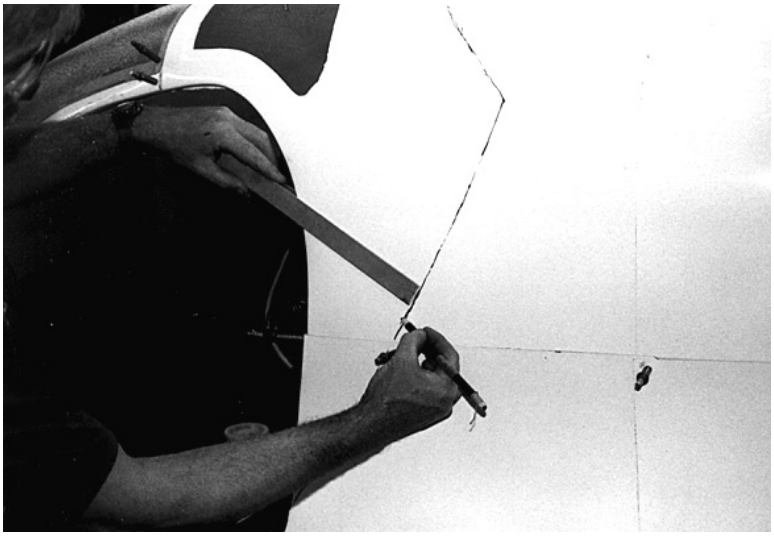


Photo #32

Trace the outline of the seat back onto the body with a grease pencil.

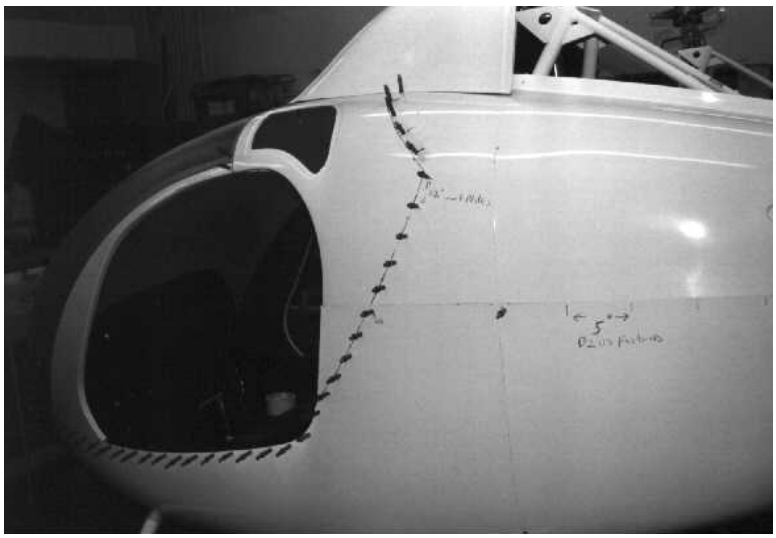


Photo #33

Layout and drill the holes for the cleco to hold the seat bulkhead to the body panels. Correct hole spacing is 2-1/2 inches apart for screws with nut plates, 5 inches apart for Dzus buttons.
Note: Place the doghouse front panel on top of the body so that the screws can be spaced around it in that area.

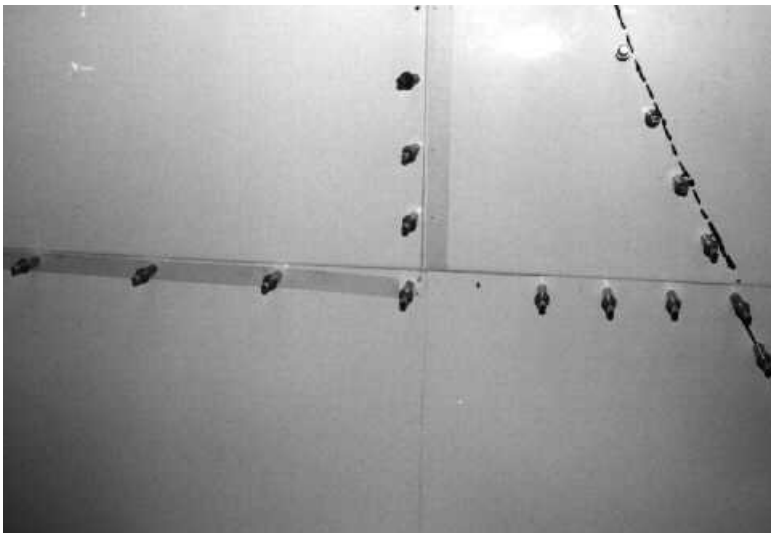


Photo #34

Continue drilling and fitting panels. As panels are being fitted, clecos can be moved and edges trimmed as necessary. In this photo, the four seams do not come together at the same point.

Photo #35

A file or a wood block wrapped with sandpaper works well for precise fitting, and leaves a smoothly finished edge. Clecos can be relocated and panels shifted as necessary.

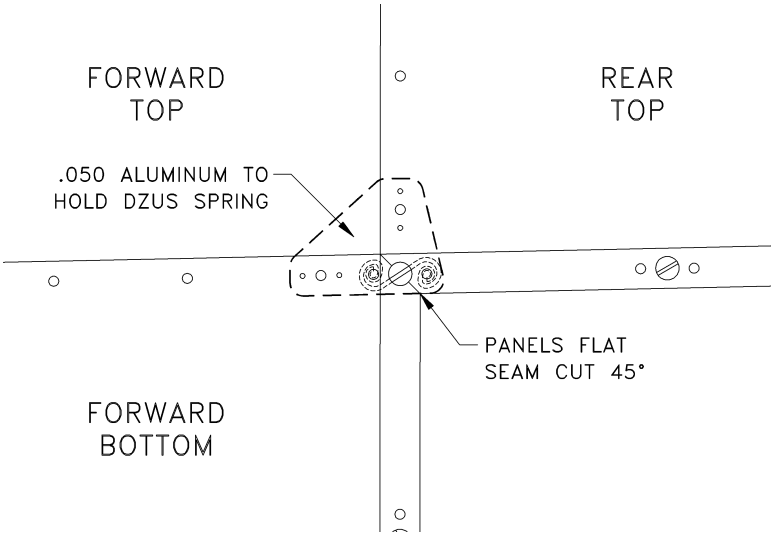


Photo #36

Cut the panels at an angle where they come together. Use nut plates to attach a piece of .050 aluminum behind the forward top panel to support the Dzus spring.

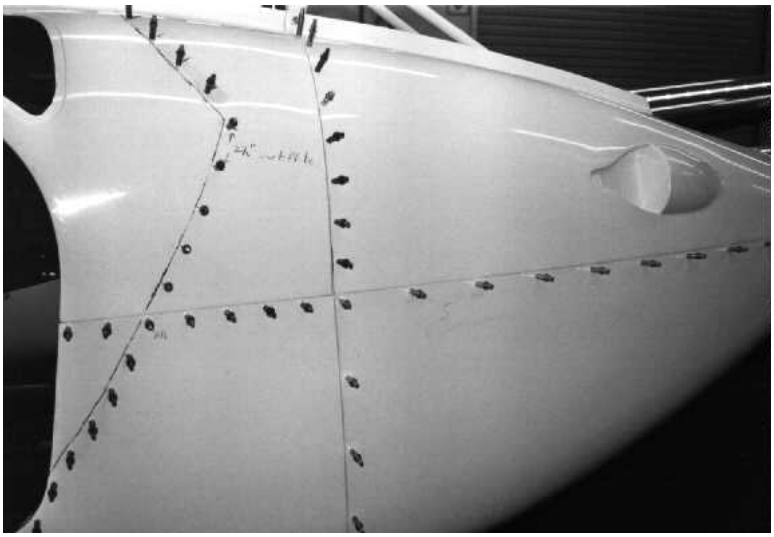


Photo #37

Overall view of the fitted body panels.
Note: The main structure will be fastened together with nut plates and screws. Panels used for inspection access will be fastened with Dzus buttons. The longer Dzus buttons will be used in areas where more than two panels overlap. Holes for fasteners should be centered on the recess where panels overlap.

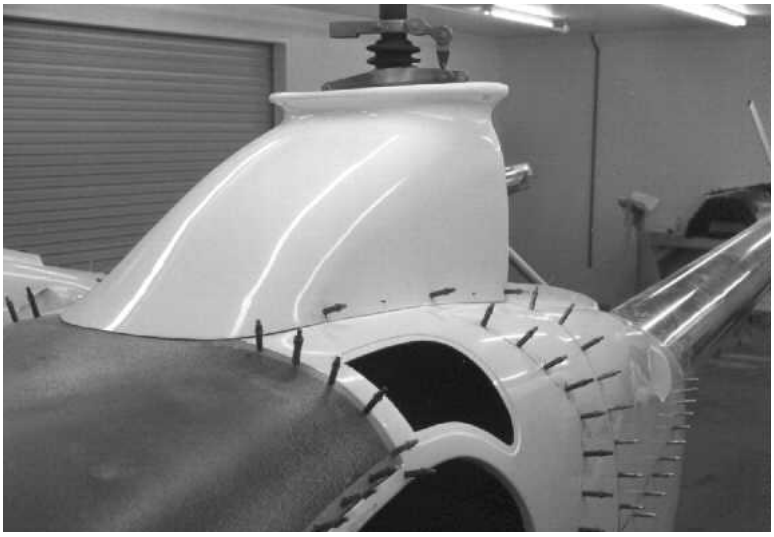


Photo #38

After all body panels are trimmed and fitted, install the doghouse front panel. There should be no pressure on the windscreen.

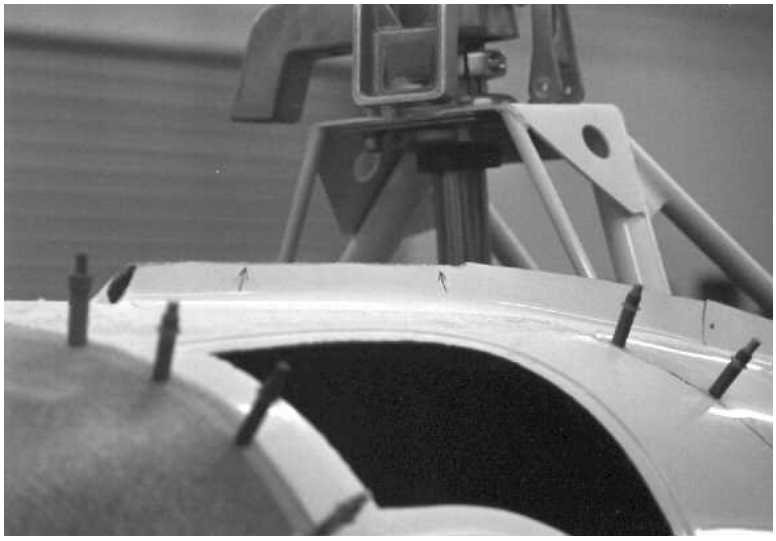


Photo #39

Trim off part of the lip on the upper front panels to clear the doghouse if necessary.

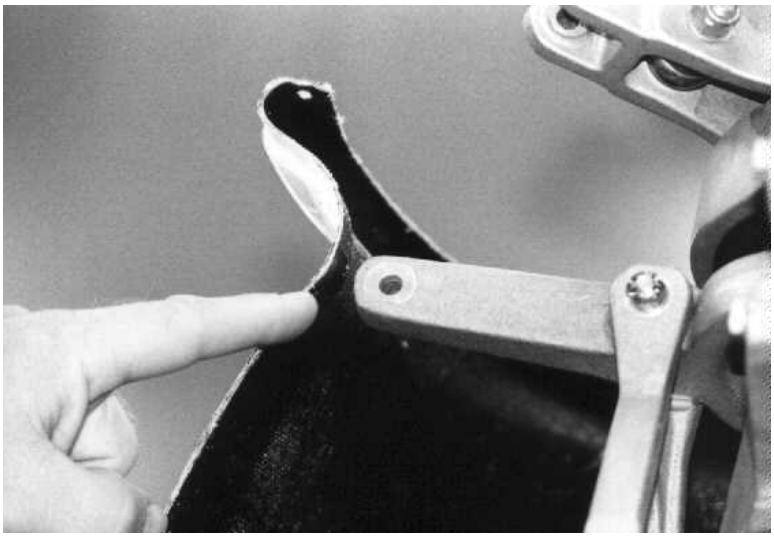


Photo #40

If the collective actuator fork contacts the fiberglass, adjust the doghouse on the body for more clearance. If this does not help, the actuator fork can be cut off as necessary up to the spot face. (The spot face is the circular machined flat around the hole in the fork.)
Note: Do not remove the actuator fork from the main rotor shaft assembly. Cut it in place with a hacksaw or air grinder. Do not locate a Dzus button where it will come in contact with the actuator fork.

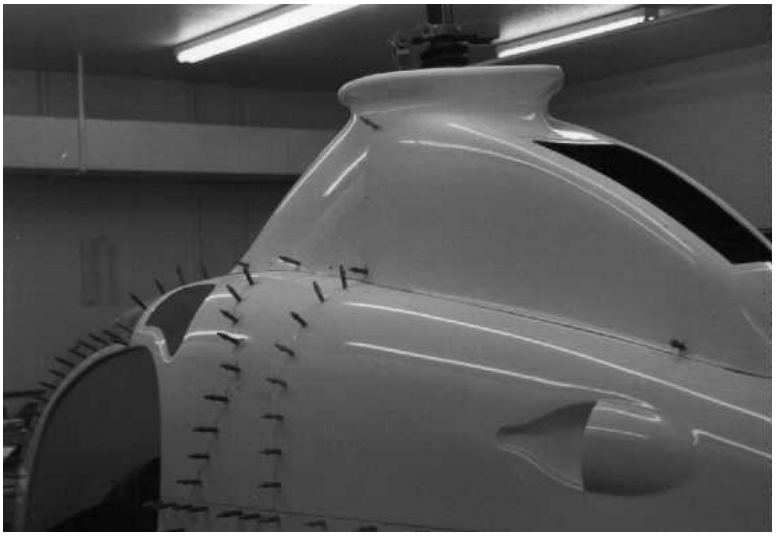


Photo #41

Install the rear doghouse.

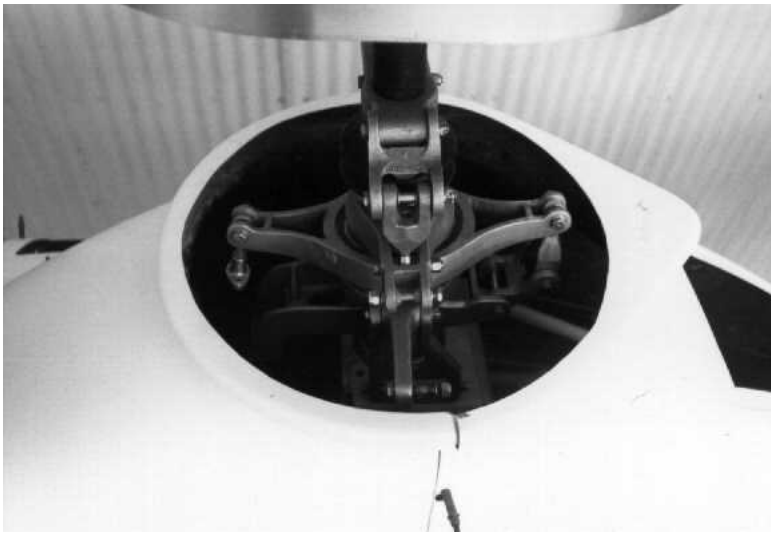


Photo #42

Check the swash plate clearance around the doghouse opening. Trim and fit the doghouse as necessary, then install remaining clecos.

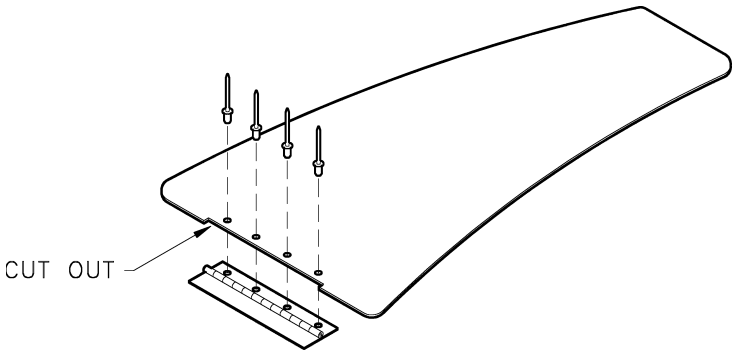


Photo #43

Install the hinge on the doghouse inspection panel as follows: Cut a slight notch in the inspection panel. (This will prevent the hinge pin from coming out.) Drill and countersink the rivet holes in the panel, and match drill the holes in the hinge. Rivet the hinge to the panel, cover the rivets with bondo, and sand smooth.

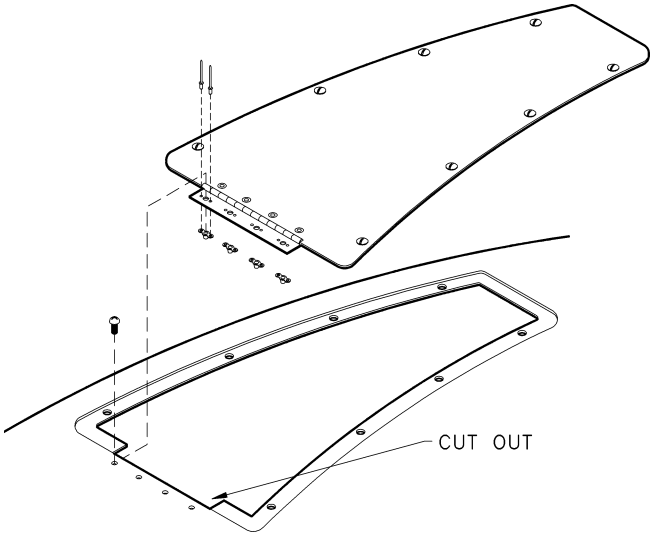


Photo #44

Drill the other side of the hinge and rivet four 8-32 nut plates to the hinge. Cut out an opening in the doghouse for the hinge to fit into. File the fiberglass underneath so that the hinge will fit flat against the underside of the doghouse. Mount the panel on the doghouse with four screws, then locate and install the Dzus buttons.

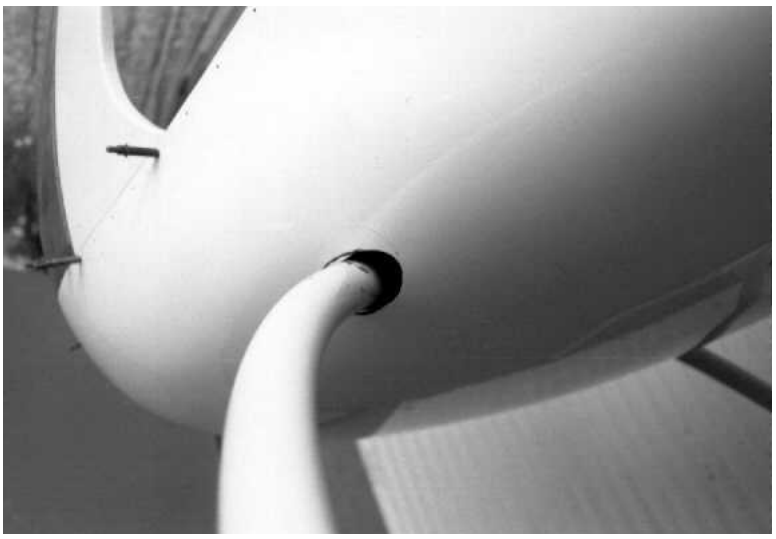


Photo #45

The openings around the landing gear should be close to, but not touching, the gear. This will be trimmed again later because the weight of the completed ship will cause the gear to flex.

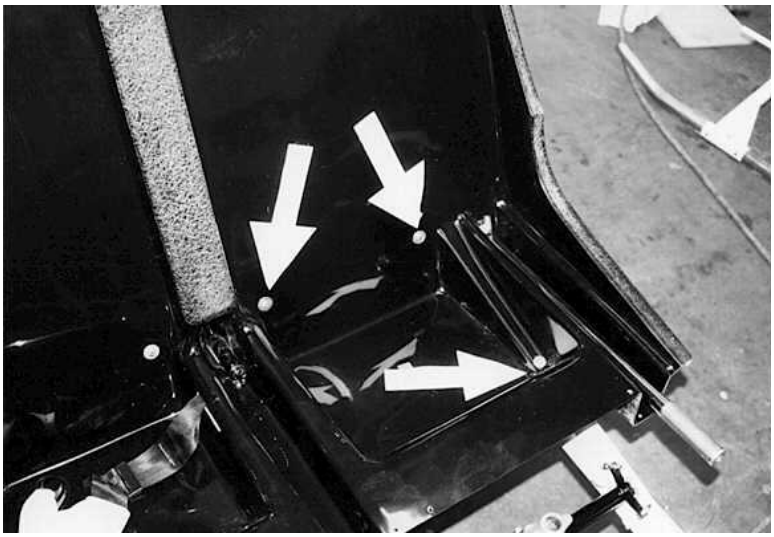
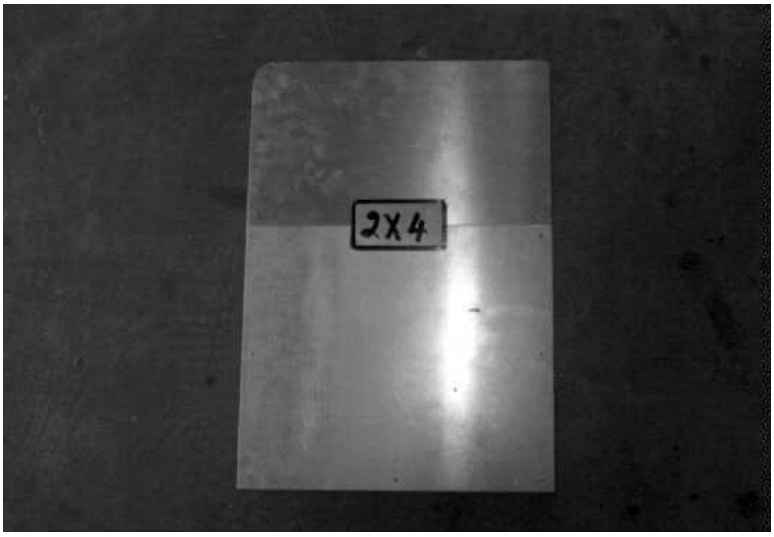


Photo #46

When body fit is satisfactory, open the cleco holes in the seat bottom to 3/16" and install the bolts. Secure the seat with 2 more bolts on each side, through the seat bulkhead and the 1" diameter cross tube of the airframe. Arrows indicate the locations of all three bolts.
Note: Use 3/16 x 1-5/8 (E00-2308) and 3/16 x 2-1/8 (E00-2312) bolts, found on E32 CARD 3.



SEAT BACK INSPECTION PANELS

Photo #47

Using templates E32-1 and E32-2, cut out the seat back and battery access panels. The 2"x4" doublers are to reinforce the seams.
Note: These templates will also be used later to locate the electrical components on the seat back panels.

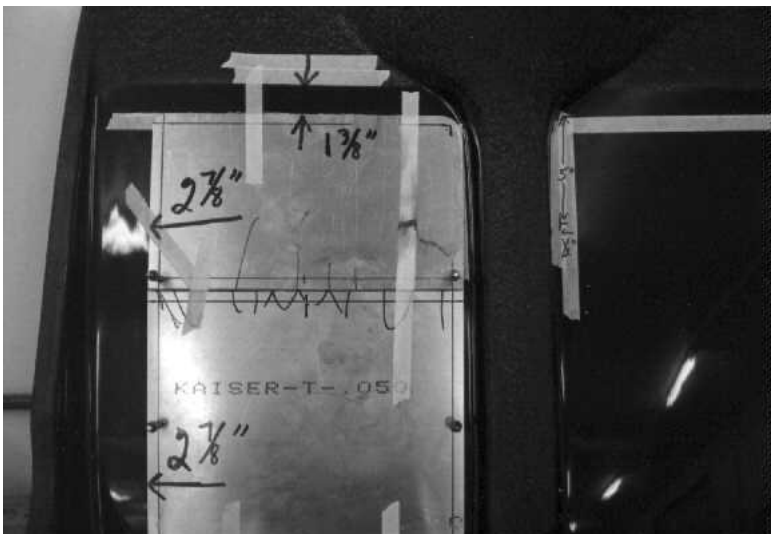


Photo #48

Locate the panels on the shiny area of the seat bulkhead as follows:

The top of the panels should be 1-3/8" below the top edge of the shiny surface.

The side of the panels should be 2-7/8" from the edge of the shiny surface.

Locate the battery access panel on the seat bottom, passenger side.
Note: For best fit, fabricate and install the ECU mounting plate at the same time as the battery access panel. See Section 21.

Photo #49

Cut out the openings 3/4" smaller than the panels on all sides.

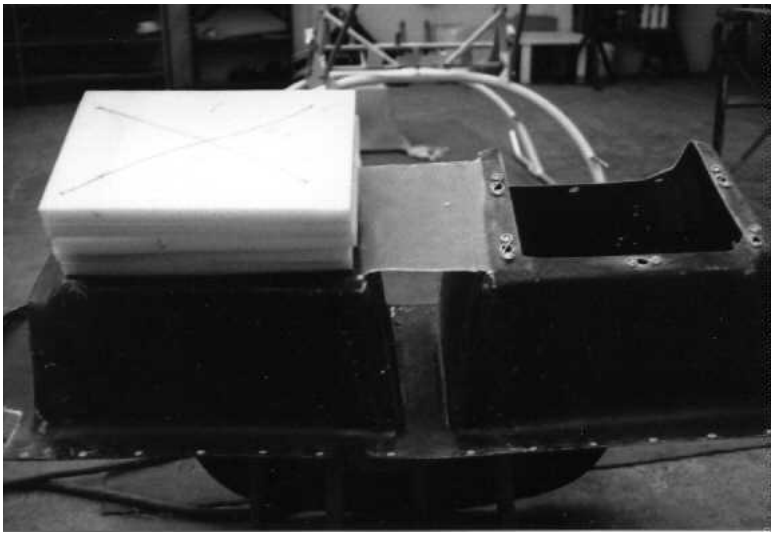


Photo #50

Wire 5 pieces of seat filler foam under the pilot seat and 5 pieces under the battery inspection panel on the passenger seat. Use safety wire in a cross pattern. This precaution will provide a good deal of cushioning in the event of a hard landing.

Photo #51

Foam wired to bottom of battery inspection panel.

Photo #52

In addition, cut 5 pieces of foam, approximately the same size, to fit in the pocket under each seat cushion.
Note: Foam can be added or removed under the cushion to adjust seat height, but the foam between the fiberglass bottom of the seat and the tub should not be removed. There should always be a MINIMUM of 5 layers for both pilot and passenger.

Photo #53

Using template E32-2, cut out the aluminum heel plates and install them in the floor pan using 8 pop rivets each. These are wear plates and also provide smooth surfaces for your heels to slide on during directional control movements.

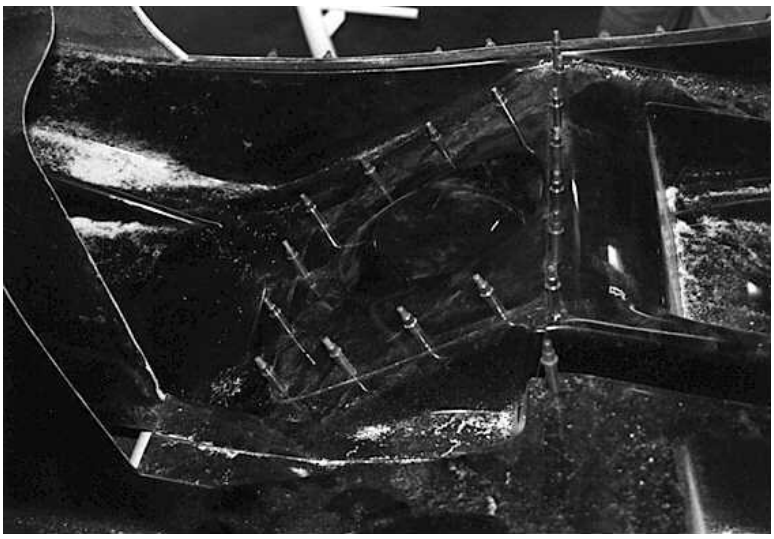
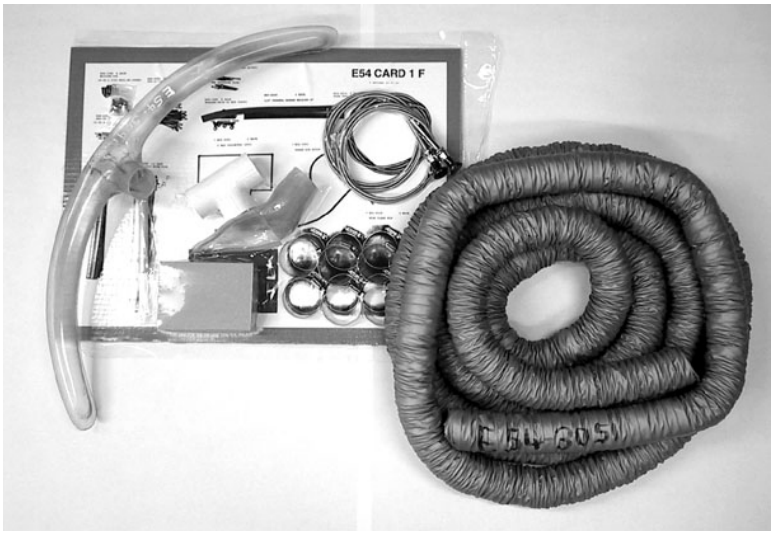


Photo #54

Fitting and attachment of the cyclic inspection panels should be accomplished after the cyclic control is installed to best position the panel around the cyclic handle. The rear edge of the panel should tuck under the front of the seat bulkhead. The panels will be secured with screws and nut plates on final assembly. Hole size for the cyclic boot is 4-1/4".



CABIN COMFORT

Photo #55

Cabin comfort parts as received from RotorWay International. Cabin comfort small parts and hardware are found on E54 CARD 1.

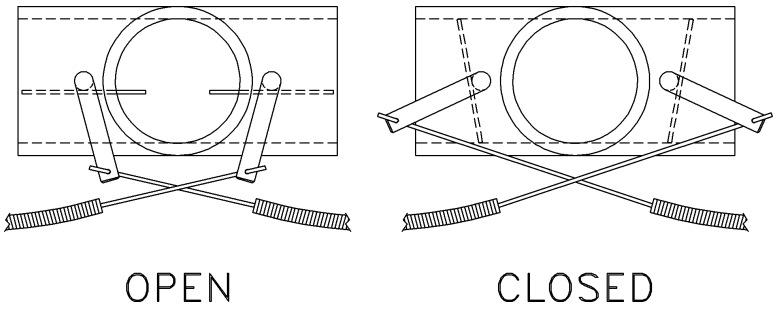


Photo #56

Overview of the assembled three way collector. The inlets are directly across from each other. The outlet is the hole that is 90 degrees from the two inlets. Each butterfly will open when the cable is pulled out and close when the cable is pushed in. See Section 22 for cable routing.

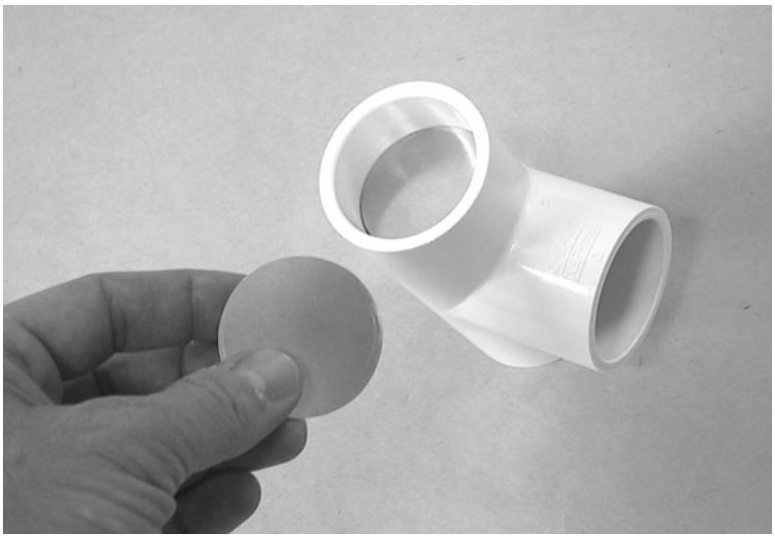


Photo #57

Cut out the butterflies from .050 aluminum and fit them into the openings.

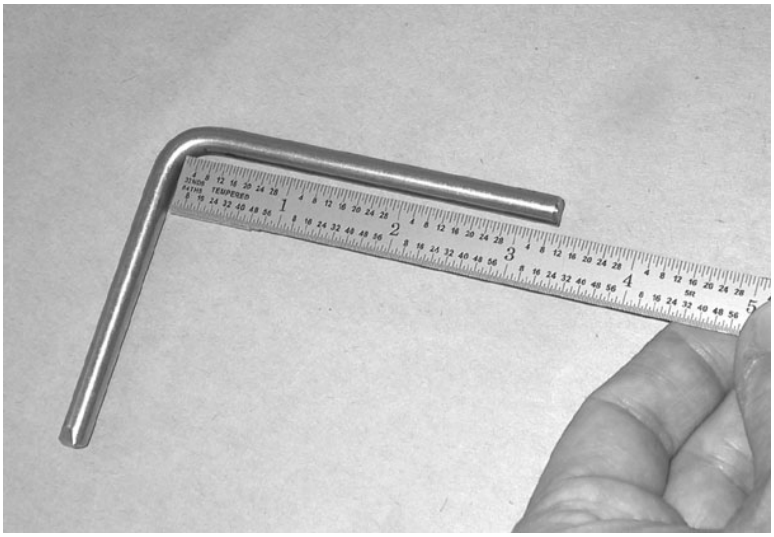


Photo #58

Bend the butterfly shafts 90 degrees, 3-1/4" from one end. The shafts may be heated to make bending easier.

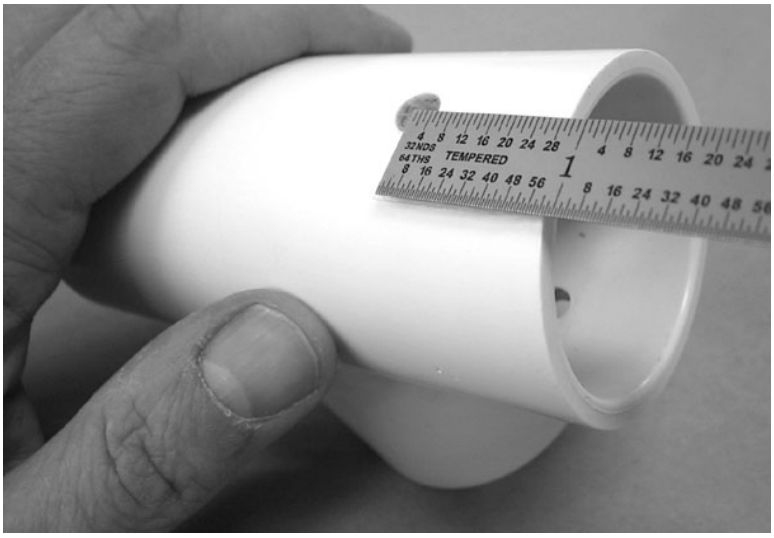


Photo #59

Measure 7/8" from each end of the collector and drill a 1/4" hole in each location for the butterfly shafts. The holes must be parallel to the 90 degree outlet hole.

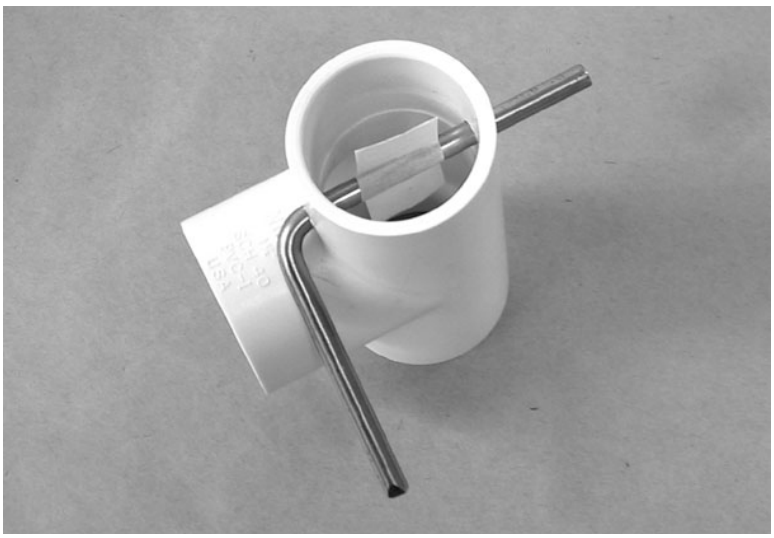


Photo #60

Place a piece of tape on the shaft to verify that the butterflies will be mounted correctly. Observe open and closed positions.

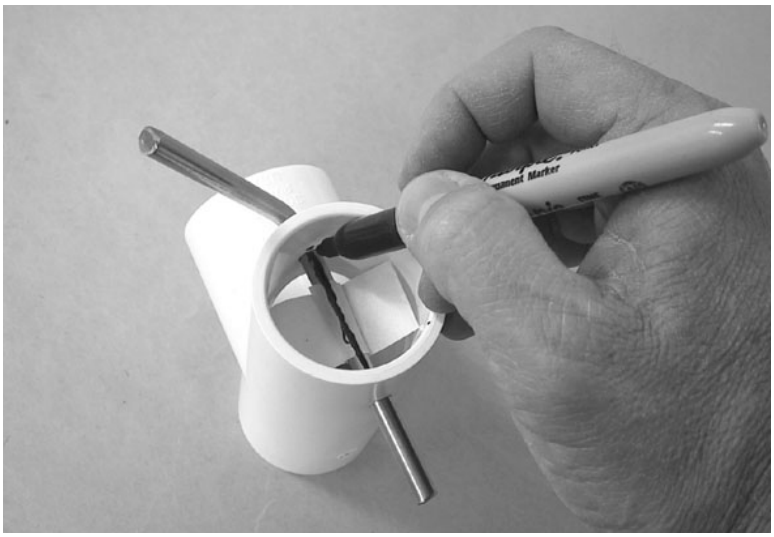


Photo #61

Hold the shaft in the closed position and draw a line on the shaft inside the collector, across the entire inside diameter. This will be the center line of the butterfly mounting holes.

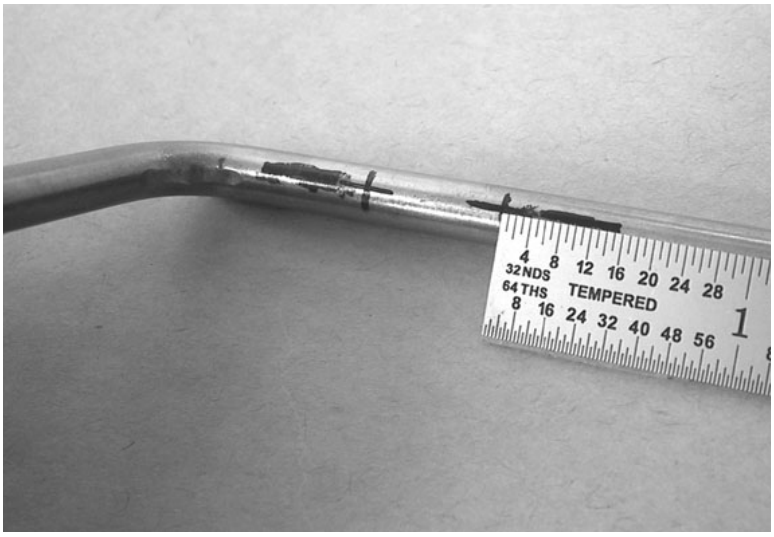


Photo #62

Remove the tape and the shaft. Locate the mounting holes by measuring 1/2" from each end of the line. Drill a 1/8" hole at each location.

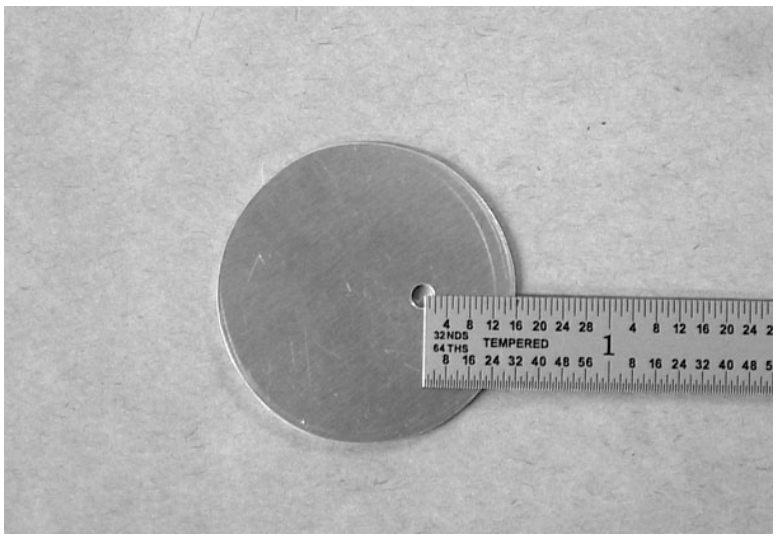


Photo #63

Measure 1/2" from the edge of the butterfly and drill one 1/8" hole.

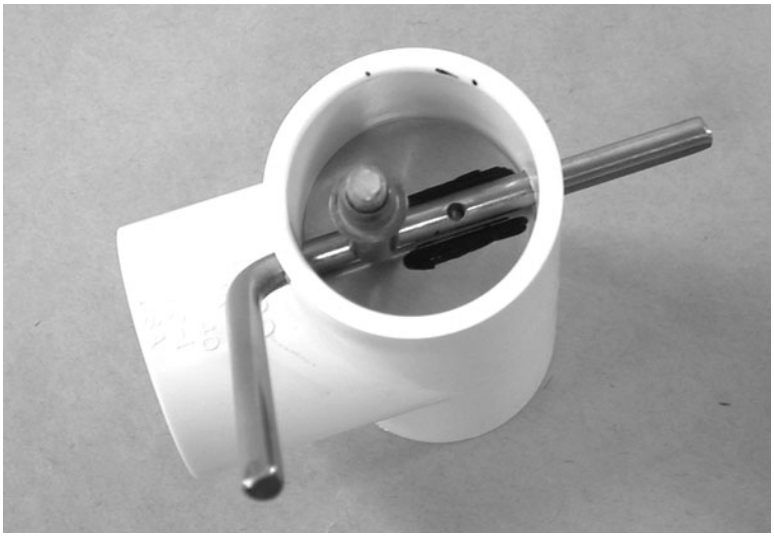


Photo #64

Install the shaft and hold the butterfly in the three way collector with one cleco. Mark each side of the shaft.

Photo #65

Remove the shaft and butterfly. Cleco them together, align the shaft with the marks and drill the second hole.

Photo #66

Install the butterflies in the collector and file them to fit if necessary.

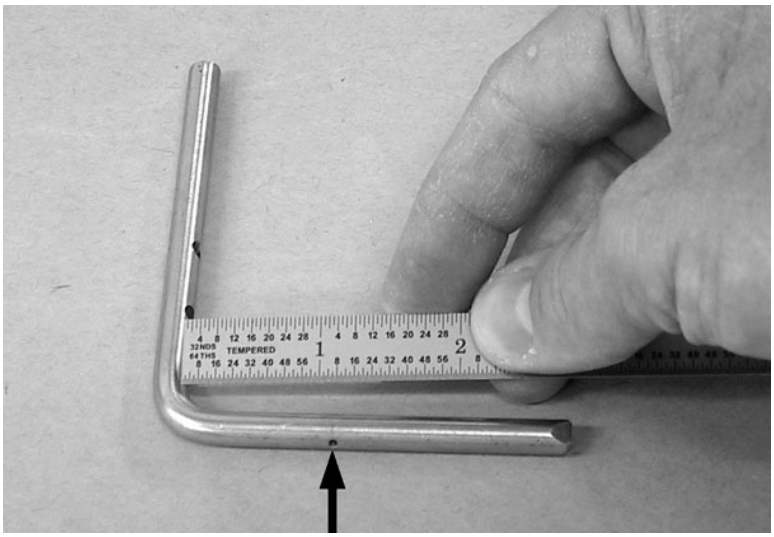


Photo #67

Remove the shaft and measure 1-1/8" from the bend. With a #53 drill bit (.0595 inch), drill a hole parallel to the butterfly shaft. This hole is where the control cable will be attached.

Photo #68

Before final installation, trim off any excess shaft material. Cleco the butterflies in place. Remove one cleco and install the pop rivet, then install the second pop rivet.

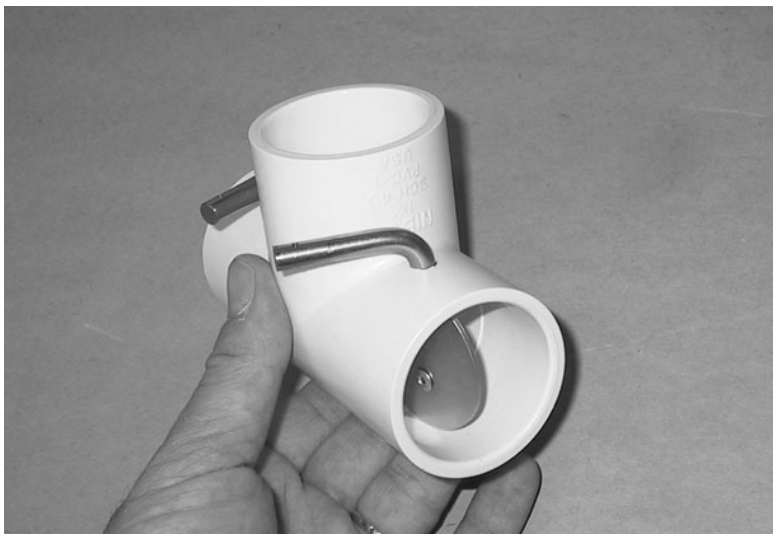


Photo #69

Final installation of the butterflies on the shafts.

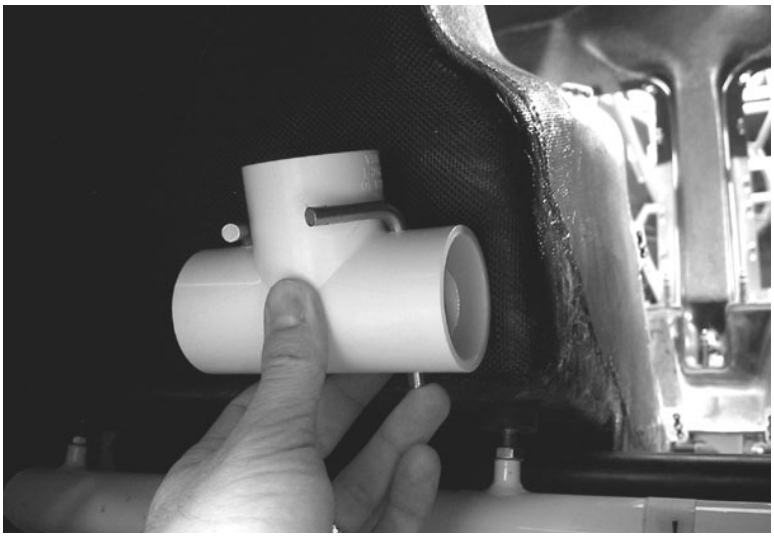


Photo #70

Locate the collector on the underside of the floor pan in front of the passenger foot pedals. Mount it to the floor pan using two nut plates riveted to the inside of the collector. Nut plates should be located in the center of the collector. It will be necessary to countersink the rivet holes in the collector deeper because of the thickness of the material.

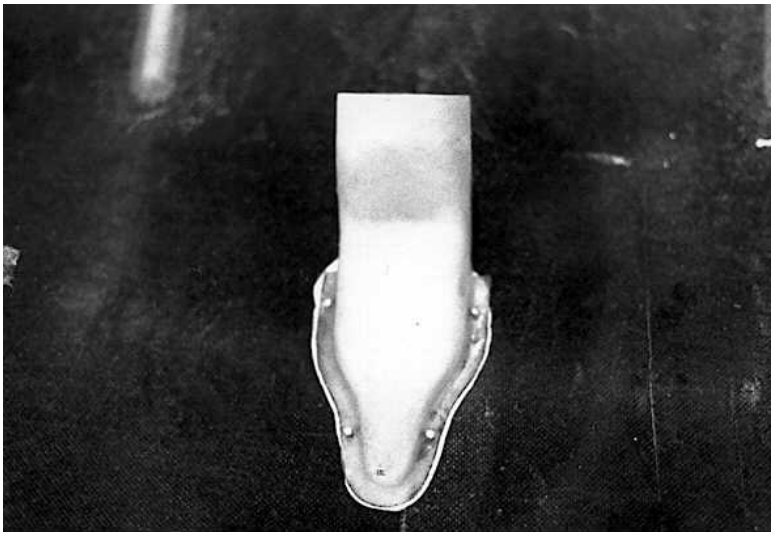


Photo #71

Place the cabin fresh air scoop in the tub so it is centered and 20-1/2" from the front edge of the tub (just in front of the engine fresh air intake scoop). Use the scoop as a pattern to cut the hole in the tub. Attach the scoop to the tub with pop rivets and silicone. (This view is of the inside of the tub.)

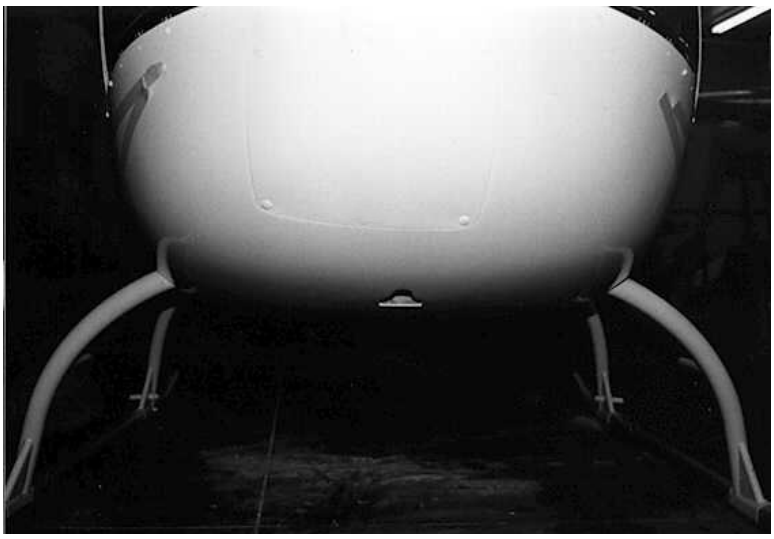


Photo #72

A view of the fresh air scoop from the outside of the tub. Note that the shape and size of the opening are the same as the scoop design.

Photo #73

Use masking tape to lay out the cabin air inlet slots. There will be four slots, two on each side. Find the center of the pod and measure 4" to the left and 4" to the right. This will be the starting point of the slots. Each slot will be 3-1/2" long and 3/8" wide, with 3-1/2" between. The front edge of all slots will be 3/4" from the windscreen edge of the pod.

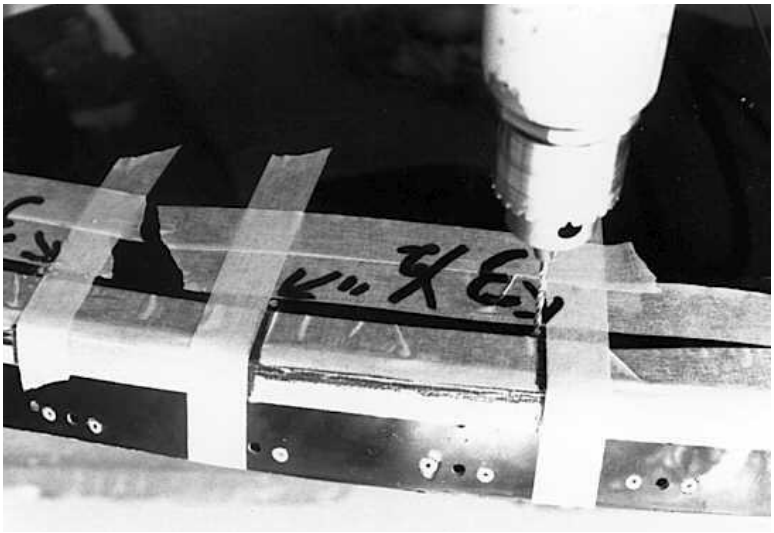


Photo #74

Drill a 3/8" hole at each end of the slots.

Photo #75

After the holes are drilled, use a cutting wheel on an air grinder to cut the slot openings between the holes.

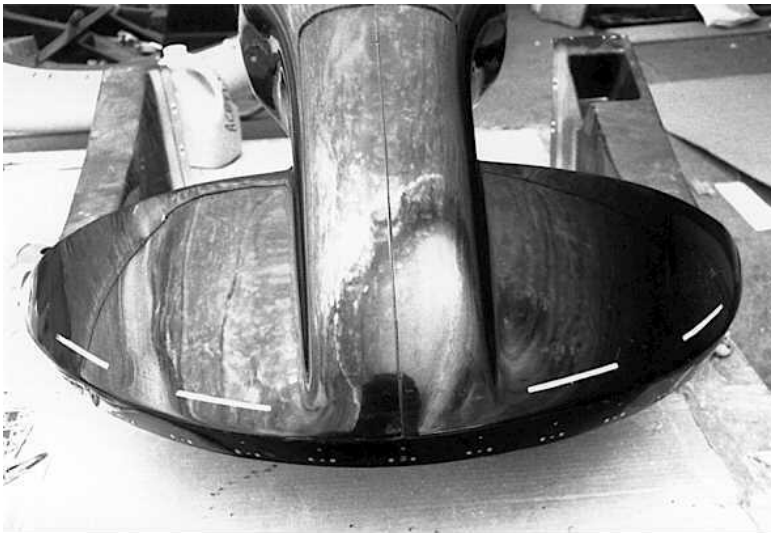


Photo #76

Remove the tape and deburr the slots with a file and sandpaper.

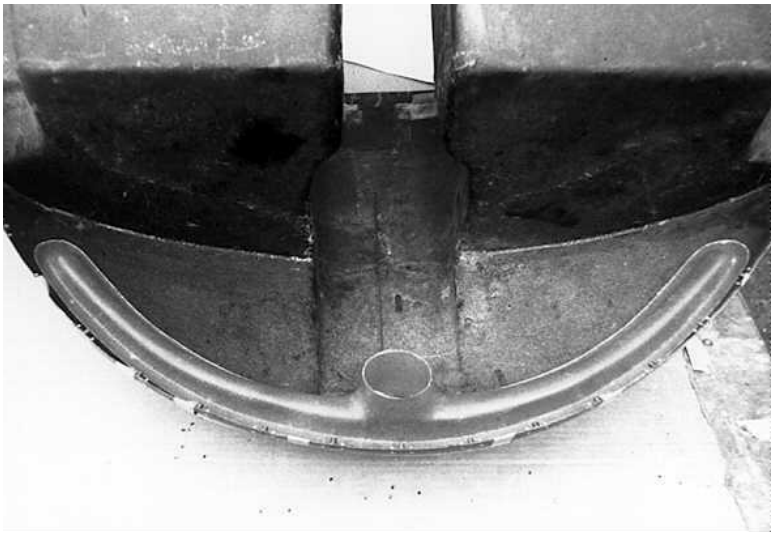
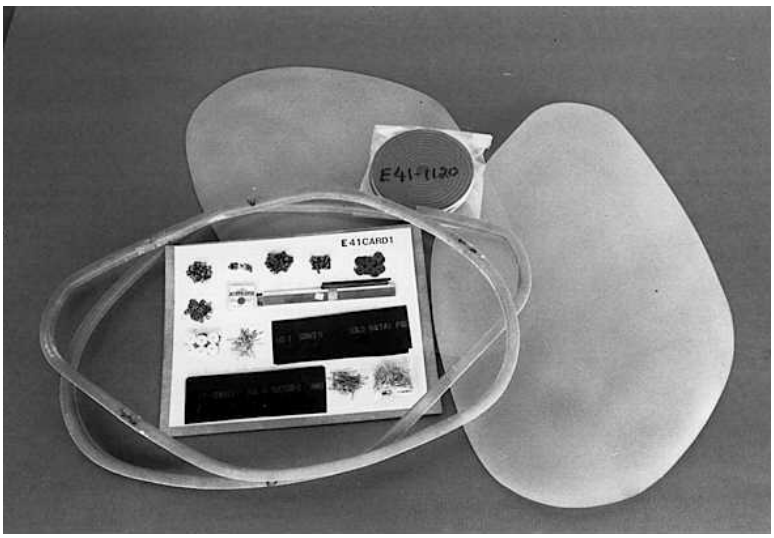


Photo #77

Use fiberglass mat and resin to bond the plenum (curved fiberglass part) to the underside of the floor pan/instrument pod. Hold it in place with clamps while the bond is curing. Be sure that the plenum is correctly aligned under the slots.
Note: Paint the exterior of the plenum black prior to final assembly. This will make it less visible from above.



DOORS

Photo #78

Use print E41-2000 and templates E41-1 and E41-2 when constructing the doors. Parts as received from RotorWay International.
Note: Small parts and hardware for the doors is found on E41 CARD 1.

Photo #79

Cut several pieces of 3/16" thick cardboard into 1" wide strips and tape them to the inside openings of the doors.

Photo #80

Overview of cardboard in the door opening. The cardboard will provide the clearance needed between the door stiffener and the body when opening and closing the door.

Photo #81

Fit the door stiffener tight against the cardboard. It may be necessary to cut the stiffener to make it fit.

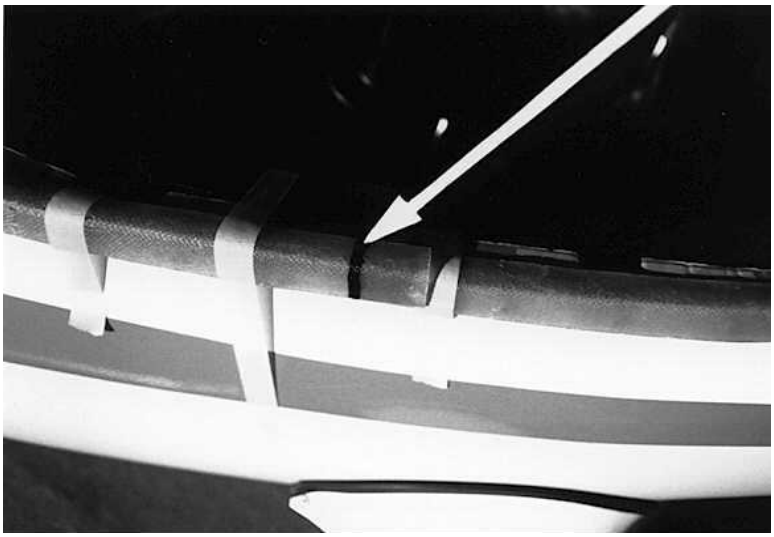


Photo #82

If necessary, remove a section of the stiffener so that when it is butted together there is a tight fit between the stiffener and cardboard. Use masking tape to hold it in place.
After sizing, re-join the stiffener using 2 or 3 layers of fiberglass cloth and resin applied to the side of the stiffener opposite the plexiglass (the side that fits against the body).

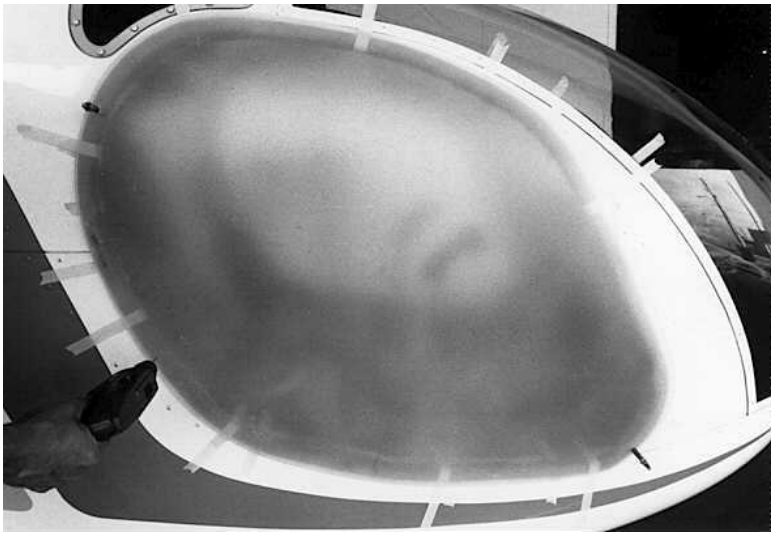


Photo #83

Hold the door against the stiffener so that it extends beyond the stiffener all the way around the door. Use masking tape to hold it in place.

Photo #84

Drill a 1/8" hole through the plexiglass door and stiffener with a hand drill, and install a cleco.

Photo #85

Place a thin piece of wood or metal scrap between the stiffener and the body panel when drilling to prevent damage to the body panel.

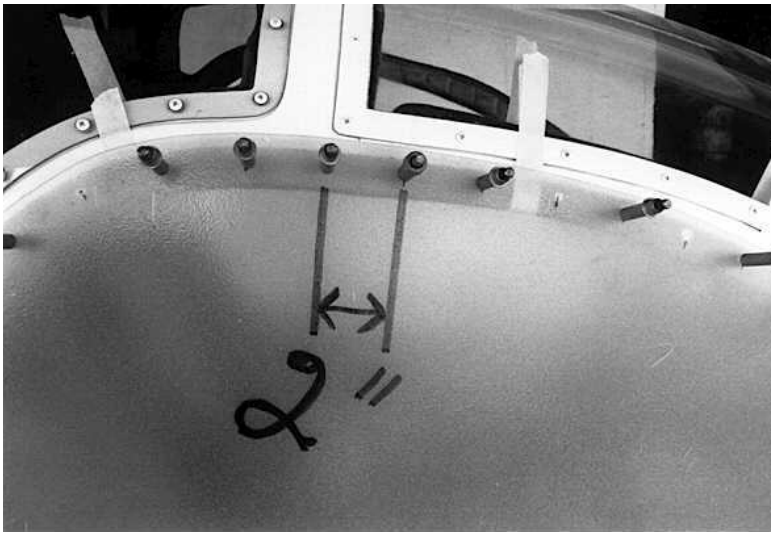


Photo #86

Lay out the location of the rivet holes around the door with a felt tip pen. The rivets will be two inches apart and centered on the stiffener.

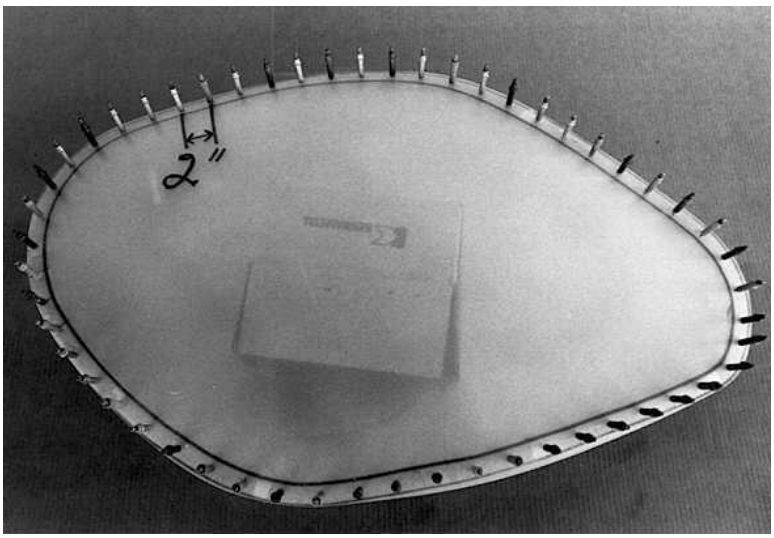


Photo #87

The 1/8" holes drilled and cleco installed.

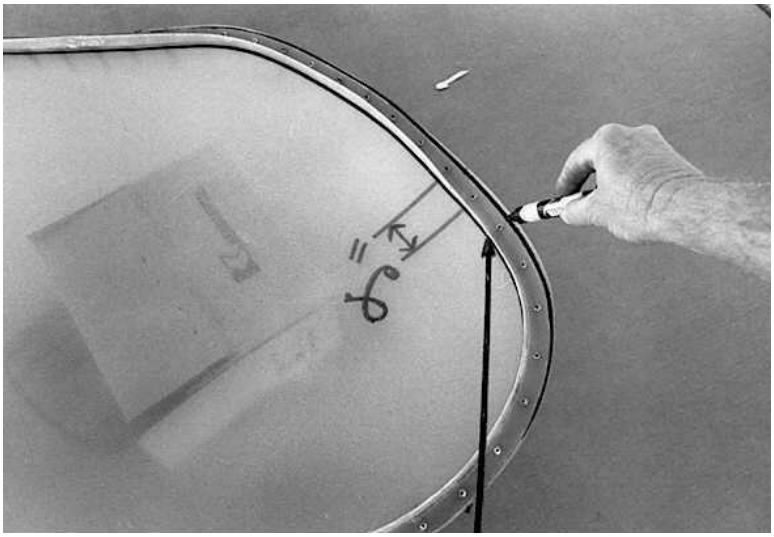


Photo #88

Using a felt tip pen, outline both sides of the stiffener.

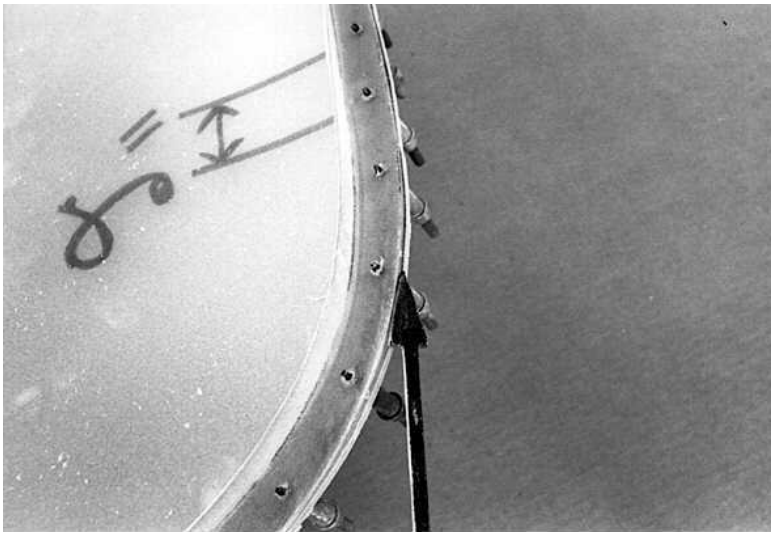


Photo #89

Trim the plexiglass to the line and edge of the stiffener.

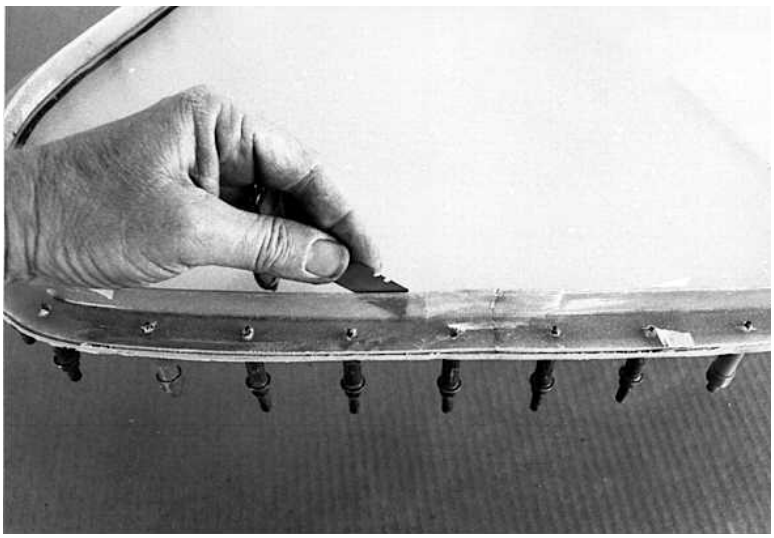


Photo #90

Use a utility knife blade to cut the protective film on the plexiglass even with the inside of the stiffener.

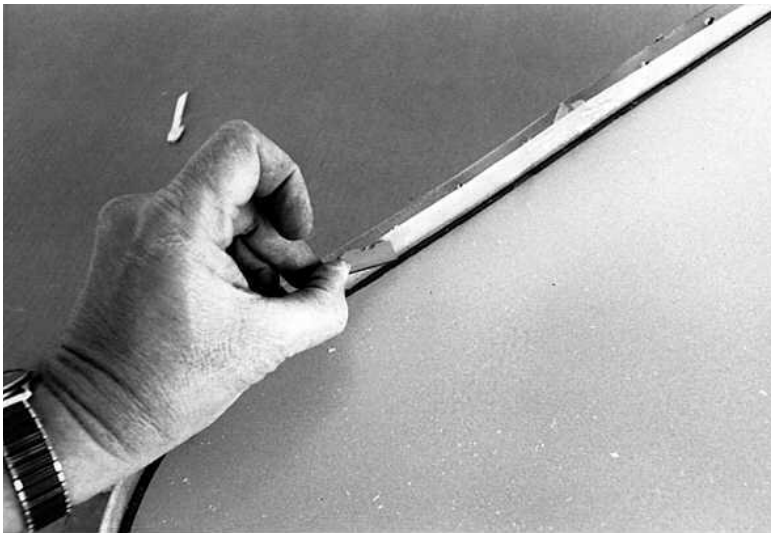


Photo #91

Another view of cutting the protective film. Be careful to cut only the film.

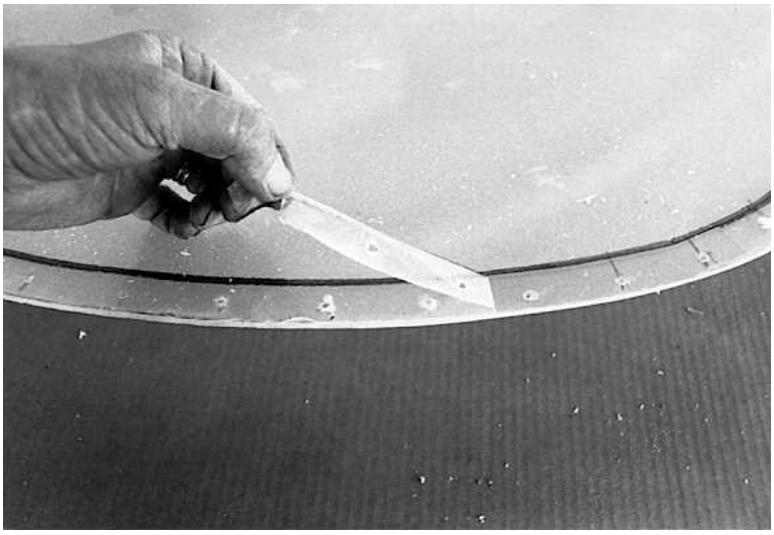


Photo #92

Remove the protective film from the edge of the plexiglass door.

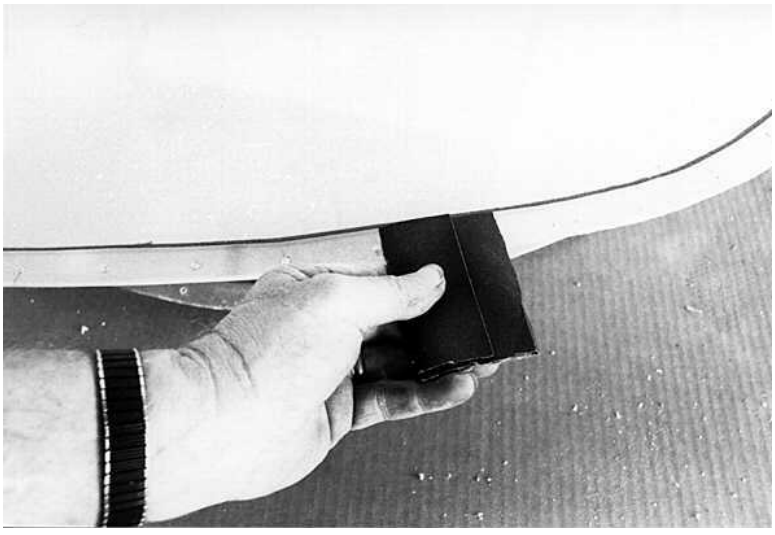


Photo #93

Use 220 grit sandpaper to sand the plexiglass that will be bonded to the stiffener. Wipe clean with acetone.

Photo #94

Use 220 grit sandpaper to sand the stiffener where it will be bonded to the plexiglass. Wipe clean with acetone.

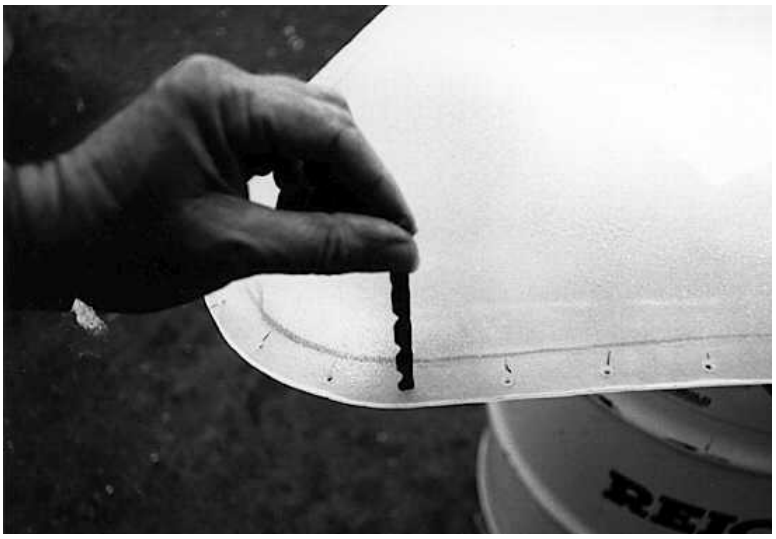


Photo #95

Countersink the holes in the plexiglass for the head of the pop rivets.

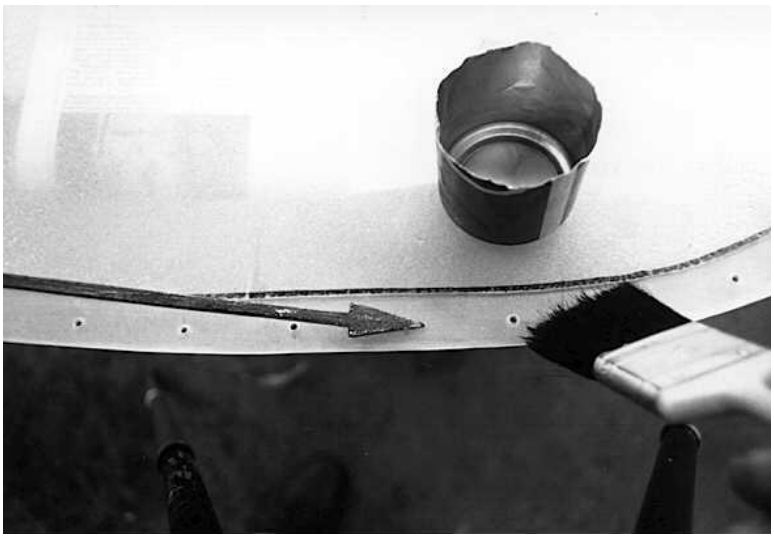


Photo #96

Mix some resin and catalyst and apply a coat on the edge of the plexiglass door where the stiffener is to be bonded.

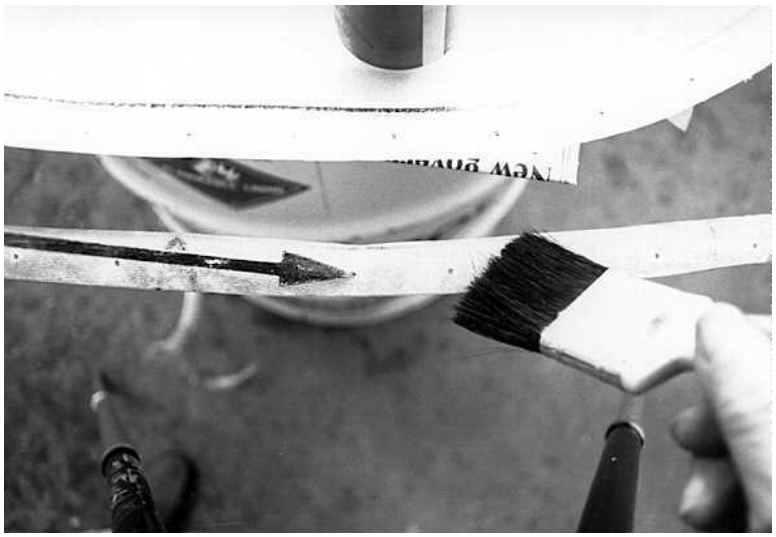


Photo #97

Apply the resin to the stiffener where it is to be bonded to the plexiglass.

Photo #98

Place the stiffener on the plexiglass and install the pop rivets.

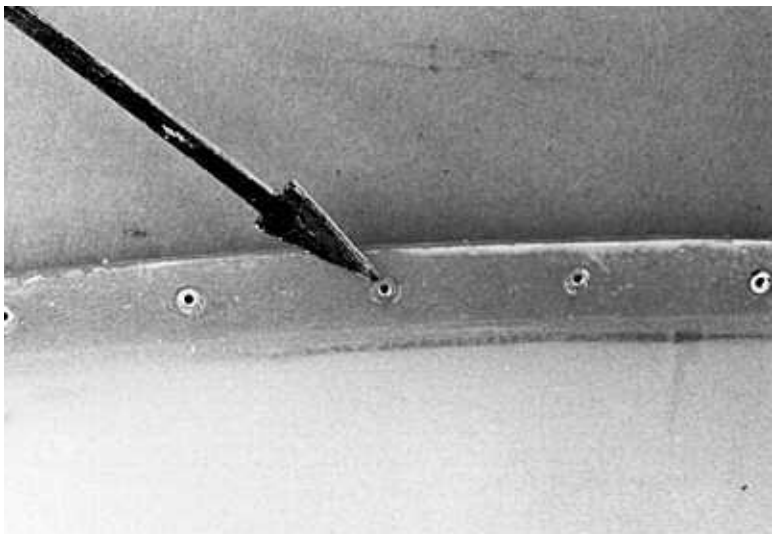


Photo #99

View of the head of the pop rivet installed.

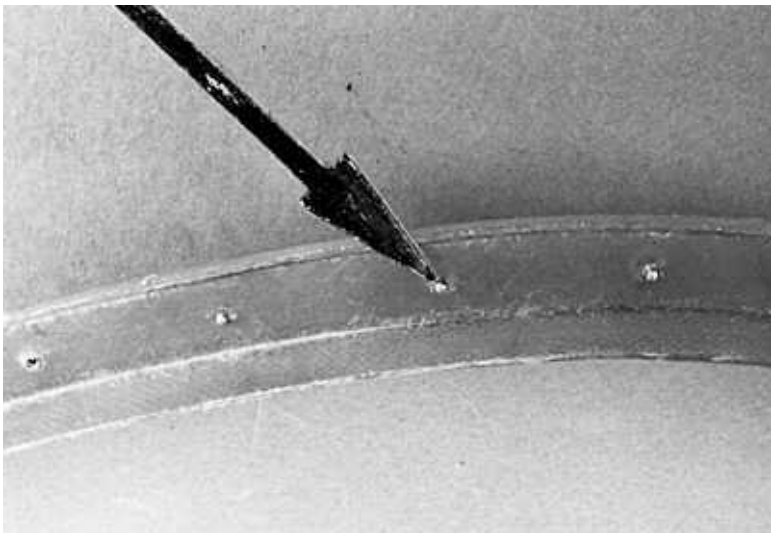


Photo #100

View of the bottom of the pop rivet installed.

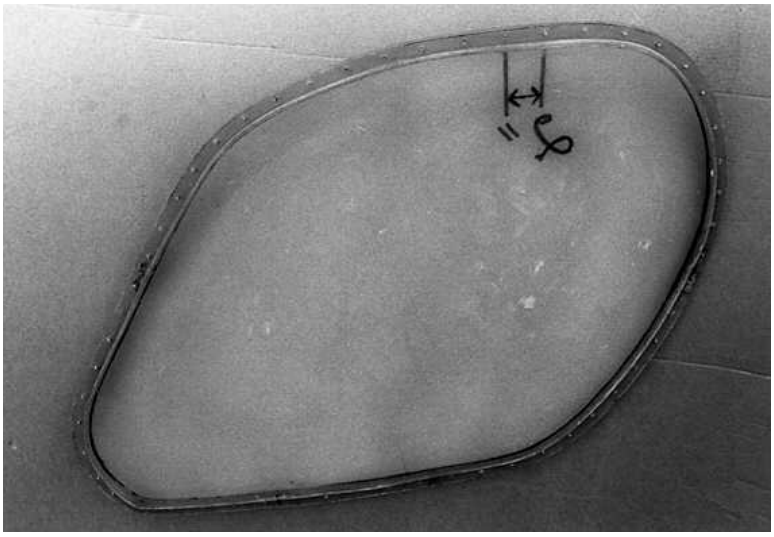


Photo #101

Overview of the door with the stiffener bonded and pop riveted together.

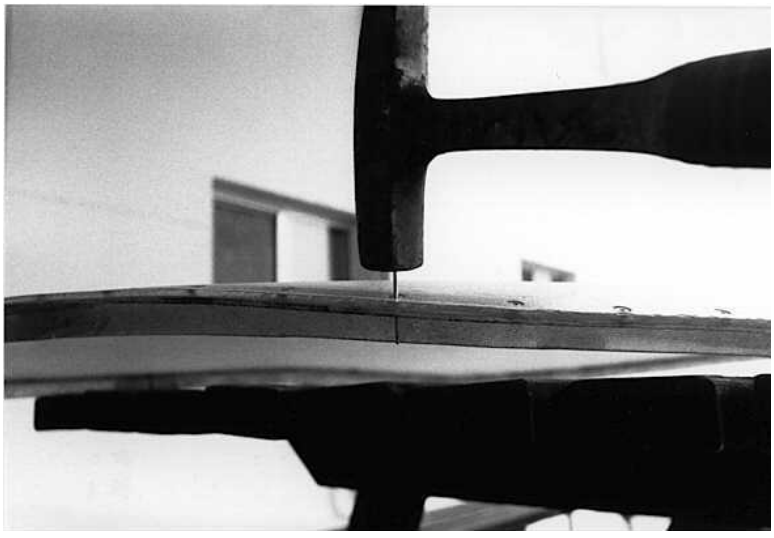


Photo #102

Use a pop rivet and a hammer to drive out the ball in the pop rivets.

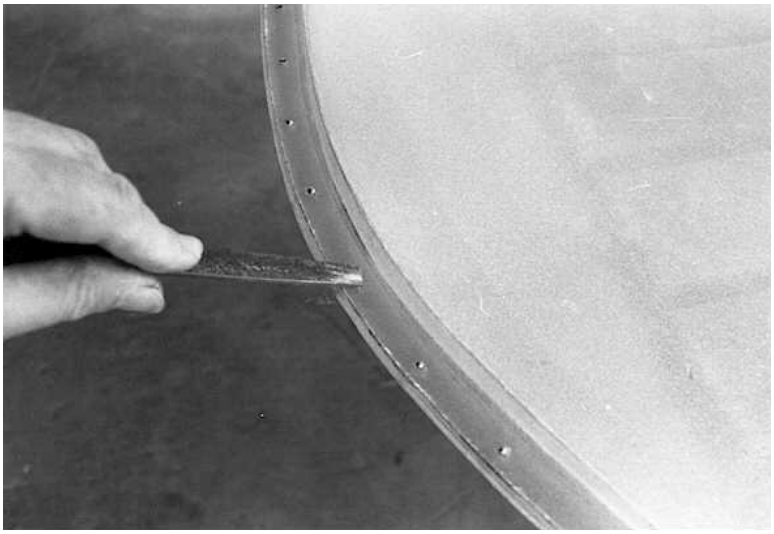


Photo #103

File the end of the pop rivets flush with the stiffener.

Photo #104

Sand the surface of the stiffener smooth with sandpaper.

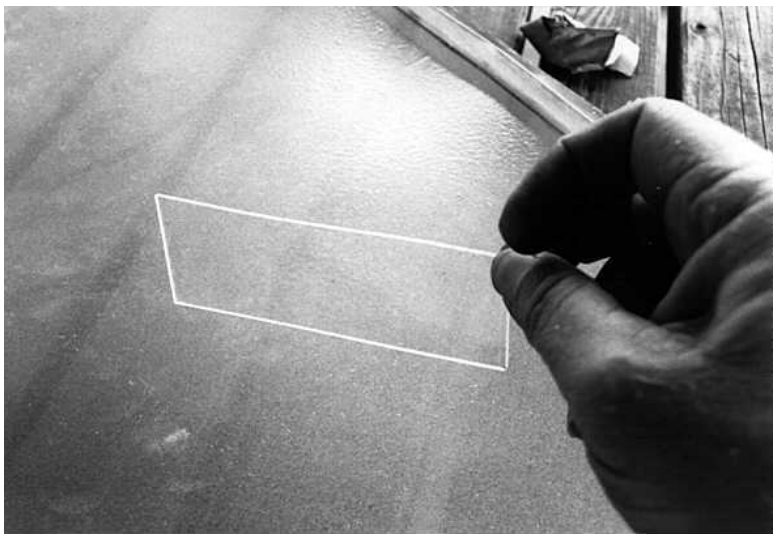


Photo #105

Cut a piece of plexiglass and smooth the edges to fit against the stiffener and door.

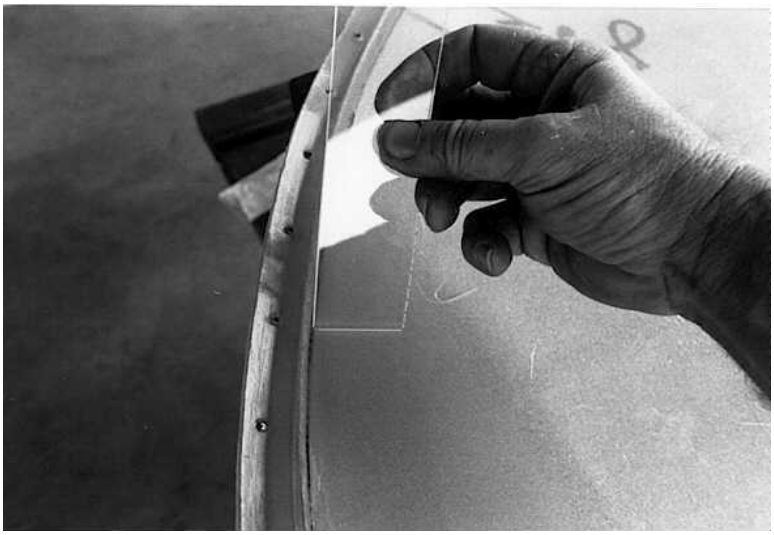


Photo #106

Use the piece of plexiglass to apply bondo in the corner where the stiffener and door meet.

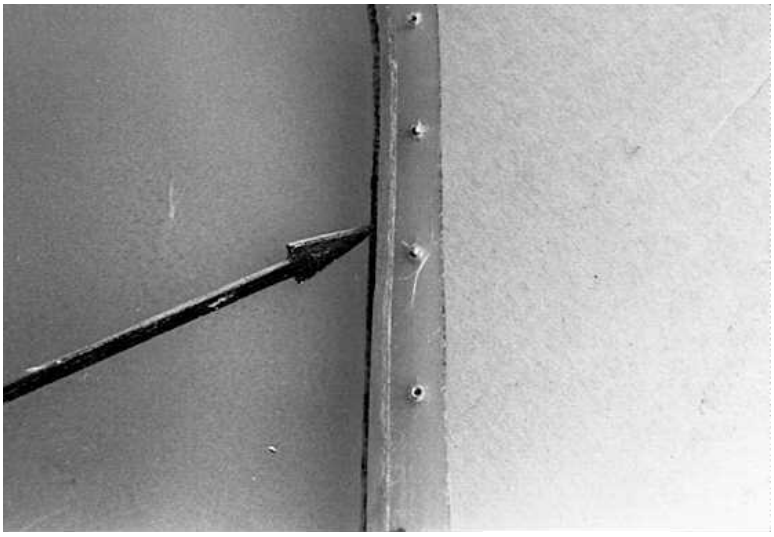


Photo #107

Arrow indicating where to apply the bondo.

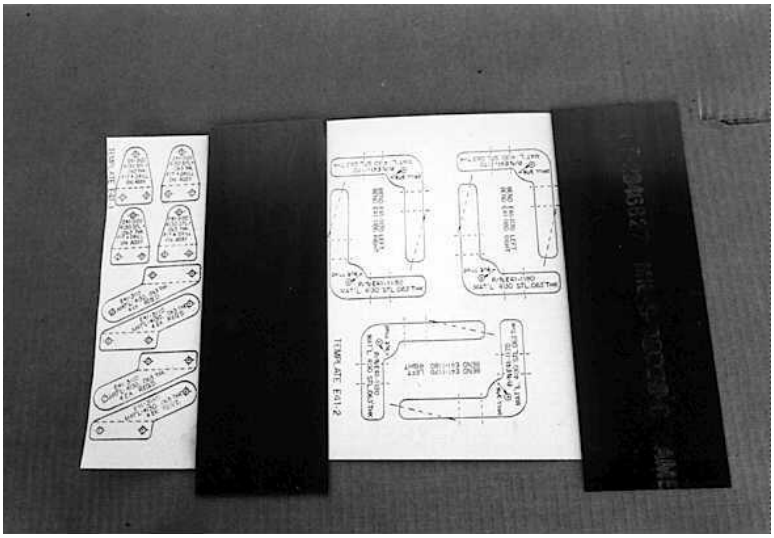


Photo #108

Door hinges and latches as received from RotorWay International.

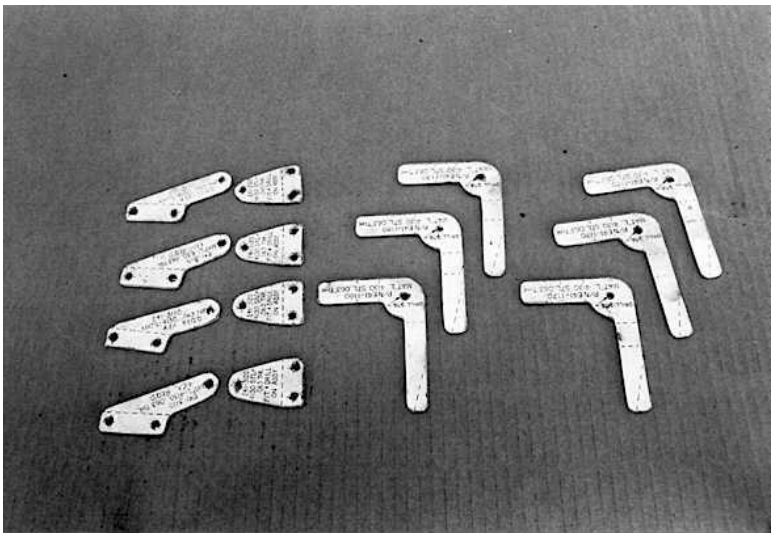


Photo #109

Clean the 4130 steel with acetone and apply the templates to it. Drill the holes where indicated on the templates, then cut out the parts.

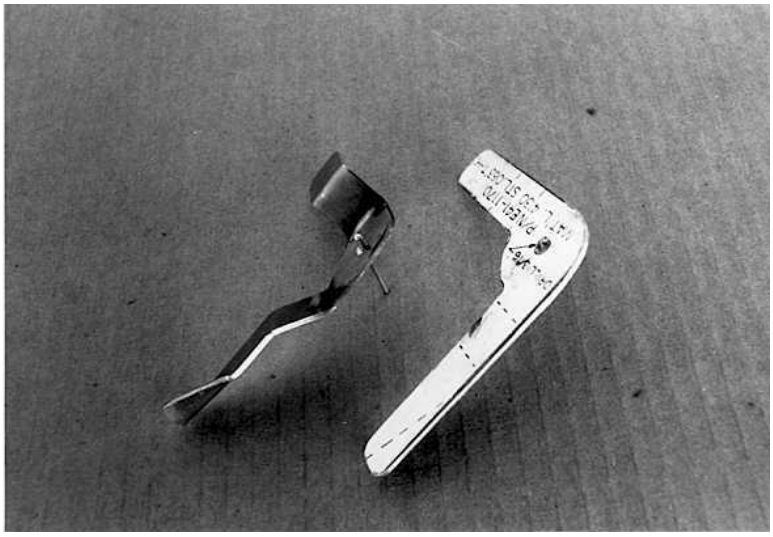


Photo #110

Bend the door latches where indicated on the templates.
Note: The bends will be opposite on the opposite sides of the ship.

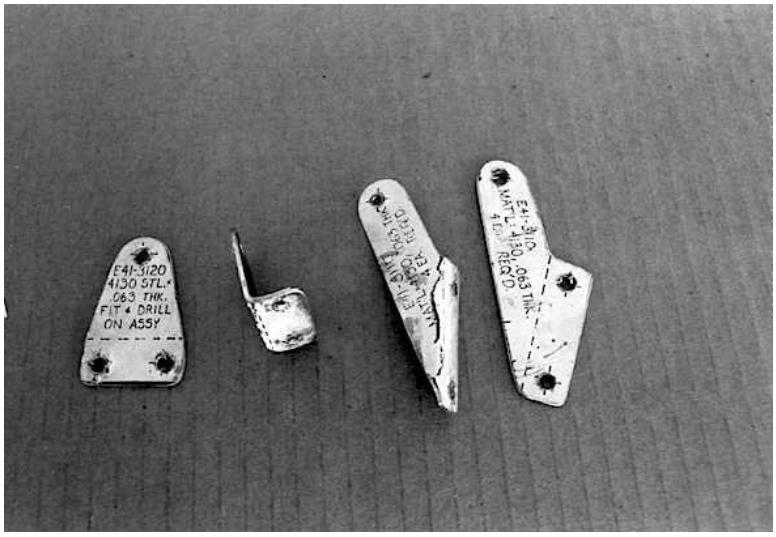


Photo #111

Bend the door hinges where indicated on the templates.

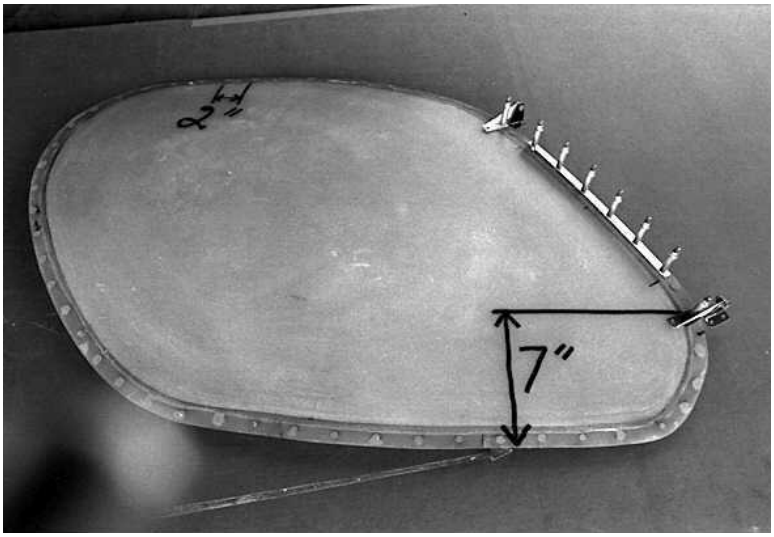


Photo #112

Draw a line parallel to the bottom of the door seven inches from the bottom. This will be the location of the bolt to hold the hinge to the door.

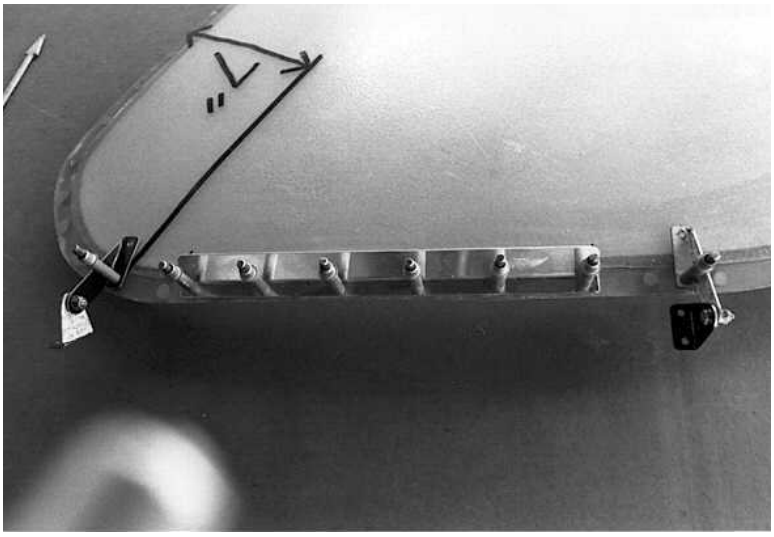


Photo #113

Install only one cleco in each hinge. Refer to print E41-2000 for hinge and stall strip location.
Note: Installation of the stall strips is very important and must not be overlooked. These strips direct the flow of air over the doors, preventing them from opening during high speed flight.

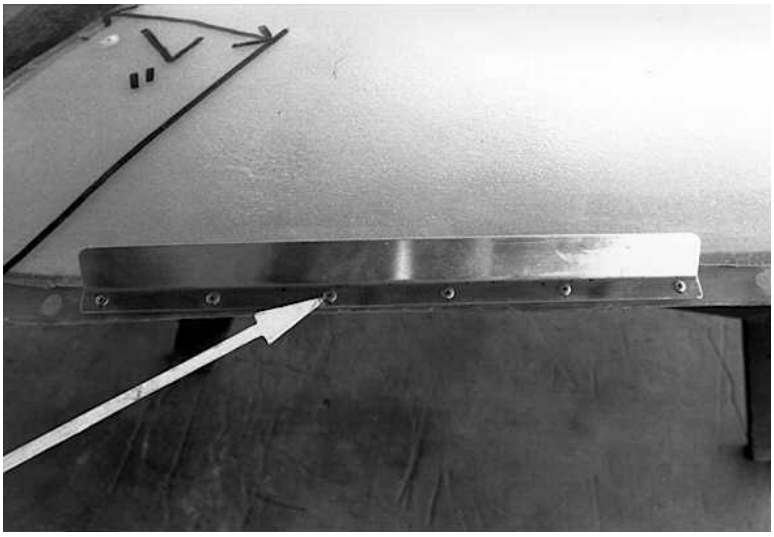


Photo #114

Install the pop rivets that hold the stall strip to the front of the door.

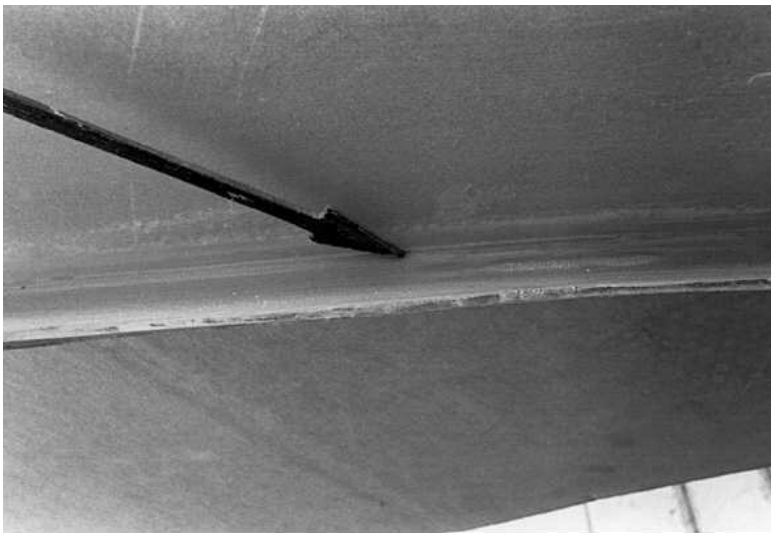


Photo #115

Apply the bondo between the stiffener and the plexiglass door and sand it to a smooth finish.

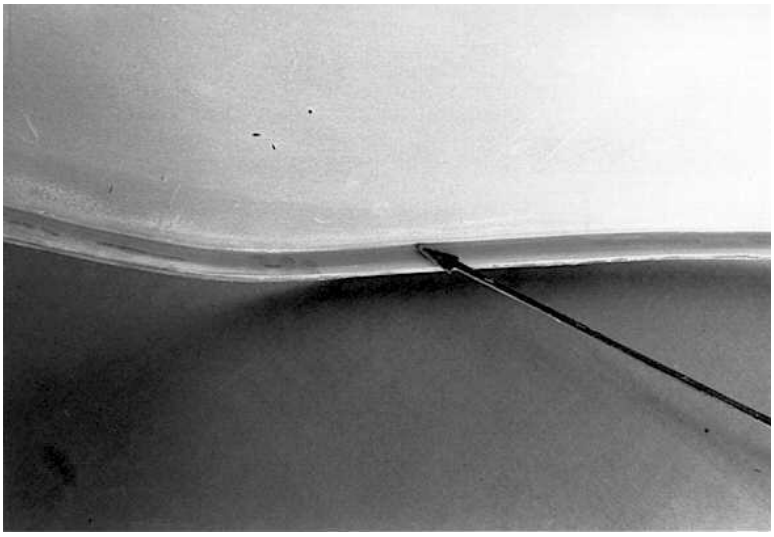


Photo #116

Another view of the area where bondo is applied around the stiffener and door.

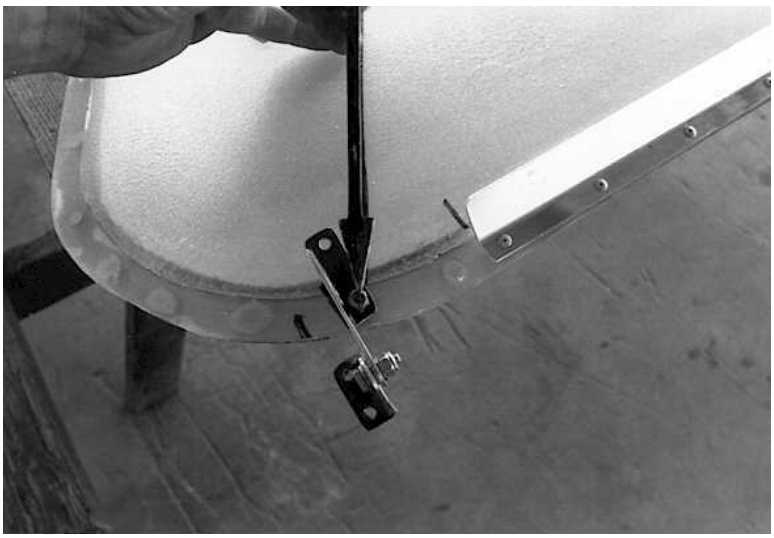


Photo #117

Bolt the two parts of the hinge together. Install one bolt in each hinge to hold the hinge to the door.

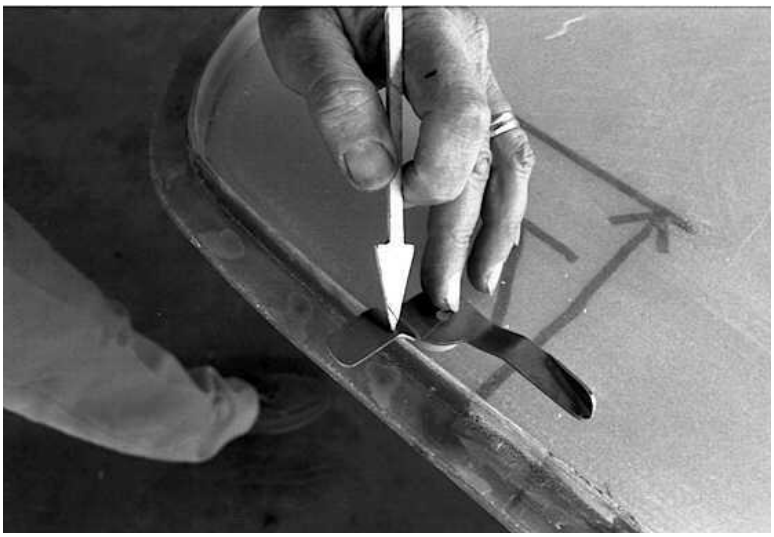


Photo #118

Place the bent latch on the spacer. Position the latch so the bend clears the door stiffener and is at the location called for on print E41-2000.

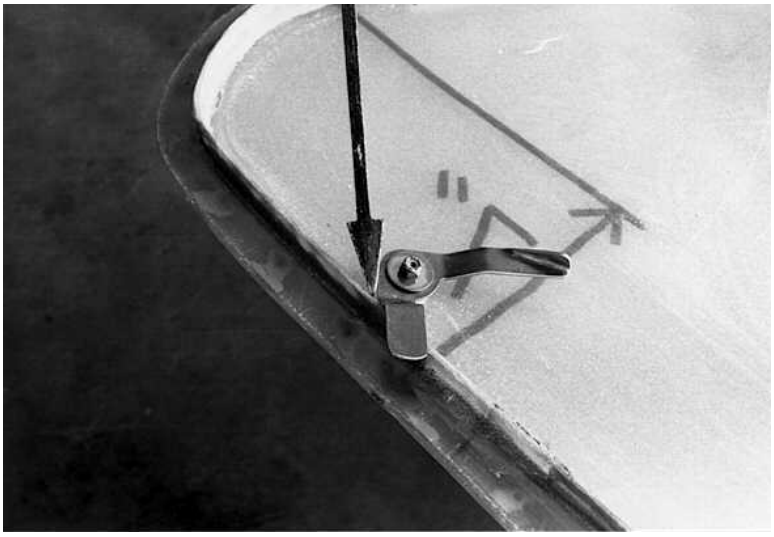


Photo #119

Before drilling the hole for the bolt, rotate the latch to check the clearance between the latch and stiffener.

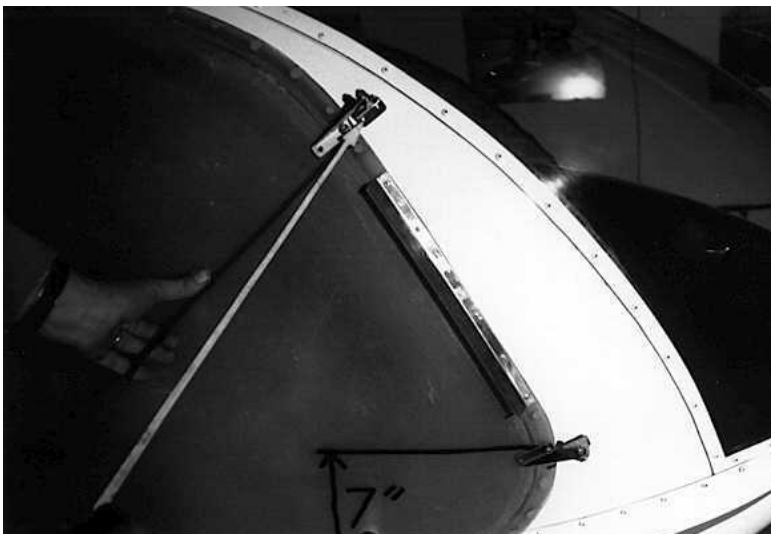


Photo #120

Place the cardboard around the door opening. Hold the door in the opening and drill one hole in the part of the hinge on the door post. Open the door. If the hinges do not try to move, they are in alignment. Drill the remaining hole and install the bolts.

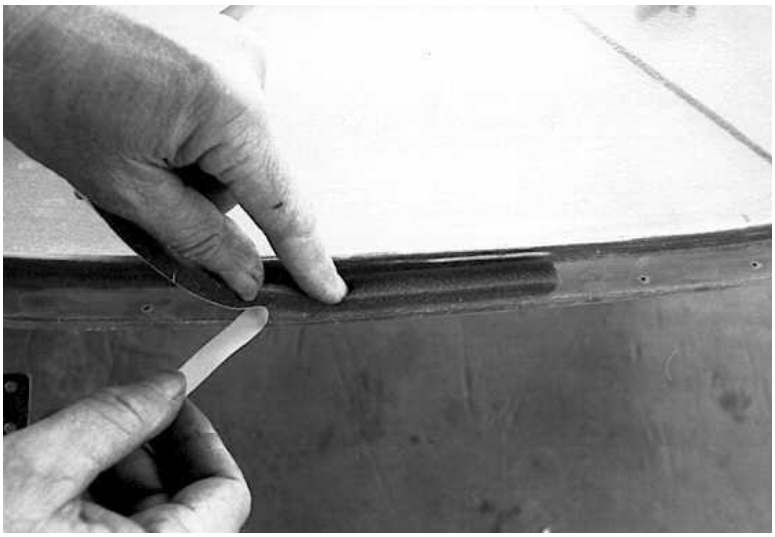


Photo #121

Remove the door and cardboard. Install the weather stripping to the door stiffener as shown.
Note: It may be necessary to trim the fiberglass around the door opening to achieve the desired fit around the latches. Locate and cut the slots in the floor pan for the bottom latch. Cut out and rivet a piece of .050" aluminum around the slot as a wear plate for best results.

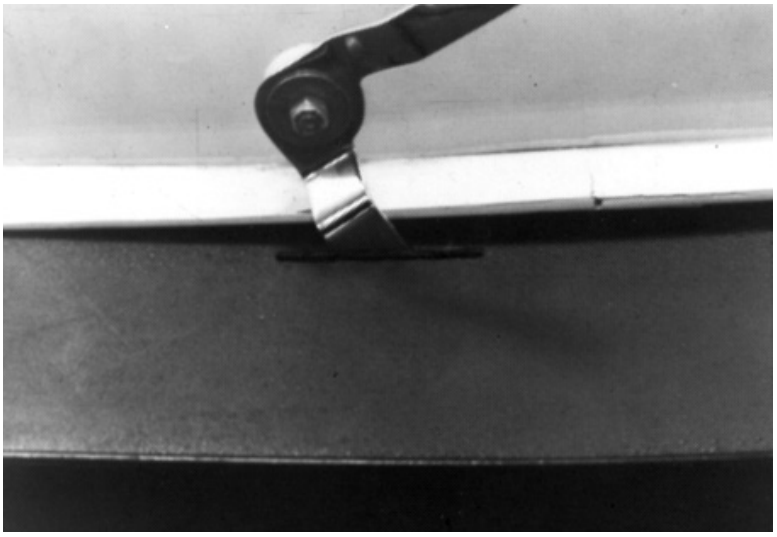
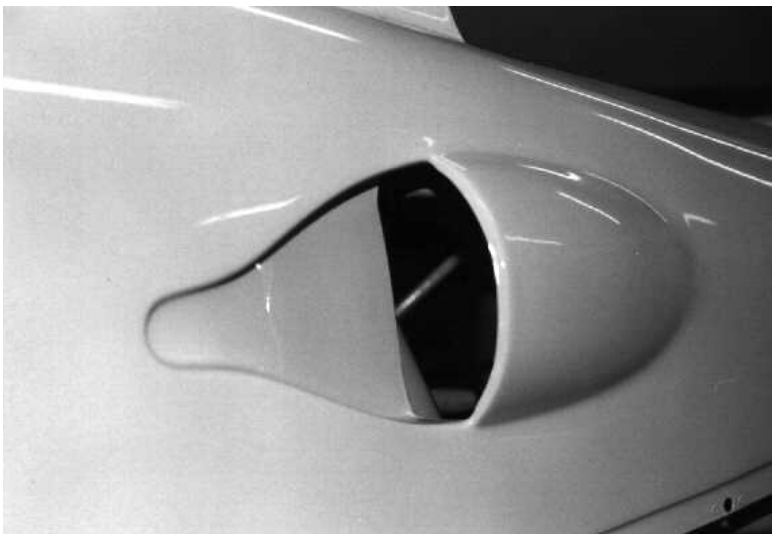


Photo #122

Photo showing the door latch and slot.
Note: The protective film can be removed from the doors after all work on them is finished.



FINAL BODY COMPLETION

At this point in the construction, the body has been assembled and fitted, with only minor details remaining. Dzus buttons and nut plates should be installed in all panels, if not already done. The following photos show other steps to be completed as the body is being disassembled for painting.

Photo #123

Cut an opening in the side air scoops as shown. Leave about a 1/4" lip around the edge of the opening to provide rigidity.

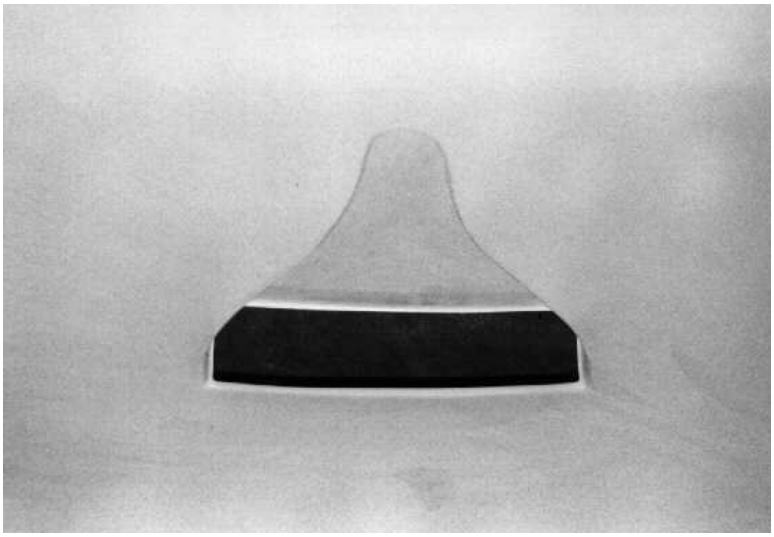


Photo #124

Cut out the opening of the air intake scoop in the bottom of the tub. Leave a slight lip (about 1/4") around the opening for stiffness.
Note: If equipped with optional ACIS, refer to Section 27 for instructions on installing the ACIS air filter housing.

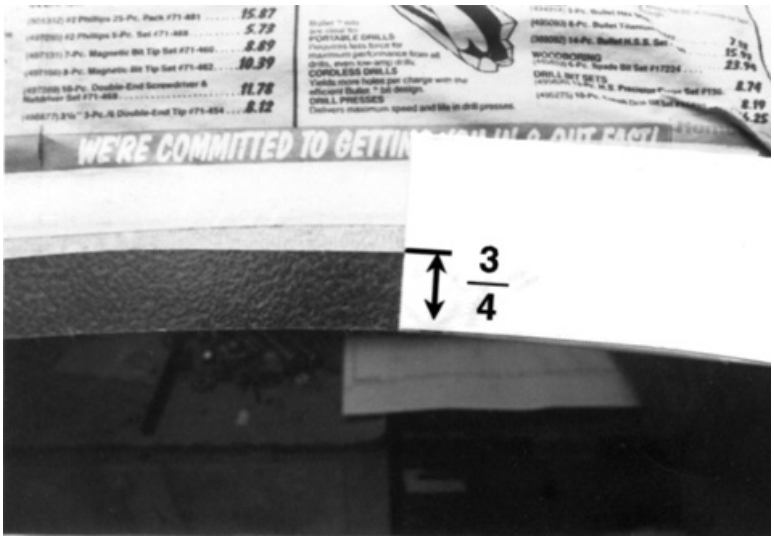


Photo #125

After the windscreen has been completely fitted, remove it from the ship and mask off 3/4 inch from the outside of the windscreen all the way around.

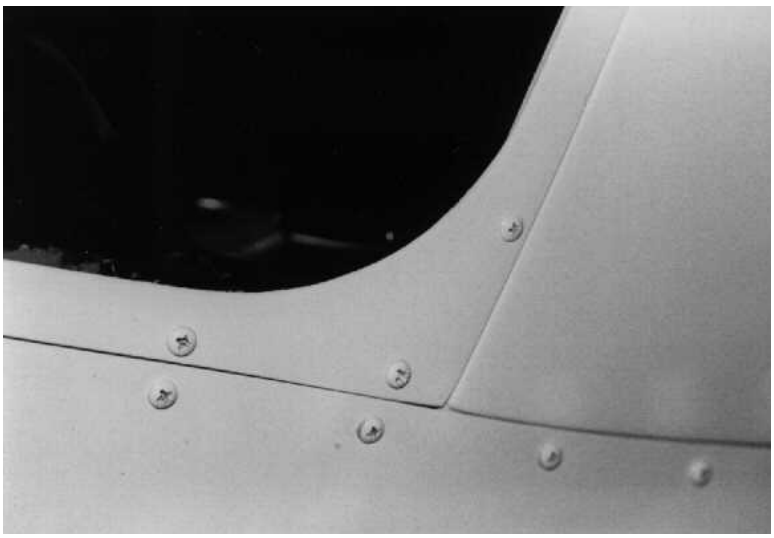


Photo #126

In the lower front corners of the windscreen, cut pieces of fiberglass mat and fit them so that there will be a 3-1/2 inch radius in those corners. (Finished windscreen shown.)

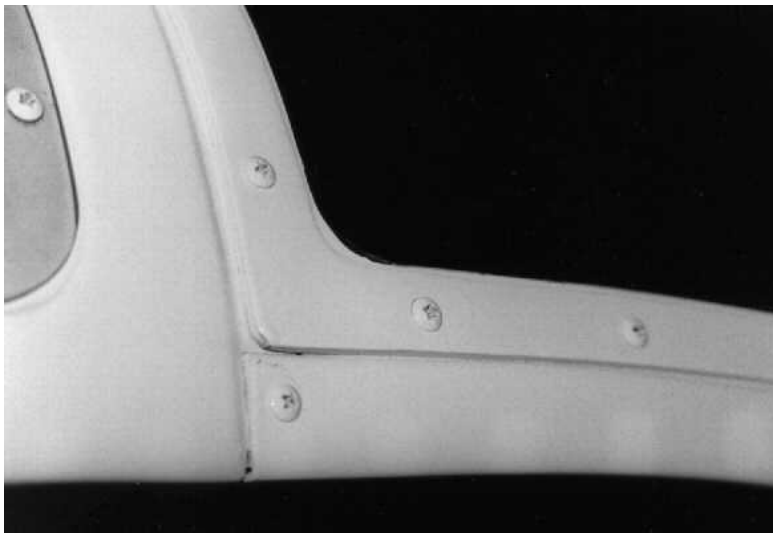


Photo #127

Cut and fit fiberglass to make a smaller radius on the upper rear corners of the windscreen. (Finished windscreen shown.)

Photo #128

Sand the area with 220 grit sandpaper so the resin will stick to the plexiglass.
Note: Remove the protective coating in the area to be sanded.

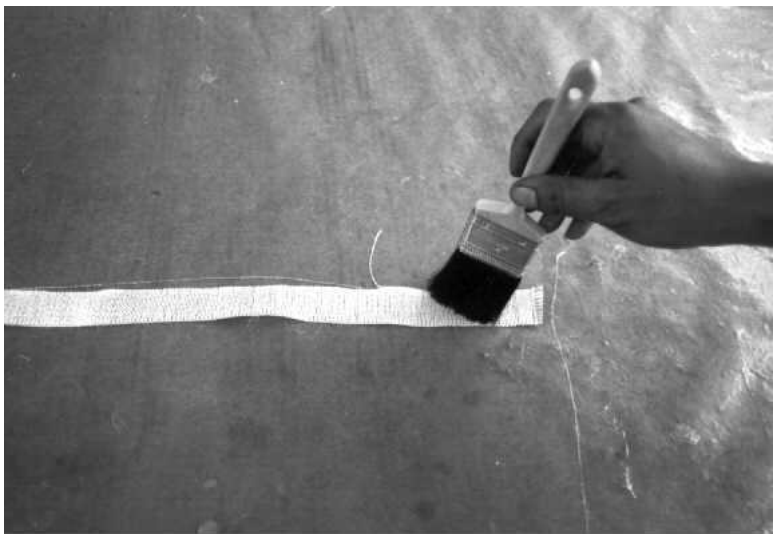


Photo #129

Place the strip of fiberglass cloth on a clean surface and saturate it with resin.
Note: This fiberglass cloth, part number E32-1170, is found on E32 CARD 2.

Photo #130

Apply a coat of resin to the sanded edges of the windscreen.

Photo #131

Place the fiberglass cloth around the edges of the windscreen, allowing the edge to overhang. When the resin hardens, trim off the overhang with a razor knife. Re-drill all windscreen screw holes with a 5/32" drill.
Note: When painting the body, paint the reinforced edge of the windscreen the same color as the body.

Photo #132

Sand and polish the seam on the top of the instrument pod.

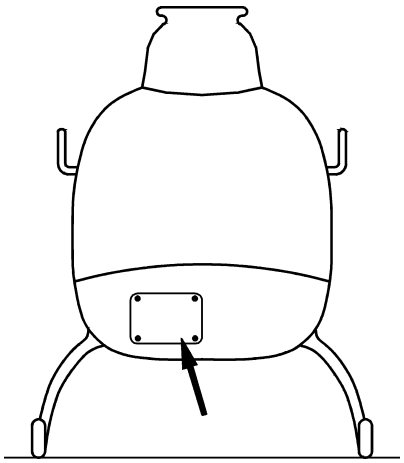


Photo #133

Fit and install the front inspection panel. Use 4 Dzus buttons.