Installing the Seats

The builder must fabricate his own cushion support system as described below. Beware, however: upholstery is dead weight and detracts from performance, so make it light. Also, don't run upholstery over outside edge of seat as clearances are very tight.

As the seats come to you, there is paint inside the tracks that are part of the airframe, both the channels at the rear of the seat and the "ears" at the front. This paint should be sanded out to ensure smooth operation. Also, the "ears" may need a little tweaking to make sure there is sufficient clearance for the seat rails because they sometimes pull in while being welded.

Installing the seats is pretty obvious, but the locking mechanism is not (see below). Also, there are several ways you can go about making up the cushion supports (plywood, aluminum, etc.). We'll touch on those later.

Assembling the Seats

When assembling the backs to the bottoms, the back sits *off center to the center of the airplane* and drops down so bolts go through the bushings welded in the frames. The frames do NOT line up with one another.

Seat Cushion Platform

This is where each builder's taste comes into play as there are a number of ways to suspend the cushions:

Upholstery straps. Strapping may be purchased at any upholstery store and woven over the seat frames.

Plywood. Plywood is unnecessarily heavy and its use is discouraged.

Aluminum. This can be done in a number of ways including forming the wedges in the aluminum (see the photo).

Aircraft Fabric. The human form is pretty blunt where it hits the seat, not a lot of sharp corners usually. Plus the cushion is between you and the support platform. For that reason, using heavy weight Dacron and fabric glue, like PolyTac, is absolutely up to the task and it is the lightest way to suspend the flight crew.

Foam for Padding

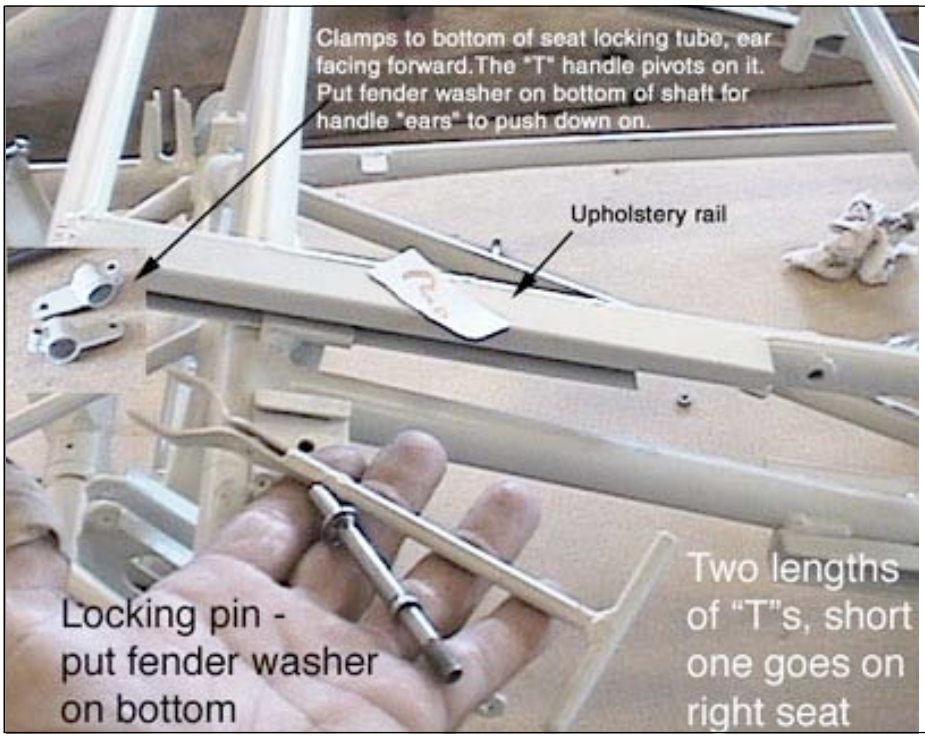
Almost any type of foam can be used on the back but on the bottom it is suggested that some form of heat sensitive foam, such as "Temperfoam" be used for its superior conforming abilities.

When building the seat cushions remember that this is where you fine tune the seating position to suit the leg length and sitting height of you and your passengers, so have the rudder pedals in place before doing the seat cushions. If you are planning on doing occasional bush work, make up some removable cushions, like stadium seats, that you can drop in place, and get maximum visibility, when it's needed.

Builder Jan Gutwein's approach to the seat pan shape

Installing the Back Seat

The backseat is secured to the floor by four, special 5/16 bolts supplied with the kit. They are readily identifiable because they have thick steel tabs welded to the heads. These thread into the four bushings welded in the floor. In early kits, these must be tapped (threaded) for the bolts. Later kits are already tapped.



Seat Lock Mechanism

There are two variations. Early airplanes have an ear welded to a sleeve that clamps to the tubing sticking down under the seat. The later version has the ear welded to the tube under the seat. The ear faces forward.

The T-shaped handle faces forward under the seat and pivots on the ear and presses down on a fender washer bolted to the bottom of the shaft. Put a hardware store spring inbetween to provide tension. There are two lenghts of T-handles, the short one goes under the right seat. to clear the flap mechanism.

Before attempting to cut these threads, run a drill bit of the proper size (lettered bit, "I", .2720") for a 5/16 x 24 tap.

Approach the tapping operation carefully and with a lot of patience because getting in a hurry will result in a broken tap, which isn't easy to remove.

The bushing has been welded on, which causes it to be harder in some areas than others and where it is hard, it can be very hard, and will resist the tap. So proceed slowly.

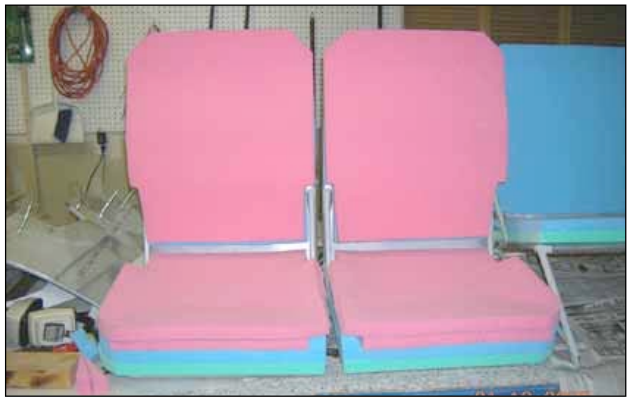
This is the way the seat latch looks from the front, when assembled. The short "T" handle goes under the right seat to clear to the flap handle. Drill holes in the track on 1" intervals.

The key to success is lots of cutting oil and a tapping method where you turn the tap only 90 degrees at a time and *back it up 45 degrees after each rotation*. If you stick to this, you're very unlikely to break a tap. **If you yield to temptation and try to speed it up or force it, you'll snap a tap and a broken tap is a bear to get out.**

The taps are made of a very hard, but brittle steel and you should treat them as if they are made of glass.

The rear seats can be cross-bolted into position or, if you plan on removing them often, use "pit pins," those are usually T-shaped pins with a push button in the middle that retracts two balls in the pin allowing it to be withdrawn.

The seats can be mounted facing backward, which moves the CG of the rear passengers ahead about seven inches. However, the seat angle is such that you'll have to slide the front seats ahead for clearance, or fabricate a truss from steel tubing to hold the back of the rear seat (which is now the front) four inches off the floor of the fuselage.



Rough cut foam on the seats. Notice how the bottom is built up out of three different densities.

Installing the Stringers

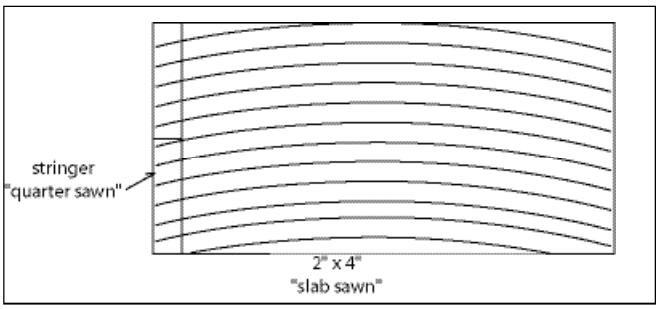
The stringers contribute zero strength but 100% of the shape. The better job you do of shaping and mounting the stringers the more smoothly the lines of your airplane will flow.

Stringer Material

The stringers can be made of either aluminum, using the extruded rectangles from Steen Aerolab, or wood using locally available Doug fir. Neither of the materials is noticeably better.

Wood Stringers

If using wood, spend some time at a higher quality lumber yard picking out a board that is at least twelve feet long and a full inch deep. They'll say the thickness dimension is 5/4. Use only spruce or Doug Fir. Do not use pine.



Note how the grain oin the board is "slab sawn" but it yields a stringer with the desired quarter-sawn grain, which is much more resistant to breaking under impact.

It's cheaper and you'll have more boards to chose from if you rip strips off a two-by-four and then cut them down to the right width dimension.

In evaluating the wood, you have to do it exactly the opposite to what you would for normal usage because you're going to be cutting 5/16 strips off the edge. Ideally, when cut, these strips should be quarter-saw, where the grain runs 90 degrees across the small dimension. However, that means the board you cut them from has grain that is "slab" cut not quarter cut: when you look at the end, the tree rings appear to be running nearly parallel to the wide surfaces of the board. That way, when you cut the stringer, the grain is quarter-saw on the stringer, which is the optimum.

You want those strips to be straight grain with very little "runout" where the grain runs off the side of the stringer at an angle.

Be especially careful not to pick a board that had a knot in the tree in close proximity to where the board was cut. This will be identifiable by a grain pattern that is running straight, then suddenly diverts off the board and then returns. Wood with grain run-out is more likely to break in that area.

Shaping the stringers

Round the outside edges of the stringers so they have smooth surfaces, which flow away from the fabric. Sand them down as smooth as you like, but only the rounded edge is critical. Then finish them with urethane because the glue and paint you use later may dissolve any other finish. Remember to sand again after putting the finish on to get rid of the "whiskers" caused by raised grain.

Installing the stringers

The stringers nest in the "U"-shaped pieces on the end of the standoffs. You can secure them with bolts or simply put cotter pins through them, but make sure the ends of the pins are cut off, so when bent over, they can't reach the fabric. As the fabric shrinks, it will pull the stringers ever tighter into the saddles.

Bottom Stringer Mis-alignment

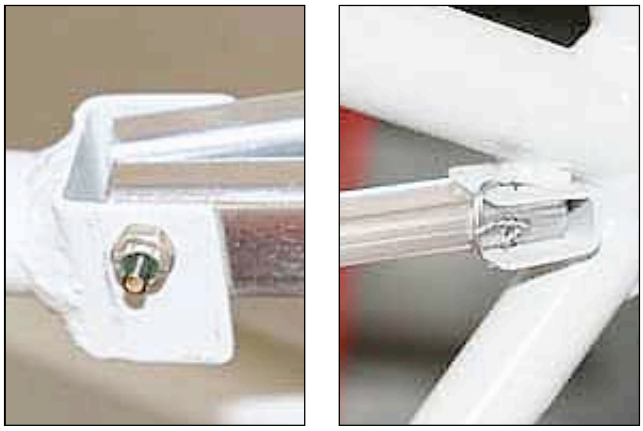
Several of the earlier kits have been found to have stringer stand-offs on the bottom that are slightly too short to let the fabric clear the pulleys. If you find that to be the case, contact AviPro and

we'll send new stringer stand-offs. They require no welding as you just cut off the saddle on the existing ones and slide these down over the existing stand-off tubes and epoxy them in place. If that's you, we apologize for the inconvenience.

Stringers at the rear of the fuselage

On the sides and bottom of the fuselage, the stringers don't go completely to the tail or they would tend to run into each other. So they end short and have to be specially shaped to allow the fabric to "flow" off of them with no abrupt drop offs or edges that would not only cause unsightly lumps and bumps, but, as the fabric drums in flight, they would eventually wear through .

Whether aluminum or wood, the aft end of the stringers under the tail must be shaped so they move away from the fabric ins a smooth fashion, with no abrupt or sharp corners.



When attaching the stringers you'll find some odd areas, such as at the front of the vertical fin (left) where you'll have to pad it to give the fabric a smooth contact area. Doubled safety wire can be used to attach in some cases (right).

The stringers will be tapered in such a way that when they end, the fabric continues in a straight line to the unsupported area.

To keep the bottom stringers from "leaning" over, use a piece of stringer matrial pop riveted crosswise between them.

Some builders put a small bulkhead ahead of the tailwheel and leave an area open just ahead of the tailwheel spring so foreign objects can find their way out.

The stringers on both the sides and the top should form a pleasing line, when viewed from the rear. .

Regardless of what is used for stringer material it is impor - tant that the stringer surface be above the edges of the clips so nothing is touching the fabric.

Almost anything can be used to fasten the stringer in the saddle including pop rivets, No. 6 bolts, etc.

Make sure you go-no-go gage every single nicopress. Note the eveness of the ridges between each squeeze of the tool.

The bottom sample shows what the tool is supposed to do to the Nicopress thimble each time the tool is compressed.

Running the Control Cables

We've already talked about what cables run through what pulleys. Now we can connect them to the elevator rudder and flap arms.

Incidentally, on the upper right of the fuselage, above the baggage door, a fair lead mount is welded in a location that looks wrong. It's not. That's where one of the flap cables goes and it's hidden inside the wing fairing.

Making the connection: Nicopresses

Everywhere cables run in the airplane they are terminated with some version of Nicopressed connection. Almost without exception, your life depends on the quality of the Nicopress installation because, if they slip, you're going to lose control of that portion of the airplane. If a flap Nicopress fails, when the flaps are down, there's a possibility you'll lose control of the entire airplane. For those reasons, it is critical that you understand how to install and check Nicopresses.

It is beyond the scope of this manual to explain the way to install and check Nicopresses. For that information go to the Bingelis books and AC 43.13 and study the information closely to make sure you get it right.

One point we *will* mention: measure the diameter of your cables to make sure they are what you think they are. On several occasions, cables have come from a major supplier mis-labeled. They were supposed to be 1/8" and were actually 3/32". It's easy to miss that seemingly minor mistake, but in that situation, besides the cable being under strength, Nicopresses look and gage right, but they will slip almost immediately under load. So, verify your wire diameter and make sure it matches the Nicopress sleeves and vice versa.

General cable routing

Words won't adequately describe where, and how the flap cables are routed so study the plans, Bear Tracks and the pictures. Basically, it's a single cable with tension put on it by the springs in the wings that hold up the flaps. The cable goes from the bottom of the lever to behind the cargo department, comes up and splits to go to each wing via pulleys and attaches to the torque tube arms.

Pulley Guards

Alll cables, should have cable guards on the pulleys to keep the cables in place.

Cable guards should be made of .062 steel and fit over the pully with a minimum of clearance. Their purpose to to keep the pully from climbing over the edge of the pully groove.

Some pully guards benefit from having an extended lege that is secured to a stationary surface to keep them from rotating with the pulley or cable. This is the aileron pully in the wings

Fuselage Systems: Fuel System

Before even looking at this picture, pull out your Beartracks or go to page 64 in The Bearhawk Book from the designer, Bob Barrows. *Also reference the plans, sheet 16 and 17. There you'll find a schematic of the fuel system with all the parts numbers called out on it. Okay, now look at the photo. You can clearly see two lines coming out of the wing root area: one coming out of the back of the tank and going down the rear door jam and the other coming out of the front of the tank and going down the front jam. The lines go continually downward, as measured in a climbing attitude and join with the selector valve and gascolator under the front floor.*

Fuel System Thoughts

There are as many ways to plumb a fuel system as there are airplanes. The system we're going to outline below is that preferred by the designer and shown in Bear Tracks. If you go to the Bingelis books you'll find further information that outlines the do's and don'ts of fuel systems, the primary ones being:

1.The lines should go downhill, with no low points from the tank to the engine.

2. Any low points (measured while in a three-point on the ground) should have quickdrains to eliminate trapped water.

3. 3/8 lines are required for the 0-540 and, although overkill for a 180, they can't hurt.

4. Use no Teflon tape to seal joints because it might get in the lines or the carb. Use Teflon paste.

5. Use nothing but semi-rigid (easily bent) aluminum line for plumbing with flared fittings on the ends. Don't jury rig with hoses and clamps.

A Tip on Working W/Fuel Line

If you buy 3003 fuel line it will be shipped to you in a coil. The stuff is very soft and easily bent with your fingers, but a tubing bender makes more precise, regular bends. Buy one at your local NAPA store. 5052 line is much harder and stiffer and shipped straight.

A problem you might run into with 3003 is that because the line is coiled, it's tough to get back straight and have it look good. So, try this trick: Uncoil it as best you can and squeeze one end tightly in your vice, Then hog down on the other end with a big pair of Vice Grips. Pull the tubing as straight as you can and smack the vice grips with a hammer pulling the tubing taut. That'll pull the fuel line as straight as if it came out of a die and makes it much easier to work with.

The fuel down line connects to lines off the front and back of the tank, snakes down behind the door frame and forward. Be careful that, as the line goes under the door frame that it continues going down so no

Fuel Selector Valve Placement

If installed as per the plans, the valve will be ahead of the flap handle on the floor bolted to the trapezoidal gusset provided. Some builders have located it closer to the base of the flap handle on one side or the other, which makes it easier to reach. In either situation, a guard should be constructed that shields the handle so it can't be kicked while getting in or out of the airplane.

Main Quick Drain

The positioning of the quick drain and the fittings required are clearly spelled out in Beartracks and The Bearhawk Book from the designer. In addition, the Bingelis books go into great detail in how to deal with running the fuel lines through the fuselage and up to the engine. Study them as they give excellent detailed information.

This builder mounted the fuel selector valve under his right thigh at the base of the flap handle for easier access. This requires a floor stiffening plate and a guard to keep from kick - ing it.

Another variation on mounting the fuel valve that will allow the builder to remove the floor boards with less trouble.

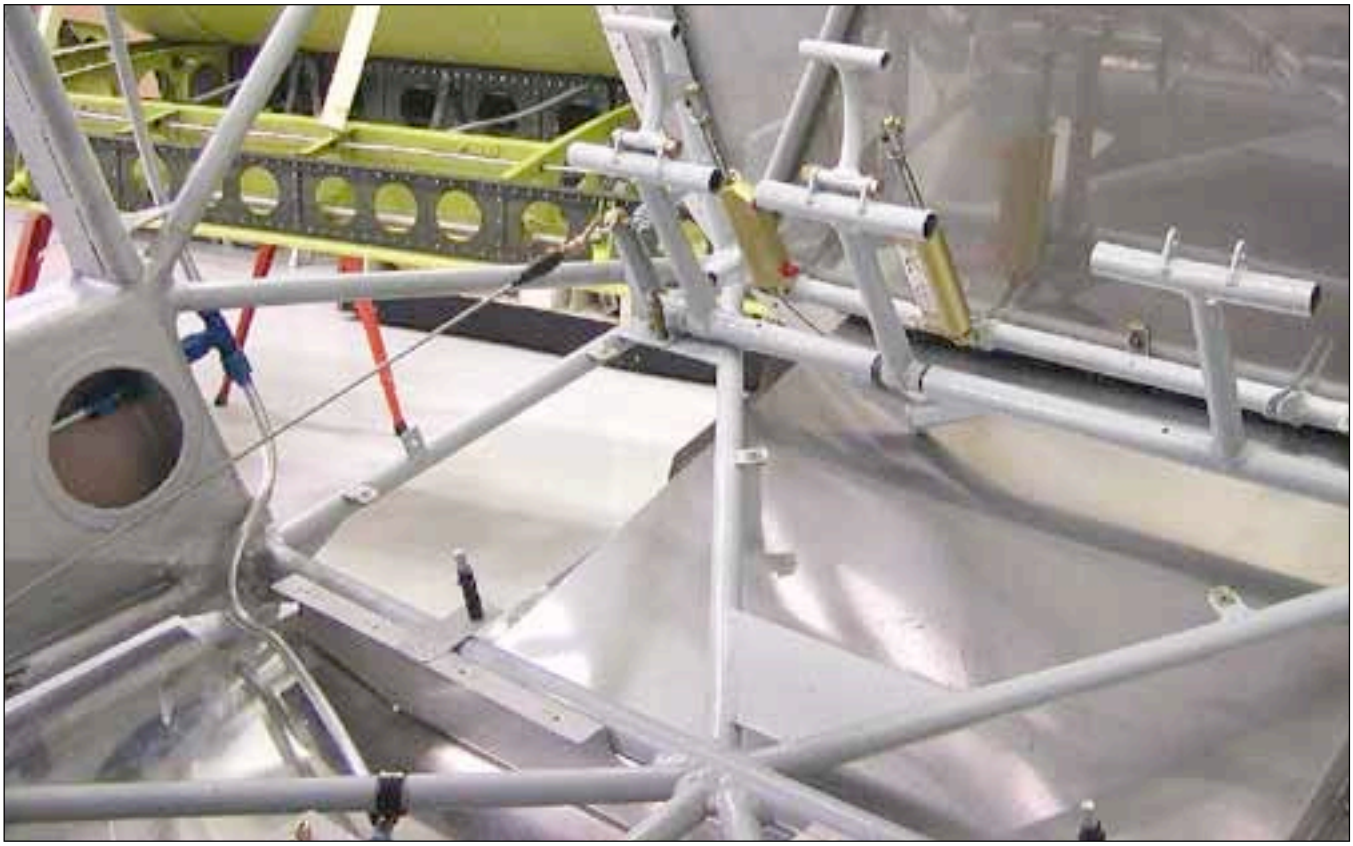
fuel valve plumbing depends entirely on what type of valve you are using and the positions on that valve. A Left-Right-Off-Both is optimum, but many builders opt for a Left-Right-Off only.

Fuel Selector

Even if you have aux tanks installed (they will be plumbed into the mains, as explained in the wing section), the fuel valve should be a simple *Right-Both-Left-Off* valve.

Wing Connection

For the time being just run a stub line up to where the wing root will eventually be. Leave that piece of tubing long with no fitting and put a piece of tape over the end. We'll get to that connection when we're doing the wings.

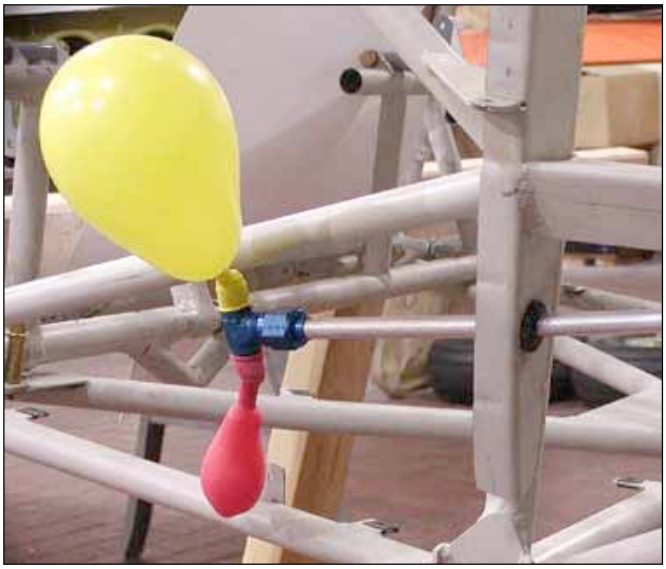


There's a lot of good information in this shot beyond just the fuel system. The fuel line coming down in front of the door is clearly visible. He has his fuel valve located closer to the seat so the line goes back, once it's inside the cabin. If the valve were mounted on the trapazoidal area in the "X" member it would have gone forward. Also, notice the inspection panel ring in the interior fabric giving him access to the other side of the bulkhead fitting.

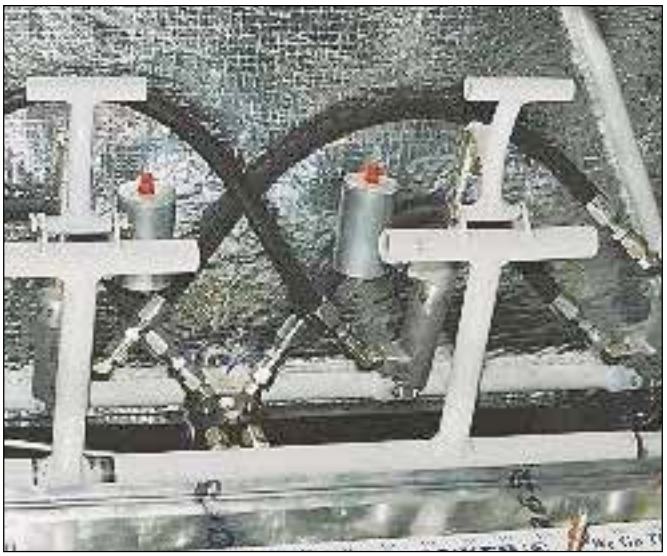
You can also see the top flange of the lower boot cowl bulkhead under the floor tubing. This is an early kit without the mounting tabs on the Station "B" tubing, so he has a tab going forward from the bulkhead to hold it in place while the floor boards are removed.

We also have a good view of how the rudder pedal torque tube relates to the fuselage tubing. He used Tinnermans on the tabs to fasten the floor boards down.

The fuel lines, both front and rear, exit the tank and snuggle close to the tubing, being eventually held in place by Adel clamps and going downhill every inch of the way.



One way to avoid leaks is to check each section of line as you plumb it. Blow up the balloons from the other end and soap up the connections, as you go, rather than waiting until finished.



Although it's entirely possible to use master cylinders that have integral resevoirs, they are difficult to fill and pose possible clearance problems with the firewall. They do, however, avoid the plumbing associated with a firewall mounted reservoir.

The brake system is actually pretty straight forward and installation is primarily a matter of cutting and bending tubing, affixing 37° fittings and having flex lines made up at your local hydraulic shop.

The reservoir for the hydraulic fluid is mounted on the engine side of the firewall. A line comes through the firewall via a bulkhead fitting and is connected to both master cylinders so they are always full. Flex lines go from the respective cylinders, to hard lines in the fuselage, to flex lines where the landing gear attaches, to hard lines inside the gear Vees to flex lines that attach to the calipers. The flex lines at the bottom are optional and extra aluminum line that is allowed to flex can be substituted.

It is possible to plumb the entire system with armored flex line, but they are extremely heavy. It is also possible to use plastic lines, as offered by several aircraft supply houses and as used in several homebuilt designs. However, it is the philosophy of AviPro that everything on the Bearhawk should be done exactly as if it were a certified airplane, therefore the hard lines are highly recommended.

Mounting the Brake Pedals

No magic here: simply bolt the supplied pedals to the rudder pedals using the appropriate bolts and castellated nuts.

Mounting the Master Cylinders

The shaft portion of the cylinder goes on the top and the fork on the shaft will probably have to be adjusted all the way down until they bottom on the threads. This moves the brake pedals as far forward as possible. However, this will change depending on the exact position in which you have mounted your rudder pedal assembly.

Mounting the Fluid reservoir

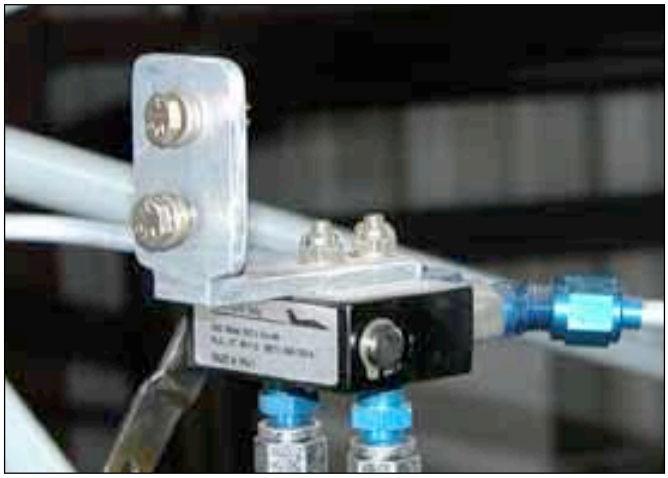
The exact type of reservoir used is of no importance. The cast aluminum type look good but are more expensive than the ones that look like flat oil cans with screw-off tops. Just make sure the reservoir has a vent.

The reservoir simply bolts through the firewall. Although the position isn't critical, other than being well above the brake cylinders, it is generally mounted on the right side (as seen by the pilot). If you only have left side brakes, mount it on the left side. You want it low enough and far enough to the outside that there is no chance of interference with anything on the back of the engine. If you mount it just above the line where the cowling halves join and six to eight inches in from the side of the firewall it will be clear and easily accessible for filling and checking of the fluid level. If possible, try to use some of the bolts already in place that secure the firewall to the tubing tabs.

Working with Hydraulic Lines

It is suggested that you go to the section in

Tony Bingelis's book that details working with brake lines. He gives an excellent short course in cutting, flaring and bending hard lines as well as making up flex lines. All hydraulic lines should be pressure tested before being flown.



Not all brake systems use a hydraulic parking brake. It pro - vides a hydraulic lock by depressing the pedals and pulling on a knob attached to the lever see to the left. It bolts to the back of the firewall.

Plumbing the reservoir

Run a hard line from the bottom of the reservoir to a ninety-degree bulkhead fitting. Position the bulkhead fitting as close to the reservoir as possible.

On the back side of the firewall, put a "T" fitting on the bulkhead fitting as you'll be running a line to each of the brake cylinders. This assumes you're running master cylinders that have no integral reservoirs. Put an Adel clamp or two that will stabilize the line against the firewall. If you run dual brakes, run the supply line to the middle two cylinders, meaning the right cylinder on the left set and the left cylinder on the right set then run a flex line to the cylinder on the other set.

In this application the left and right master cylinders are plumbed together with the "out" lines plumbed to hard lines to the landing gear in the middle. Integral resevoirs are used on this installation.

If you're running dual brakes, interconnect the sets together as per the photo. Note, that the cylinders pictured have integral reservoirs on the middle two. To make up the flex lines go to Bingilis again although it's generally easier to take the fittings and lines to a hydraulic shop that already has the mandrels and have them assembled.

View from the front of a system using a firewall mounted reservoir and a parking brake.

Running the Lines to the Brakes

Run a line to the side of the fuselage. Whether it is a hard or flex line is a matter of choice but a hard line is recommended. Running one flex line all the way from the pedal to the caliper on the wheel is heavier but eliminates a number of fittings.

If a flex line is used full length, larger holes are required in the rib at the top of each gear leg and it is important a rubber or plastic grommet be installed to avoid chaffing.

If a flex line is used between two hard lines at the interface between the landing gear and the fuselage, it is suggested that a ninety-degree bulkhead fitting be installed at the top landing gear rib. A 90 degree fitting is used, rather than a straight one to give clearance. An Adel clamp or two should be installed inside the fuselage at that point to stabilize the line before it leaves the fuselage.

This is the Gerdes Long Shaft master cylinder for use with a firewall mounted reservoir, If a short shaft cylinder is used, a clevis fork can make up the difference in length. All of the pivot bolts need to be drilled/pinned bolts or clevis pins. The rule is that anything that rotates needs a cotter pin.

There are several variation of flex lines including the armored Aeroquip lines that make a very neat, compact installation.

Connect a flex line to a bulkhead fitting at the top of the gear leg. where it goes into the fuselage.

Running the Brake Line Down the Leg

Tabs are pre-welded to the back of the front gear leg to allow the installation of Adel clamps for holding the brake line.

If a hard line is used, it is suggested that a short flex line be installed just below the bottom tab to absorb for any movement that occurs at the caliper, although, as mentioned, slack in the hard-line can be left at the bottom to absorb that movement.

Fuselage Systems: Cabin Air Vents

Cessna type wing root ducting can feed any kind of interior vent, in this case an eyeball vent

A NACA vent can be installed in the bottom of the wing. This what feeds the eyeball vent to the left. This vent CANNOT be installed in the .032 root section of the wing.

The kits have no specific parts dedicated to venting air through the cabin, so there have been quite a few approaches to this problem by various builders.We won't try to address exactly how to do it, but will try to present the various systems in picture form and comment in the attached captions. While viewing these, remember they all weigh something and weight is the enemy.

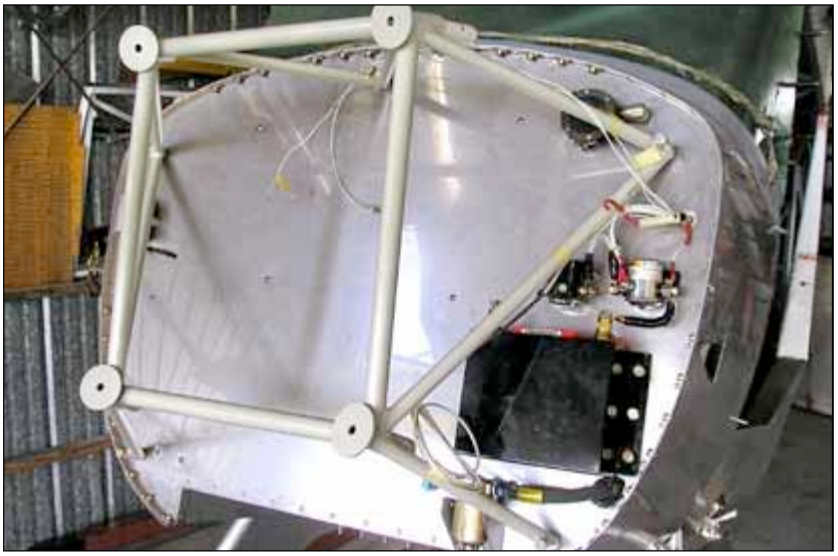
NACA scoops are available from a variety of aircraft supply houses. Although the concept is good, they have to be prop - erly located to work well but they are the most low drag way of getting air into the ventilation system. This one is mounted in the boot cowl and feeds eyeball vents under the panel.

Simple and effective! It is installed in a side window and rotate forward, when you want a blast of air.

Jan Gutwein's superbly detailed rear vent system. He picks up the air in scoops on top the airplane.

This is behind the NACA scoop above. Eyeball vents are available from all of the supply houses and offer a ready- made system to direct the air. Scat hose attaches to the back.

Fuselage: Installing the firewall



The firewall is not bolted between the motor mount and the fuselage but is cut away just enough to clear the motor mount and is held in place by the boot cowl skin and bolts through the mounting tabs. The battery is usually mounted on the firewall, or on the side of the boot cowl for CG purposes. An Oddyssy R680 drycell is pictured here. Compact, but powerful. Plenty for a 540.

Before we get into the nitty gritty of the firewall process let's discuss concept. First, the firewall will not be sandwiched between the motor mount and the fuselage. Instead, you'll enlarge the mounting holes just enough to let motor mount tubes stick through. This gives a very solid steel-to-steel connection. The firewall will be held in position by bolting through the tabs on the tubing.

In the next section we'll discuss the fasteners that go around the firewall and attach the boot cowl metal, so ignore that for the time being.

Positioning the firewall

Note: The firewall is attached with the mounting flange facing *forward*.

First, run a 3/8" drill bit or reamer through the bushings on the fuselage. They are slightly undersized and will have weld scale inside of them. Do the same thing on the motor mount. Try not to let the drill move around and wallow out the holes. They don't need to be a super precise fit, although, if you want to ream them, that will give a better overall product.

There are pilot holes in the firewall for the top two holes but before drilling anything in the firewall itself, be aware that it is stainless steel, which is quite hard. The key to drilling it is to use high quality drill bits, and keep them cool. The bits don't have to be real expensive ones but don't use cheap bits from China or they'll wear out in a heartbeat and drive you nuts. Keep a cup of water handy and dip the bit in it every few seconds, or keep a constant stream of water hitting the surface you're drilling.

Drill out one of the top holes, slide a bolt through it and the appropriate fuselage bushing. Then clamp the firewall in place with the other pilot hole centered in the other top bushing and drill it out.

Run bolts through both holes and use them to index the firewall in position while you drill the rest of the holes.

Center punch each of the mounting tabs and drill the tab and the firewall at the same time. Drill from the inside using the tab as a guide.

You're going to need someone pushing on the other side of the firewall with a block of wood to keep it from flexing.

An alternative method is to drill the tabs with #40 holes. Drill through those holes into the firewall just enough to clearly mark the back surface of the firewall Remove the firewall and, after backing it up with a firm surface so it doesn't dimple, center punch each of the drill makes and drill with a #40 bit.

Reposition the firewall on the fuselage and cleco in place. Then go back and match drill all of the holes with #30 and cleco in position.

With the firewall bolted and cleco'ed in position, spot the surface where the bottom two holes go with a 3/8" bit through the bottom two bushings, remove, pilot drill with #30, then drill with 3/8" bit. Then remount and run the bit through the holes again to true them up.

It's not important that the 3/8" holes through the firewall be exact because the clecos will hold it in position and those 3/8" holes are going to be removed in the next operation anyway.

~~**Removing Firewall Metal to Clear Motor Mount**~~

~~We want the motor mount to contact the fuselage metal with nothing between it. To do that~~

Fuselage: Boot Cowl

The boot cowl can be screwed/bolted in place to allow it to be com - pletely removed or permanently riveted in place. In both methods provisions are made for access to the bottom, inside of the area for inspection.

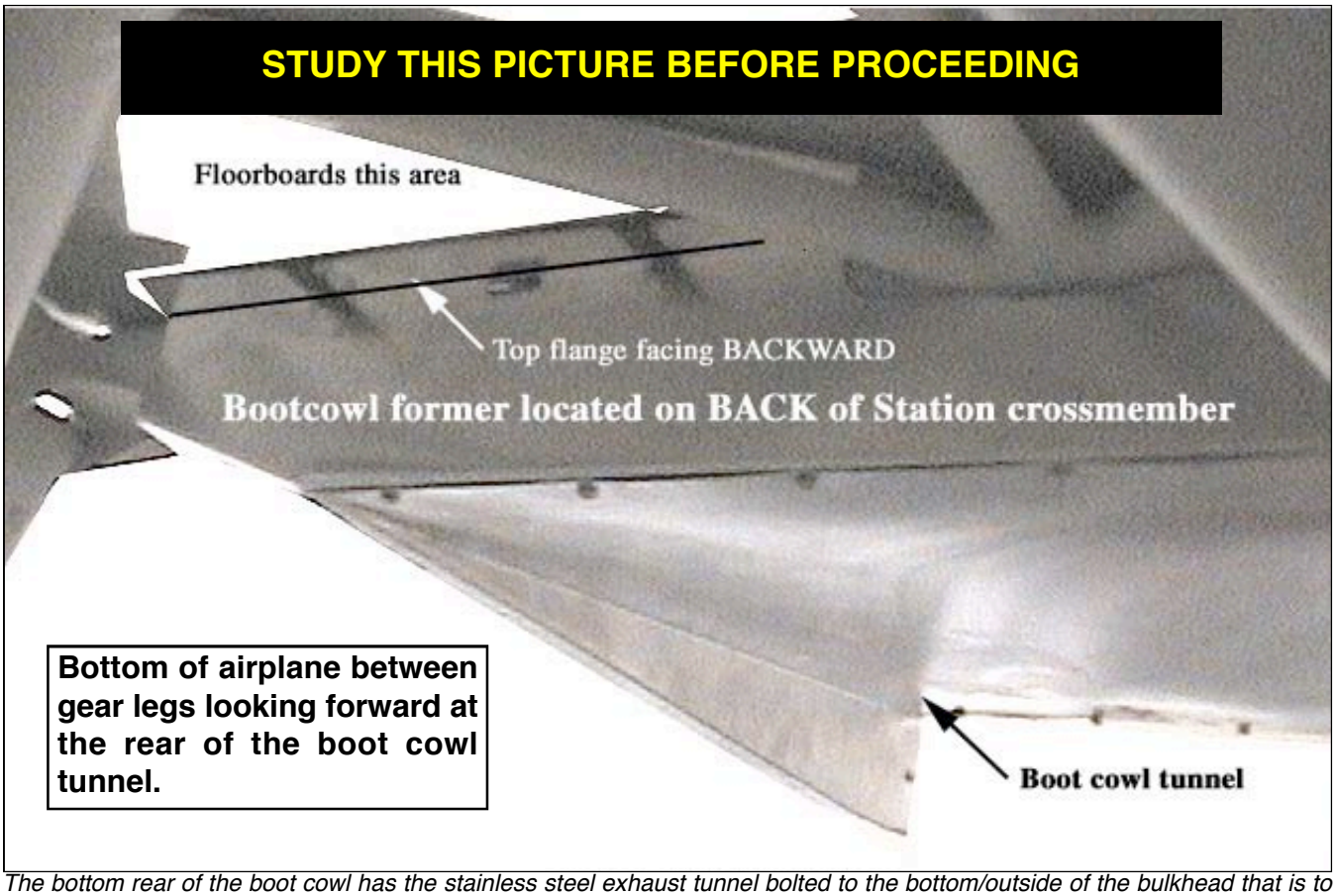
Before we get started on installing the boot cowl, let's talk about the overall concept and what we're trying to accomplish. The boot cowl incorporates everything from the exhaust area on the belly to the metal between the instrument panel and the firewall. While it isn't a particularly complicated structure, it is going to take some talking to understand all the various aspects of it. Also, if you have an early kit, which doesn't include vertical mounting tabs for the back bulkhead on the belly, it'll be a little easier to install, if the floor boards are already in place, although that is definitely not required.

First, you should know three things:

• Your exact firewall location, fore and aft, may change depending on how you install it so you'll have to do a little fitting of the sheet metal.

• The sheet metal pieces for the sides and top of the boot cowl in the kit are cut oversize, fore and aft, to allow for exact fit.

• There are some differences between



The bottom rear of the boot cowl has the stainless steel exhaust tunnel bolted to the bottom/outside of the bulkhead that is to be attached at Station "B" on the back of the tubing structure. That bulkhead is against the tubing and attaches to the floor boards or tabs (tabs not on early kits) NOT to the tubing truss. The top flange faces back and, if vertical tabs are present to which the bulkhead can be attached, that flange can be removed, if desired.

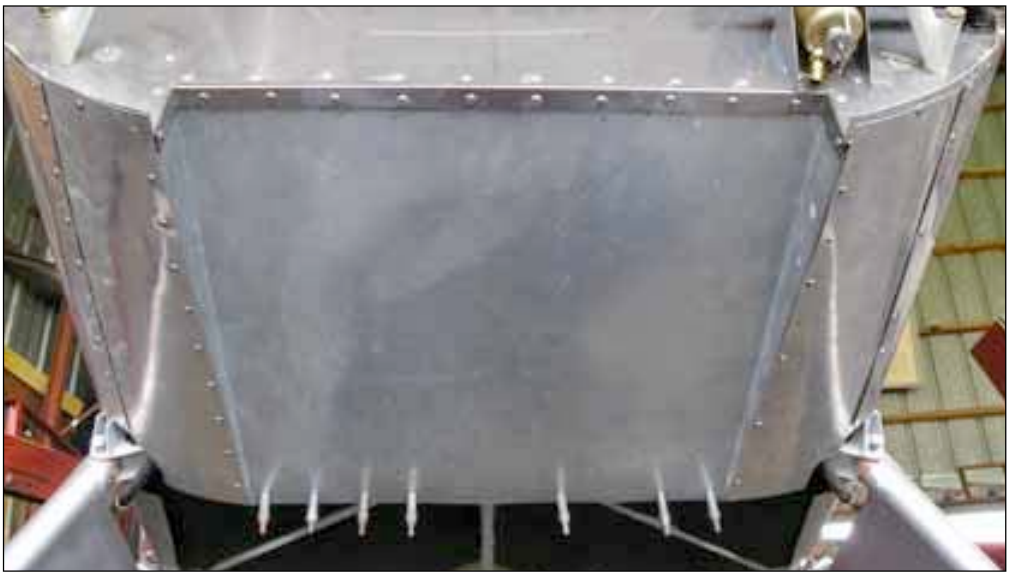
AviPro's boot cowl installation and that which Bob outlines in Bear Tracks so examine these instructions first.

The following are the sequence of events necessary for installing the AviPro boot cowl.

These assume you have the firewall already fastened in place.

1. Either install floorboards or cleco/clamp aluminum angle across Station B at floorboard level to act as floorboards. On later kits there are tabs on the back of the Station "B" tubing to which the bulkhead mounts so the floorboards do not need to be in position. The rear bulkhead of the boot cowl on early kits attaches to the floor boards. In no case does the bulkhead mount to the Station B tubing. The bulkhead, however should be positioned against the tubing.

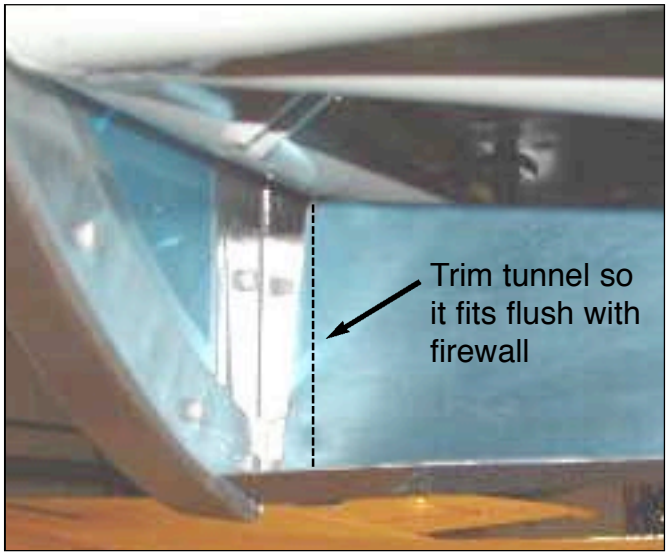
2. Cleco the formed stainless steel tunnel flush w/front of firewall. It goes on the outside (bottom) of firewall cut out flange. In some instances, it may fit better on the inside (top of the firewall cut-out flange), which is preferred.



The firewall tunnel can be attached to the outside/bottom of the firewall flange or the outside. Before attaching, to inside, put a small bead of high-temp RTV sealant between to prevent oil from running down the inside of the tunnel.

You'll get a better fit if you snip the corners of the firewall flange so the center portion can be bent down to match the slope of the tunnel.Before snipping it, drill a 1/8" hole in the corner and snip to the hole so there is a relief radius in the corner to prevent cracking. The front of the tunnel must be trimmed so it is the same angle as the firewall

3. The rear lip of the tunnel goes on the bottom (outside) of the rear bulkhead flange.



Trim the front of the tunnel to fit against the back of the fire - wall. This will also move it forward to line up at bulkhead at the rear. Although the firewall tunnel attaches to the outside/bottom of the firewall flange some may fit better inside of the flange, as this builder did.

4. Install rear boot cowl bulkhead behind station B *with top flange facing back, bottom flange facing forward.*

5. Cleco/clamp top of bulkhead former to floorboard or a temporary strip (hardware store aluminum angle works well) that represents the floorboards. *Later kits have tabs hanging down in that area for attaching the bulkhead. If these tabs are present, the rearward facing flange at the top of the bulkhead can be cut off, if desired.*

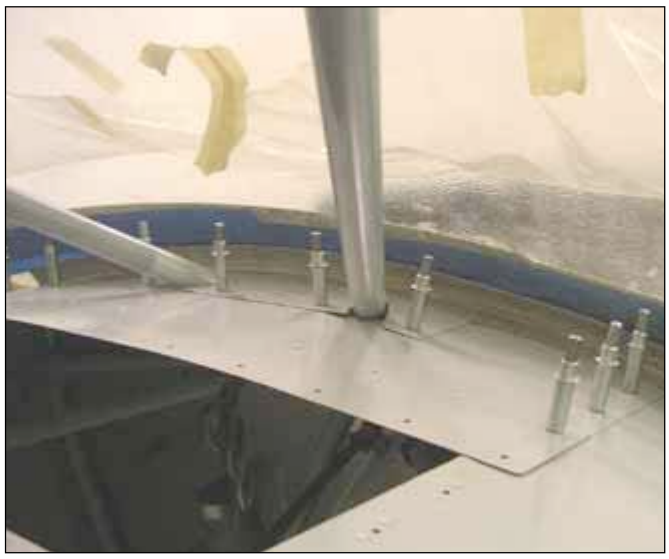
6. Now move to the top of the boot cowl and the piece that bridges between the instrument panel, the firewall and the two side pieces

7. Clamp or bolt the instrument panel in position and make a cardboard pattern that goes from the top of the panel to the top of the firewall. This will require cutting slots in it to go around the two pieces of tubing (the cabane) that come down from the wings in a "V" that terminates at the top of the firewall. The pattern will slide in from

The access cover on the top of the panel should be cut after the sheet metal in the area is completely installed. Make a cover that laps on the outside edges of the hole and rivet a piece to the leading edge of that cover to form a lip that goes under the panel top and holds the cover in place.

behind and forward to the firewall. Later, after that piece is installed, you will screw a small piece of aluminum underneath that piece that bridges across the gaps to stiffen it. Cleco the center piece in position and prepare to install the side pieces.

8. For access to the back of the instrument



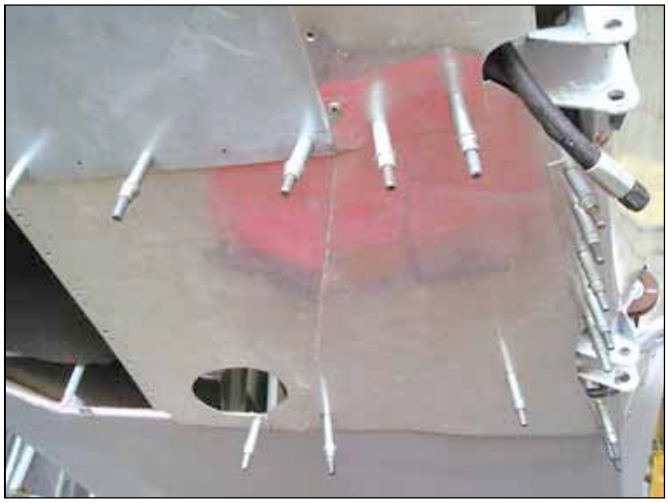
The piece that goes around the cabane struts can be fit really tight using the posterboard system explained in a caption for the picture to the right.

panel you may want to cut a 15" wide panel out of the centerpiece that goes from the top of the instrument panel forward to within 4" of the tubing "V". Make a cover that bridges that hole and overlaps on the sides. At the front, rivet a strip to the bottom of that removable piece so it goes *under* the front of the panel top while the sides of that cover lay on top

Lower left view of the boot cowl, looking up, nose to left. The lower corners of the cowl are to be removable for inspections. Put nutplates on the edges of the removeable panel.

of the panel. This will help locate it.

9. On the outside, flex the boot cowl sides around the firewall and door formers so they overlap the edges of the top/center piece and clamp in place. The boot cowl sides will be overly long in all dimensions, so flush them with the front edge of the firewall flange and trim them at the rear of the door



To keep the sheet metal around the struts from being a cut and try operation, do it first in poster board. Leave room for the struts to flex and for clearance around the filler plug. To accuately locate the hole in the aluminum, a) make a poster - board pattern for the entire piece b) make a separate hand-sized pattern with just the hole in it, c) With the struts attached, slide the small pattern around the strut, slide it up to the main pattern, which has a large hole in it, and tape it in place. This gives a perfectly placed hole in the pattern.

frame. This includes fitting them around the door hinges, struts, etc. If you do this first in poster board, you'll avoid making mistakes and can fine tune it to get an exact fit.

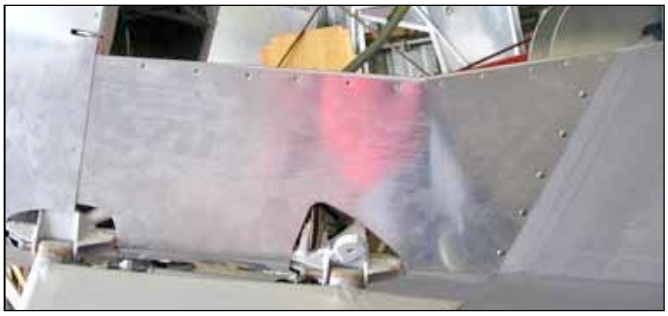
Bear Tracks shows breaking the top end of

the side pieces 90 degrees before riveting them to the middle piece to stiffen it. This is not necessary and the side pieces aren't long enough to allow for that. If you desire stiffening in that area, break a piece of .032 or .025 into a 3/4" angle and rivet it in with the same rivets used to join the center piece with the side pieces.

10. Clamp everything in position using small C-clamps (you should have a at least eighteen two-inch C-clamps in your tool bin. Side clamp clecos are even handier) then, when satisfied with the position of all the pieces, drill the side skins and door former holes and cleco the sides in place.

11. The side pieces won't meet the tunnel at the bottom. They will be short of the tunnel by about 5", which is intentional as inspection panels will fill the gap. Find the bottom access panels provided in the kit to cover the openings on each side of tunnel. They overlap the sides about 3/4" inch. Get them in position, drill and cleco, but, when drilling, give some consideration about the location of the nut plates that will eventually hold these panels in place.

12. These small bottom panels are designed to be removable so install nut plates on the inside of the bottom edge of the boot cowl side skin . Also put nutplates on the inside of the tunnel flange lined up with the holes drilled in the last step. Sheet metal Tinnermans are also acceptable. You'll want to take those panels off when doing annual inspections. Break the edges to form a 1/4", 5° lip.



The piece of aluminum that goes under the doors is provided, but is optional. The prototypes didn't have it and it doesn't show in the plans. However, it provides a convenient place to securely fasten the wing root and landing gear fairings and cleans up the transition to the bottom sheet metal.

13. Rivet or bolt boot cowl sides to firewall and door frame formers.

14. The sheet metal panel piece that goes crossways on the belly and extends from the back of the tunnel to the front stringer bulkhead at Station C and bridges around the shock struts is also left wide to allow you to make an exact fit. The fuselages currently in the field don't have stiffeners for the back of this piece, where it angles back to the rear of the gear leg fairing (see photo below), so trim it square across the back so it lays against the 3/8" Station C tubing former the stringers attach to. An alternative is to not trim the panel and Adel clamp a piece of aluminum angle to the fuselage tubing to provide a place for the aluminum AND fabric to attach. For more details, see a later section about attaching the side metal.

15. When fitting the piece around the shock struts, leave room for movement of the struts. At least 3/16 gap should be left on the side without the filler plug and 3/8" on the side with the plug. The hole will be oval and about 2 1/2" x 4 3/4"

16. This piece needs to have two slight bends in it to make it line up with the stringers and the tunnel bulkhead.

17. Temporarily clamp it in place and make marks where the stringers hit it at the rear and where it intersects the center two bends in the tunnel bulkhead. Remove it and make those *slight* bends over the edge of a table and reinstall.

18. At the ends of that piece of sheet metal, space three un-padded Adel clamps along the longerons to attach the end to. Adel clamps can also be used to secure the fuselage side pieces that fit under the door sill and above the gear legs.

An attaching angle must be Adel clamped to the tubing to provide a place for the fabric to terminate and a place to attach the rear belly metal. Use hardware store aluminum angle.

19. The plans don't address the aluminum side panels that cover the fuselage area under the door sills and above the landing gear and wing strut

attach points. These pieces, which are supplied with the kit, can, if desired, be eliminated and fabric continued forward to the boot cowl, as in the plans. These side panels give a convenient place to attach strut and landing gear fairings and make a good transition from the side to the sheet metal on the bottom.

20. To protect the fabric where it wraps around the door sills from people getting in and out, fabricate a "scuff shield" of .016 stainless or .025 aluminum. It will be an angle as wide as the door sills that laps over the outside and has a 3/4" lip facing down. This not only protects the fabric but also forms a convenient place to attach the metal side panels to. To attach the top edges of the side panels to the scuff shields, nut plates on the back side of the side panels are preferable, but Tinnermans will work fine.

A thin stainless or aluminum scuff shield saves the fabric from wear and tail of people getting in and out.

21. Where the side panels under the doors meet the lower longerons, leave them long enough to wrap around the longerons and continue 3/4" under the belly to attach the belly aluminum to. To make a smooth transition around the longeron, after the metal is bolted in place but still unbent, form the aluminum around the longeron by running a block of wood back and forth along the longeron to gradually force the aluminum around the corner. Space Adel clamps along the bottom longeron with their legs laying horizontal and facing inward. Fasten both the bottoms of the side panels and the ends of the belly panel to these Adels.

22. If you decide to install the pieces under

The bottom panel that goes from the landing gear shock strut to the side of the fuselage. The top hole is for the shock strut, the bottom left for the landing gear fitting the the lower right cut for the rear landing gear fitting and lift strut. The break in the surface is not as severe as it appears. It is a slight crease to line up with the belly stringters.

Bottom view of the side metal. See the pictures at the end of this section for an alternate approach to the shock strut doors.

Normally the shock struts go through holes in the belly metal and room has to be left for them to move. This allows oil and exhaust access to the belly of the airplane. See following pic - tures for a builder's solution to that.

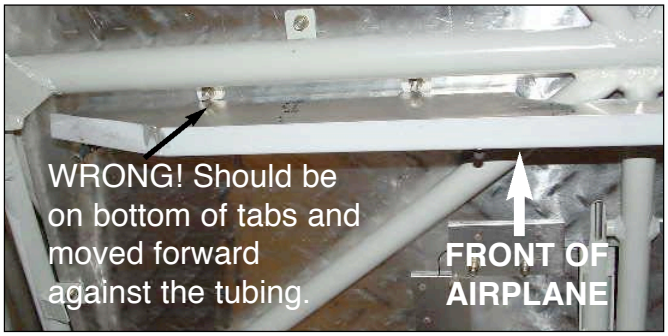
the doors, they need a support fabricated at the back. Use Adel clamps to attach a 3/4" hardware store aluminum angle between the longeron and the door sill. This angle should lay right under the back edge of the aluminum side panel. It will need to be notched to go over a diagonal tube mid-way up. Have the "L" of the angle oriented so the open edge faces back so the fabric can wrap around the other side. Install nut plates on that piece of angle to accept screws through the side panels. The fabric will wrap around the angle and continue no further.

NOTE: ALL ADEL CLAMPS MENTIONED FOR ATTACHING SHEET METAL ARE OF THE UNCUSHIONED VARIETY, I.E. NO RUBBER PADDING.

Peter Stevens, Salt Lake City builder, made hatches that screw to the belly sheet metal. A layer of innertube rubber is fastened over the strut hole and a hole cut in it barely big enough to let the door be forced down over the shock strut. The door is forced over the strut and the strut attached. This gives greatly improved sealing in that area and, when the door is dropped and slid down the shock strut, access to the area is greatly improved over the standard arrangement. Good idea, Peter!

View up the tunnel from behind. This builder decided to get his outlet area (100 square inches) by dropping the bottom of the center section of the cowling, like a reverse scoop, instead of removing a large, half-moon shaped piece of the bottom cowl.

Back of the firewall, where the tunnel is attached. Right side, facing forward



Looking up from bottom: There should be no fore and aft gap between the bulkhead and the tubing and tit should be mount - ed to the tabs, IF THE TABS ARE THERE. Later kits have vertical tabs on back of the tube for the bulkhead.

Looking up at the rear, bottom of a normal cowling showing the air outlet area. This builder has added a lip to the opening to aid in creating a negative pressure area. Don't add that lip until you've flown and know a heating problem actually exists.