Fuselage: Installing the Instrument Panel

The instrument panel is held in place by bolts through welded tabs at the bottom and screws through angles attached to the boot cowl metal at the top. The panel should NOT be vertical, but tilted back approximately 7 degrees. The boot cowl metal can overhang it as a glare shield. If a glare shield is used, the edges of that metal should be padded with split fuel line or the equiv - alent. If you look closely at this glare shield, you'll see the edge of the opening that allows access to the instruments from above

We will not attempt to design your instrument panel layout because that is one of those things that each builder really enjoys doing themselves. It's a place to show their own creativity and computers have made it easy and accurate. We will, however offer some guidelines in terms of procedures and concepts.

Bolting it in place

The kit has a number of tabs welded across the tubing at the panel station. These tabs should be bumped back slightly to allow you to install the panel with a slight upward facing angle. 7 degrees seems to be a good compromise, and artificial horizons and direction gyros are available for that angle mounting. You'll put #8 nut plates on the back of those tabs however, since they are so accessible, nuts will work just as well.

The bigger tabs in the middle are for the throttle and prop controls.

Securing the top of the panel

The boot cowling metal will overlap the panel by a couple of inches to form a glare shield but don't do that without protecting the sharp edge with something like split fuel line. This is essential to protect your face in case of an accident.

The top metal can be attached to the panel itself in a number of ways. An elegant way is to shrink a piece of aluminum angle to fit exactly, however, that is definitely not needed. It works just as well to break .032 angles and bolt them in the positions necessary to stabilize the top of the panel and the boot cowl metal.

Back of the instrument panel. A stretch-formed piece of angle can be used or the angle can be notched, although short pieces of angle will work just as well.

It is suggested that the screws going through the panel and visible in the cockpit be countersunk #6 with nut plates on the back. The screws going vertical can be any style and nut plates or Tinnermans used on the back of the angles. If riveting the angle to the panel, use machine counter sunk rivets.

Cutting the instrument holes

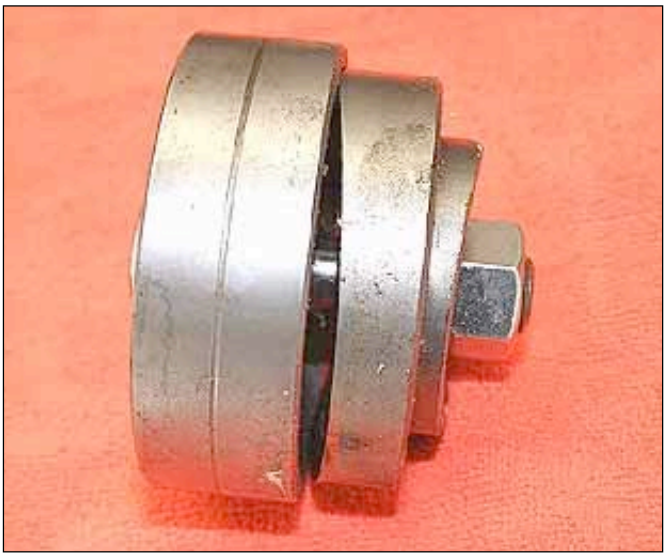
Before doing anything, buy one of those

instrument templates that every supply house sells that locates the center of the hole and the screw holes. You can't do without this and they are extremely cheap.

Inexpensive, hardened drill template locates the bolt holes before you cut the main hole.

Although it is theoretically possible to cut the instrument holes with a jig saw and file to a line, that's not only a lot of work, but doesn't produce an even edge, which can be visually obvious when looking at the panel. Inasmuch as you'll be looking at the panel every time you get in the airplane, you might as well invest in a few tools that will do the holes professionally and are the same every time.

A fly-cutter allows flexibility in the size of the hole, but you have to be precise, when setting it up for instruments. Also, all work must be done in a drill press.



The Matco type of punch is more expensive but an absolutely fool proof way of cutting a perfect instrument hole.

The hand nibbler is a simple tool that will let you cut square holes and edges in aluminum with ease and virtually no distortion.

There are two possibilities here, Matco punches (you'll probably need two sizes, 2 1/4 and 3 1/8") or a fly-cutter (you'll need only one). Matco punches are recommended because the size of the holes are pre-determined and the process is impossible to screw up. However, the punches aren't cheap.

A Matco type punch (they go under other names, as well) is a die punch that consists of two parts, the cutting die and the back up die. They are pulled together by tightening a healthy bolt with a ratchet, which pulls the cutting die right through the metal. There is no distortion and the edges are perfectly clean. The only skill or set up involved is making sure you do your panel layout accurately and drill the small guide hole exactly where you want the instrument mounted.

A fly-cutter uses a lathe type cutting bit mounted on a swinging arm that is indexed to a central 1/4" guide hole in the panel. This tool absolutely must be used in a drill press with solid back-up for good results. If you screw up with a fly-cutter the results can be pretty spectacular. Another downside is that it is very dependent on your ability to set it to get the exact diameter

required, so cut test holes in scrap. An upside is that a fly-cutter is about a fifth the price of a Matco punch and you only need one, as opposed to two Matco's.

Incidentally, it's easier to drill the four instrument mounting holes before cutting the big hole. Just drill the center hole as a #30, cleco the pattern in place, square it up and drill the corner holes. The center hole also serves as the guide hole for indexing the Matco punch or fly-cutter.

Cutting the radio holes

There is no substitute for patience when it comes to cutting square holes in the panel. Don't be in a hurry. Also be meticulous with your layout. This is where buying a cheap drafting set, some drafting triangles and a really good machinist square is worth the investment. You should also invest in a high quality, fine-toothed (32 tpi) wavy-edged blade for your jig saw, a fresh 10" mill file and a very small diameter, round metal file to finish the corners.

Do your layout with a super fine-point felt tip marker or scribe the lines but, if scribing, make it a goal to just barely file away the line so it doesn't present a stress riser. If scribing, get a wide felt tip marker (blue looks best, but black works too) and make a 1/4" wide line where the scribe lines will go (this is a poor man's way of using layout blue). Then scribe your lines through the colored area and they'll stand out much better making it easier to file down to them.

If you don't have a scribe tool, make one by gently grinding (cool it often) a long tapered point in the handle end of a triangular file.

The procedure you'll use in cutting square holes is:

• Carefully drill a 1/8" hole in the corners that doesn't touch any of the scribe lines but is close.

• Drill a series of larger holes (3/8" or so) in the piece that is to be removed at least 1/4" in from the line. This will give a place to start the jig saw.

• Cover both sides of the cut line with wide masking tape to give the saw something to ride on and protect the surface.

• Support the panel completely at the edge being cut. And clamp it down. It helps if you clamp a piece of 3/8 plywood to the back and cut it at the same time you're cutting the aluminum.

Electronics may not be traditional, but they sure yield a light panel. The Dynon display supplies all of the flight and engine parameters required.

• Keep the cut *at least* 1/32"-1/16" away from the final line and file to the line.

This where going slow and depending on elbow grease rather than machinery will keep you from making an unsightly mistake. You can also use a hand nibbler, which isn't expensive and, with care, will let you get right next to the line.

When the edge of the hole is filed to the center of the desired line, wrap high quality 320 grit sand paper around the file and finish the edge with that. Just barely "break" the sharp edge at the same time.

Fuselage: Engine Cowling/Nosebowl

The engine cowling can't be accurately installed until the engine is hung and the spinner and prop are mounted because the nose bowl, and the entire cowling, indexes to the spinner.

This section is just a little out of sequence because you can't do the cowling until the engine is in the mount with the prop and spinner attached. However, we've been talking sheet metal and don't want to change subjects. Just remember where this section is in the manual, when you get ready to do your firewall forward.

The Cowling Concept

Everything about the cowling flows back from the spinner. The spinner establishes the datum from which everything else is measured. Don't yield to temptation and think you can measure everything without the spinner in place and have it work out. Some have tried and it has always been a mistake. When someone walks up to the airplane, the focal point is the nose and it's distractive if the nosebowl and cowling don't flow back from the spinner in a natural way.

Setting the Spinner Gap.

One reason you can't make any progress without the spinner in place is that spinner backing plates are anything but standardized. Some sweep forward, some back and the overhang from one design to another is significantly different. Since you want a gap behind the spinner that pleases you and has no interference, it's best to set things up with the spinner initially in place to eliminate all guess work. Borrow one, if you don't want to buy it at this stage.

The prop doesn't have to be installed permanently or torqued down. Just snug the bolts and bolt the spinner in place.

Positioning the Nosebowl

First, carefully tape the nosebowl halves together so the flanges line up and fit as tightly as possible. Sit the nosebowl on the workbench, flange down, so it is square. Then drill three #30 holes in the nose bowl on each side and two on the inboard edge of each air inlet so you can cleco the two halves together.

Jigging the nosebowl so it is square to the firewall horizontal - ly and square to the crankshaft vertically, is critical. Don't make the nose gap less than about 1/4". 1.2" is shown

Now decide how much gap you want behind the spinner. In theory, the smaller the gap, the more aerodynamically efficient the entire unit will be but there's a limit. 1/4" should be about the minimum and 1/2" the maximum.

Tape a piece of plywood or masonite the thickness of the gap you're looking for to the back of the spinner. Now, sight down that material and see where that surface lies in relation to the face of the crankshaft. *That identifies the plane where the*

face of the nosebowl will lie. Chances are it'll be slightly in front of the mating surface of the crank flange. Mark that on the prop/crankshaft flange with a fine felt marker and measure as carefully as possible how far in front (or behind) the face of the crank (the line where the propeller and crankshaft meet) the front of the nosebowl flat must lie.

Now remove the prop.

To join the two halves of the nose bowl, use No. 8 stainless steel machine screws with nutplates riveted to the flanges. Use dead soft rivets when riveting the nut plates or put an aluminum strip doubler on the front of the back flange to hold the rivet.

Jigging the Nosebowl

We're going to establish a surface to which you can clamp the nosebowl and, with that firmly in position, cut the sheet metal that bridges from the nosebowl to the firewall. The nosebowl establishes the front line for the sheet metal. As it comes to you, that metal is about two inches too long because it must accommodate a wide variety of engines.

With the propeller removed (stuff a clean, lint-free, lightly oiled rag in the crankshaft hole), set the propeller flange down on a piece of 1/8" masonite. If your measurements say, the nosebowl plane should be 1/4" ahead of the crank flange, then use 1/4" ply, which is preferable because it's stiffer.

With the prop sitting on the plywood, tap or pry on the top of the bolts, so they leave marks in the ply to give you references to drill a bolt pattern that will allow you to bolt or clamp that piece of ply to the crankshaft. It only has to stick out past the flange enough to give approximately a 13 1/2" -14" diameter disk . With just a little care, your disk should come out perfectly centered.

Before drilling out the big hole in the middle of the ply for the crank snoot that sticks up into the prop hub, use a big compass to make a line 6 3/4" from the center all the way around, so, when you trim the ply on that line, you have a solid disk that fits inside (or outside, depending on the gap you want) the front nose bowl flange. Now bolt the plywood disk to the crankshaft flange. Put masking tape on the crank flange to protect it.

The wooden disk is bolted to the crank flange and establishes the gap between the nosebowl and the spinner. At the same time, it gives a surface to which the nosebowl can be clamped and kept square and in position. 1" x 2" boards can be clamped to this surface and used to square the back of the nose bowl to the back of the spinner. They also establish datums for measuring distances back to the firewall.

When clamping the nosebowl to the plywood disk, pay particular attention to getting the nosebowl situated so the crank is in the exact middle of the cowling hole so everything lines up with the spinner.

Also, *and this is important*, you need to square the back of the nosebowl with the firewall. Clamp a 3 foot piece of 1 x 2 wood to the disk so it is laying horizontal. Then looking down on the nosebowl from above, measure from both ends of the 1 x 2 to the firewall and shim as necessary to get the back flange square. It should need little, if any, correction.

Clamp the 1 x 2 vertically on the disk and measure from the firewall to the back nosebowl flange at the top and the bottom to make sure it's square to the firewall in the vertical plane. It's possible you may have to spring the nosebowl a little to get everything square, but it doesn't have to be absolutely exact. Get it square enough to get measurements for your cowling sheet metal and your sheet metal will hold it in position.

Install the Top Piece

The top piece of cowling sheet metal is rel-

This is the intersection of the cowling hinge line and the fire - wall. The nose of the airplane is to the right. The top cowl piece overlaps the firewall flange and is easiest to put in. It also holds the nose bowl square. The channels for the hinge go under the firewall flange. The channels are provided in the kit but the hinges are not.

atively square and easy to put in, plus, it helps hold the nosebowl in position when installing the rest of the cowling sheet metal.

There are aluminum channels that go on each side of the top piece to support the hinges. The aluminum channels go *under/inside* the nosebowl and firewall flanges, so, when the cowling metal has been attached to the channels, the nosebowl and firewall flanges are trapped between the cowling metal and the channels. The piano hinges for the doors will go lengthwise between the "U" channels and the top piece.

The top cowling piece will help jig the nose bowl left and right, *but you have to make sure the nosebowl is vertical before you trim the lower cowl piece*. Cleco the front edge of the top cowl piece to the nosebowl, but leave the back edge temporarily clamped in position so you can adust it later, if necessary.

Making the Bottom Cowl

For most engine installations, it will be much easier if you remove the carburetor from the engine before working on the bottom cowl because a hole must be cut in the bottom cowl to accommodate it. That's more easily done when the cowling is closer to being complete and is stiffer.

Before doing anything, establish the position for the "U" channels on both sides of the cowl that form the top of the bottom cowl sides. These act as doublers to give the CamLocs in the doors something to mount into. They also establish the line for the cowl break and this isn't something to be taken lightly. The bottom edges of the cowl doors should be slightly below the cylinders, but more important, they should be parallel to the cabin doors. If the cowl break has even a slight angle to the doors, it will look awful plus it will make it difficult to layout paint stripes.

Cleco the channels into position on the sides between the nosebowl flanges and the firewall flanges using #40 clecos from the inside. Drill the front hole (nosebowl flange) first. Then cleco the clannels in place. *Before drilling the final hole on the back end of each channel, look down on the nosebowl from above and make sure it is still square to the firewall.*

We're going to use these channels as the indices to position the bottom sheet metal.

The sheet metal for the bottom cowl is shipped flat and in two pieces to be joined in the middle with most of the joint being under the air scoop. If you have a roller to shape the curve into each piece, fine, but it isn't needed. You can hand bend the approximate shape into it and let the firewall and nosebowl hold the exact shape. When hand bending, just "spring" it around something like a basement lally column and gradually work the curve into it. Don't get too aggressive or you may put a visible bend in it, when all you want is a gentle curve.

In reality, it doesn't need to be pre-bent at all and can be sprung into position and held by the screws. However, that puts an awful lot of load on it and not only promotes cracking, but makes it extremely difficult to handle when removing for maintenance, etc.

Trying to hold the metal in place while you accurately mark it is very cumbersome. You'll need someone to help you. It also really helps if you have a couple of small, ratchet operated cargo straps. Bungees will work too.

It's actually easiest, if you work half of the sheet metal at a time. Get one half in position, drill and cleco it and it'll stiffen the entire assembly so the other side is much easier.

Put one half in approximate position and run the straps or bungees around the entire nose in several positions so as to clamp the metal tight to both the firewall and the nose bowl. Tighten, as

necessary to get it in position. Use small "2" C-clamps to help hold things securely in place on the U-channel, but pad the C-clamps with masking tape first to prevent making marks.

The front edge of the bottom cowl metal is cut in the arc necessary to interface with the bottom of the nosebowl. Depending on the type of engine and motor mount installed, the back of the cowling sheet metal is at least 1-2" too long to allow for exact trimming and is a similar amount too wide to allow for overlap at the bottom and to make sure you have enough to completely cover the U-channels at the bottom of each side cowl opening.

The concept we're going to apply here is first cleco the bottom metal to the nosebowl, then trace the rear section for hole positions, remove the metal, drill the back holes, then, remount the metal and match drill the holes on the firewall flange from the outside to ensure the metal is laying completely tight to the firewall flange. The actual steps follow.

Mount the front edge, where it hits the nose bowl, first. Mark the nosebowl for where you'll want the #8 nutplates to hold the bottom sheet metal (3" spacing is good). Then, making absolutely certain the top edge of the sheet metal is flush with the top of the U-channel and pulled up tight to both the nosebowl and the firewall flanges, drill one #40 hole through the sheet metal and through the nosebowl flange and install a cleco. This hole should be about 2" down from the U-channel.

If you want to be on the safe side, you can let the side metal stand about 1/4" above the U-channel to allow for minor adjustments before final riveting and bolting. You'll remove the 1/4" prior to riveting the side metal to the U-channels.

Before doing anything else, double check to make sure the back of the sheet metal hasn't shifted because the instant you put a second cleco in place in the nosebowl, the shape of the cowling is fixed, so measure three times, cleco once. Recheck the nosebowl again for squareness.

From that point on, you'll carefully force the metal to "walk" away from that cleco and lay flat against the nosebowl flange before drilling the next hole. You'll continue this process and work down from the U-channel toward the bottom, which ensures the metal will flow downward and lay flat against the flange with no puckers. Every so often, check the back of the cowl for inadvertent movement.

every time you install a cleco, the cowling assembly gets that much more stable and easier to handle. This is a good thing

Now go to the back edge of the cowling. You'll see there's a lot of extra metal back there. Ignore it for the time being.

Check inside the cowling to make sure the metal is laying flat against the firewall flange all the way around. ALSO, CHECK TO MAKE CERTAIN THE NOSEBOWL IS STILL VERTICAL AND HASN'T MOVED. If it has moved, loosen the C-clamps on the U-channel and adjust by tapping the top and bottom metal fore and aft to get it square.

Reach inside and run a fine point magic marker all the way around the front edge of the firewall flange leaving a mark on the inside of the bottom cowl. Use a new marker, not a blunt one, because we want a narrow line to adjust to. Do this to the top cowl piece installed in the previous section, as well as marking the bottom piece you just installed. This clearly indicates where the front of the firewall flange is. This will be your reference for drilling your holes. Make a couple of marks that run fore and aft on the metal and go over the flange as well. This will help when reinstalling the sheet metal so you get it in the same place before drilling the holes. Remember to mark where the tunnel interrupts the bottom flange.

Remove the bottom sheet metal and lay a piece of masking tape where the tunnel will be to keep from drilling holes in that area. Mark a line half the width of the flange all the way around the sheet metal *behind* the first line (which is the front edge of the firewall flange). This forms the centerline for your bolt holes. Do this to the top center piece as well.

With about 3" spacing, layout your bolt pattern on the inside of the firewall end of the cowling starting from the middle of the channel area and drill it using #40, NOT #30, holes. These are just guide holes. You'll drill through them with a bigger bit later.

Put the sheet metal back on, carefully position it so the marks on the inside of the cowl are all lining up with those you made earlier on the firewall flange and make sure it is tight to the firewall

flange. Remember, this metal is clecoed to the nosebowl, which will hold part of the curve in it. The nosebowl has remained in position through all of this with the channels on each side that form the top of the bottom cowl pieces still clecoed in place.

Clamp the bottom cowl piece, which is now re-clecoed to the nosebowl, to the U-channel pieces and remove the clecos that have been holding the channels in place from the inside. Then, using a match drill tool, one of those strap things with a bushing in the end (or a small angle drill, if you have one that will let you work from the inside), drill the top bolt holes, which should be centered on the "U" channel at the firewall end. Before drilling the first back hole, do one more check to make sure the nose bowl hasn't shifted.

Working top down, drill #40 holes in the firewall flange using the outside metal with the previously drilled holes as the guide and cleco, drill and cleco, drill and cleco.

Do NOT install nut plates in the firewall flange at this time. You're going to be putting the metal on and taking it off so many times that having screws in it would drive you nuts. Leave everything clecoed until the last minute.

Once one bottom side piece is in place, just repeat the process for the other side. Trim the overlap in the middle so it's only about 1" per side, but make sure the rivet line will be in the middle of the cowling. Then, rivet the two halves together

Finishing the Top Edge of the Bottom Cowl

Trim the top edge of the metal where it overlaps the U-channel and install six AN3 flush rivets to permanently attach the side skin to the U-channel. *Make sure the rivets aren't where you'll be installing CamLocs later.*

Making the Cowling Doors

The cowl doors in the kit have the curve in the front edges to match the nose bowl, but, again, the doors are long. Forget about the length until the last minute.

With the top cowl piece in position, trim a piece of piano hinge to the right length and insert it between the top sheet metal and the top "U" channel. Cleco this in place with at least four clecos, plus a cleco at each end of the channel holding it to the nosebowl and the firewall. We don't want anything moving around while we fit the doors.

NOTE: *Installing the camlocs should be the LAST thing you do to the cowling as that's where any adjustments can be made to ensure that the doors fit right*. So, don't install the Camlocs until the nut plates holding the cowl together and to the firewall are installed and you can permanently bolt the entire cowling together so nothing can move while you're final trimming the doors and fitting the Camlocs. *This is the only way you can be sure of getting tight fitting doors.*

Installing the cowl scoop

The position of the cowl scoop is driven by the engine being used and the air box installed on it, so the following guides are of a general nature.

Temporarily re-install the carburetor to see how it interfaces with the bottom cowl and cut the smallest possible hole. You'll enlarge it later, but right now make it tight. A good way to cut holes in the middle of a panel like this is to lay it out, then use a Unibit to drill a large diameter (3/4") hole in each corner. This makes a neater corner plus gives room for snips to start working. Go slow and try not to distort the edges with the snips.

There's a possibility the carb won't interfere with the cowling, but the air box will, so you need to settle the air box issue before you can put the cowling to bed. A number of the suppliers have air boxes that will work although they may need slight modifications. The one commonly used for

Sideview of lower cowl before the scoop is attached: Each installation will be slightly different but the air box will protrude and should be in place before the airscoop is positioned. Also, the hole shown where the alternate airsource tube has been cut off will need to be closed off with a patch and a tube mounted in the rear or rear top of the box.

the 540 is PN08-01630 from Aircraft Spruce. It'll need the alternate air source hole in the side plugged and a new hole and mount tube put in the rer. This can be welded or riveted. Also get the Bracket BA5110 filter kit.

Once your air box is mounted, you can see what other metal needs to be removed and how the scoop should be positioned to cover both the box AND an air filter, if you're going to use one.

There is quite an intense thread on the air box issue in the Bearhawk Yahoo group archives.

Piper louvers work well on the Bearhawk.

Front view of the completed air scoop, this on a 540 powered airplane. Notice the screen and bracket that is part of the Bracket Air Filter system that is attached to the front of the air box itself. Note the seam just above the scoop where the two halves of the bottom cowl are joined.

The scoop, as supplied will need only minor trimming before attaching to the bottom cowl, however every installation will be slightly different depending on engine and air box used.

Air Outlet

The different size and type of engines require different outlets, but, in general, you want an area that covers approximately 100 square inches including the tunnel area. That's usually an arch. A number of the builders utilizing 0-540's have also put a 2" lip on that cut-out, although it appears the final cooling solution for hotter areas is to install louvers on the lower sides of the cowl. Get Piper cowl louvers, PN# 87405-802 (left), PN#87405-803 (right). They are available through Intermountain Air, Salt Lake City, UT. 800-433-9617. Ask for Daniel. Do not install the louvers until the airplane is flown and a heating problem is determined to exist, as many airplanes cool just fine with the normal inlet and outlet areas,

The kit contains two flat pieces for the bottom cowl halves and two for the doors. The cowl top piece is, like the rest of the parts, long at the rear to allow exact trimming on assembly.

Fuselage: Doin' the Doors

The doors, as they come in the kit, are complete and ready to install, but the builder must cover them with .025" aluminum, complete the latch assembly (or use a vendored latch) and install the windows.

The doors are one of the features what make the BH a uniquely useful airplane. Besides giving numerous ways of getting in the airplane, the doors let you load some really large, ungainly cargo and carry it with ease. They also hold the key to making the airplane into a flying motorhome.

What Needs to be Done?

The doors require nothing to simply hang them: put them in place and drop the bolts or pins in (drill the paint out of the holes). However. there are some items that must be done first. They are:

- Install the latches as per the plans.
- Fabricate and install the metal covering.
- Bend up "L" pieces to mount windows

Latches

The kit comes with the latches as shown in the plans and the plans/newsletters are the best reference on how to install and tune them.

The rear door latches should be used as supplied but there is an excellent alternate latch available from Aircraft Spruce, PN 05-04520/21 for the front doors. This latch allows closing and latching the door by just lightly slamming it, which is a great convenience. If using the alternate latch, be sure to provide a thin stainless steel sheet striker plate on the door sill where it will be hitting. See the pictures.

Skinning the doors

Temporarily hang one of the doors in the fuselage to get an idea of what you're trying to accomplish. The door skins must go out far enough past the frame that they chin themselves on the outside door frames. They then also provide a surface to which weather stripping can be attached. A gap has been purposely left between the door and the frame so it can be sealed properly.

Sealing the gap is necessary to make the airplane weather tight. It also cuts down on the wind noise and increases the airplane's efficiency. Sealing can be left until the airplane is flying.

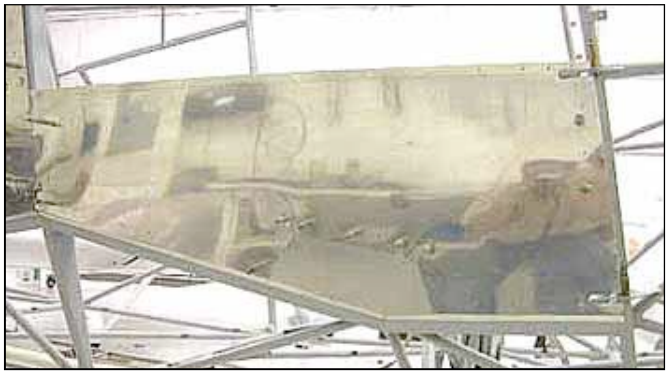
This is an alternate latch for the front doors that is available from Aircraft Spruce, PN05-04520/21. This latch lets you slam the door, rather than having to open the latch each time.

A simple striker plate of thin stainless is all that's needed to protect the airframe.

.025 2024-T3 is the usual choice for skinning the doors. It is light, tough and easily worked.You'll also use it for making the outside frame for the top half of the front doors and for making the small "L" shaped strips that hold the front windows in place.

To work the aluminum, an inexpensive

Once the skin is attached to the outside, the interior panels can be screwed directly to the door frame



PK screws or pop rivets can be used to attach the skin, but using countersunk fasteners give a cleaner look.

sheet metal apron break like that available from Harbor Freight will work fine and you'll find your self using it for many other applications, as well. One of the commonly available shear/break/roller combination tools is slightly more expensive, but makes working all of the aluminum pieces much easier and more exact.

It should be noted that all of the cutting can be done with hand shears while two C-clamps and a couple pieces of angle iron can do the bending. Having the break, however, makes neater bends.

The skinning process is the same for all of the doors except the rear cargo door, as that requires several slight bends in the middle to conform to the fuselage/stringer shape.

Riveting the Skin

The skin can be attached to the door frame with common 1/8" "pop" rivets although it is suggested that a filler be put in the rivet head holes to weather proof them and to improve appearance. Also, for appearance sake, some builders have used counter sunk pop rivets by lightly machine-countersinking the skin, which is actually too thin to counter sink, so it cuts slightly into the tubing underneath. This is okay because the doors aren't primary structure.

The skins could also be attached using small sheet metal screws (PK screws) and at least one builder has bonded the skins to the framework.

Sealing the Door Frames

Some of the earlier kits have open tubing in the door frames and it is suggested that wood or plastic plugs be epoxied into the ends of those tubes to make them weather tight.

Door Sill Protection

Although it isn't necessary, it is highly recommended that, after the aircraft is covered, you fabricate an aluminum or stainless steel scuff panel for the bottom door sills to keep careless feet from wearing down the fabric. See page 44.

Convenience Goodies

The doors are much more convenient to use if the front ones receive "hold open" devices, as pictured. These are readily available in many hardware stores. Also, a small gas cylinder for the back door works really well.

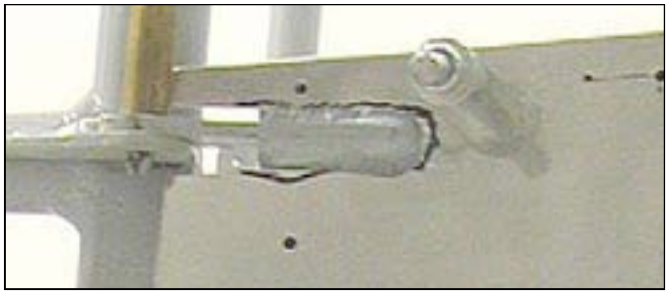
The Wing Strut Door

The little flap on the bottom of the front doors is necessary to get additional travel in the door for entry. It is nothing more than a piece of .025 aluminum attached to the door with a piano hinge. No spring is necessary as it automatically closes when you close the door.

Note: to protect the paint on the wing strut, put a piece of clear teflon tape where the door flap touches or it'll eventually scuff the paint. Bonding on a nicely trimmed and polished piece of .016 stainless would look good too.

The famous Bearhawk "mouse door," which is necessary to allow the door to open wider. A simple piano hinge is attached and the mouse door skin is lapped to the inside *of the main door skin, so that when the door is closed, the mousedoor is automatically sealed shut. Note that there is a slight break at the edges of the door skin to give a better seal.*

Rear door gas strut hold open device: this is so slick you shouldn't build the airplane without it. "Door Steward", WWW.mtnviewaviation.com, PN200C101. An automotive unit will be much less expensive, see www.allegiscorp.com



Cut the clearance slots for the hinges as tight as possible.

This over-center, hold-open device for the front door is found at local hardware stores and is another must have.

The .025 L-shaped strips hold the plexi against the door skin.

Some builders round the rear window corners w/filler pieces..

This is the result. NOTE: REAR WINDOWS MUST BE LEXAN AS THEY HAVE A BEND IN THEM. PLEXI WILL CRAZE IN TIME.

Installing the door windows

Make the windows out of .060-.090" Plexi. Cut them just small enough to account for expansion and to give room for thin sealing strips. Don't just clamp it between two pieces of bare aluminum. Also, when installing them for the last time, run a small bead of silicone caulk at the edge where they contact the door.

To install the front door windows, you'll first have to make the outside frame cover and rivet to the frame. Then make up some 3/8" x 3/8" angles using .025 aluminum. You'll need to cut enough that you can run these angles inside the door window frames all the way around the window Attach them with small sheet metal screws (PK screws) into the door frame but NOT into the plexi. The Plexi is just clamped between the L-strips and the door skin.

The rear windows can be flexed into the channels. When attaching the outside trim for the left window, you'll be running screws through the windows and the channels. Remember to make the holes in the Plexi at least two drill sizes bigger than the bolts.

Before setting the side/rear windows in place put some sort of sealer into the channel or where the window will sit. The strip mastiff used for sealing corrugated roofing works extremely well. If you're going to use a caulking material be advised that if you use silicon, it is also a glue and could be a mess to clean up and get a clean edge if you aren't careful during installation. Mask the windows leaving just a small area for the caulking and it'll clean up much easier

Fuselage: The Windshield

The windshield is available from L & P plastics trimimed close to net , but you'll still have to do some grinding. It's available in tints with gray being the most popular

Windshields: Variation on a Theme

At this time there are only two variations of Bearhawk windshields, tinted and untinted. Which you pick is strictly your decision. The cost differential is minimal. If you go for skylights, we definitely recommend using at least the medium of the three tints available for those. We also strongly recommend putting skylights in as it not only opens up the cockpit, but lets you see over the down wing in a turn. Kits are available from Jim Clevenger, 407-361-2580 or see builder Ron Jone's website, www.mykitlog.com/jonesronc for how he did his own.

Leave the plastic covering on the windshield until the last minute, but don't leave it somewhere where it can get hot because the plastic covering has been known to become seriously stuck to the windshield and hard to remove.

Installing the Windshield Without the Wings

If you're doing the fuselage first you should know that you're taking a chance of you try to install the windshield without the wings on the airplane. The top corners of the windshield should flow right into the wing roots and without the wings you have nothing to reference to. So, there's the chance the alignment won't be quite right and your windshield/wing fairing will look funky. THERE IS A WAY AROUND THAT, HOWEVER!

If you really want to get the windshield in without the wings, you can take drawing No. 7, the airfoil mylar, that's in the plans and make a dummy root rib out of plywood. Then spend some time measuring your wings getting the exact dimension from the front of the wing fittings to the nose of the wing. Also see exactly how far the wing mount bolt hole is from the rib. You can make up a wood jig that holds the plywood rib in position where the wing would be and build the windshield to that. Check and double check your dummy rib against the wings and the fuselage to make sure you have it in the right place.

It's safer to wait until the wings are in place to make sure you get it right.

Installation: the General Concept

Installing the windshield isn't particularly difficult, but it can be tedious because the generally brittle nature of the material demands that you make haste very slowly. It's easy to scratch or crack it, so think of the cost every time you get close to it.

You'll need a 1/4" plexiglass bit and some extra sanding wheels for your angle head grinder. *Don't yield to temptation and try to drill plexi with regular bits. If they grab, you'll be ordering another windshield.*

You want to get the windshield relationship to the wing just right to make your fairings fit better.

Once you have the boot cowl and the extension to the panel in place, you have the surfaces ready to receive the windshield. The top of the windshield should slide into the channel at the top of the fuselage and the sides go **outside** of the tabs on the side. The bottom tab won't be used because the windshield doesn't go down that far.

Trimming to fit

The windshield, if a trimmed unit from L & P, is not a stock C-170 windshield as the plans call for, and should require only minor trimming to fit perfectly. However, because everyone's sheet metal is a little different we can't give you actual dimensions. *DO NOT ATTEMPT TO WORK A COLD WINDSHIELD BECAUSE IT'S BRITTLE.*

There is so little trimming needed that it could all be done with a rasp or, if you have a steady hand, a 60 grit flapper wheel on a 4" angle head grinder. Be careful when using a power sander because one slip could be expensive.

The procedure is literally a "cut and try" operation. Sit it up in place and see how high the back of it is above the channel in the back. Make sure you don't lean it back to make it hit the channel and, in so doing, change the line of the windshield to the cabin roof. If should flow smoothly over the top. This is decided by eye. The amount it sits above the channel tells you how much it needs to come down and most of that will come out of the front middle at the bottom.

Slowly grind away material until you get it set vertically, then tackle the horizontal (back) trimming, if any is required. Quite often little or none is required. Do your trimming very, very slowly. Lay a marker flat on the sheet metal and slide it around the sheet metal against the plexi. It'll leave a mark that exactly follows the surface, but 1/4" or so up. *You don't want to cut to that line, but you do want to parallel it*, so make a similar line about 1/16" up from the edge of the plexi and grind to that mark. Then put it on the airplane and see how it fits. Then make another mark 1/16" up from that edge. Try it out. Keep doing this process until it fits.

Take your time. Building the airplane is going to take a long time, but you're going to keep it and fly it much, much longer than that. so there's no reason to rush.

You'll notice, as you're trimming, that there are large gaps at the bottom rear corners where the instrument panel hits the side tubing. Don't worry about those. They are covered by the fairing strip you'll be fabricating.

Drilling the Mounting Holes

First, we've said it before, but we can't emphasis this enough: *USE DRILL BITS SPECIALLY DESIGNED FOR DRILLING PLEXI*. These bits have a steeper angle and have much less chance of catching and cracking the plastic. Even so, go very slowly and let the bit generate some heat and slowly worry its way through the plexi rather than actually cutting. This is a very iffy operation and the slower you go, the better you'll be.

It is suggested that you paint stripes or something on the shanks of your plexi bits as soon as you get them so you can't possibly pick up the wrong bit later on.

The only thing holding the windshield to the airplane are the screws at the side tabs, which is plenty. However, there's a procedure to be followed when drilling those holes.

First, holes in plexi glass have to be much bigger than the screws going through them to give room for expansion and contraction and to keep vibration from causing cracks because the plexi is touching a screw shank. We'll use 1/4" holes but #8 screws. Further, if, when we're all done, we have a screw that's not in the middle of the hole but is touching the edge, we'll use a round file (the kind used for sharpening chain saws) to open the hole up a little. You can bush the screws with plastic tubing to fill the holes, if desired.

Drill #30 guide holes in the tabs first with a regular bit. Then mount the windshield.

With the windshield in position (hold it with lots of speed tape), using your PLEXI BIT, drill a 1/8 hole through the plastic from inside using the tab holes as guides. Use very little pressure and let the bit grind its way through. Hold a block of wood on the outside to back it up to prevent flexing and to keep the drill from slamming forward, when it breaks through. As you feel it starting to come through the plastic, ease off the drill pressure.

Remove the windshield and bring the holes in the windshield up to 1/4" using the plexi bit and moving slowly.

Open the tab holes up to 3/16 using a regular bit.

After all the holes are drilled, come back

with a 3/8" bit and lightly twirl it in your fingers to chamfer the edges of each hole in the windshield to remove stress risers. A small rotary file would do the same thing.

FYI-the windshield is going to be mounted only temporarily because you can't put it in permanently until the fabric is on the airplane because the fabric wraps around, and is stuffed into the channel at the top of the windshield.

Incidentally, the holes you drill for the mounting tabs are the only holes you'll drill in the windshield. Later, when you're attaching fairing strips, *none of those screws go into the windshield*.

Center stops

The plans call for an angled strip that runs around the inside of the windshield at the bottom to keep it from moving backward under air load. It doesn't need to be a continuous strip as it would have to be stretched and shrunk. Three pieces of .032 bent to match the windshield angle, three inches long each with one inch legs and distributed across the center of the windshield will more than do the job.

Break the back-up aluminum so it exactly matches the slope of the windshield and the panel top. Be sure to round the corners and smooth the edges. Also bond thin rubber to the front surface or tape it so there is a chaffing surface to protect the windshield. Drill one hole in the bottom legs of these angles and snuggle them up against the back edge of the inside of the windshield and mark the hole position in the top of the panel. You can't drill the holes until you remove the windshield. Use #8 screws and nuts to mount. Using only one hole lets the angles self-align with the windshield surface. Put nutplates inside the instrument panel top to secure these screws.

Making the Lower Fairing Strip

Because of variations from builder to builder, AviPro can't provide the lower fairing strip and be guaranteed of it fitting exactly. For that reason, it's best if each builder fabricates their own.

If you're a sheet metal guy with shrinkers and stretchers, you can make this out of aluminum, but most will find it much easier, if a little messy, to make this out of fiberglass right on the airplane.

If you've never used fiberglass, it's a no-brainer. Go down to your local boat shop and pick

The stop angles can be either a shrunk angle or made up of a number of two-inch pieces. Bend them up out of .032 alu - minum. Note the access panel clecoed in place.

up some fine-weave cloth and the appropriate epoxy or polyester mix. If they have the glass in four-inch strips, that's what you'll want.

The first step in the process is to cover every bit of the airplane and the floor within three or four feet of the windshield with protective sheeting because you're going to make a terrific mess.

To keep the fiberglass from sticking to the fuselage or windshield, everything should be liberally coated with mold release (lots of wax will work), although a safer approach is to stretch shrink wrap plastic (Saran wrap) over the area, or cover it with packing tape, which will also give a smoother surface on the back of the glass and make it easier to get off. If you use tape, it'll bridge gaps at the bottom of the windshield and make a smoother intersection in that area, which will make your life easier, when putting the fiberglass strips in place. Wax the tape too.

Set up a piece of plywood on some saw horses close to where you'll be working as a temporary work surface and cover it with polypropylene sheeting or wax paper. Stretch it tight and staple it so it won't move while you're working on it. You're going to use this surface to stretch your glass strips out on and soak them prior to laying them up on the windshield.

Depending on the thickness of the cloth you're using, you'll be laying up a minimum of six layers with seven to ten being better.

You'll need help doing this, or you'll make even a bigger mess than normal.

Layout enough strips to make ten layers and make them at least six inches longer than needed so you don't have to worry about positioning. You're going to be doing a lot cutting and sanding after it cures, so better to have too much.. Mix up more

resin then you think you can possible use because you definitely don't want to run short.

Using a stiff brush, saturate each of the strips. You'll see it turn color and go transparent as you get it wet all the way through.

Have your helper grab one end of a piece and the two of you walk it over the nose and lay it in place around the bottom of the windshield. Press it down and use a small squeegee to get any bubbles out.

Keep laying strips on top of one another, trying to keep the edges even and the strips centered. However, it isn't critical they be perfect because you'll be sanding later. Do ten layers.

What is critical is that you try to squeegee out as much resin as you can from each layer and make sure there are no bubbles or dry spots, as indicated by whitish areas.

Pay particular attentions to the bottom, rear corners and you may want to cut some short strips and widen out the ends to cover the gaps. Generally, this isn't necessary but do it anyway. You can always cut it off.

When everything has cured, but before removing it, run masking tape from side to side on the fairing that indicates where you'll trim it. Then carefully mark the edges of the tape so you have straight lines from end to end to trim to.

From this point on it is more body work, then it is airplane work, as you'll be using something like Evercoat's polyester glazing putty, not bondo/body filler, to fill and smooth the surface. The glazing compound is flexible and sands easily.

If you used epoxy in the fiberglas, you'll have to use epoxy-based filler. If polester vinyl resin is used, you can fill with epoxy or vinyl-ester.

When the unit is all finished, you'll want to mount it with #8 screws and you'll want to put nut plates under the aluminum.

The windshield comes fairly well trimmed on the sides, but the top, where it goes into the channel, and the bottom, where it curves over the boot cowl, need to be trimmed.

Laying the soaked cloth strips in position is messy and needs two sets of hands. Cover everything in sight to protect it. The material will stretch and conform but be sure to roll out any bubbles and excess resin.

Be sure to put down a "release" surface before applying the fiberglass. This builder used electrician's tape but packing tape or even Scotch tape works fine. Don't even think about not using a release or you'll have everything stuck together.

Trim the edges then sand and fill as if you're doing automotive body work, using the same polyester two-part glazing com - pound to fill the weave and eliminate the sanding scratches.

Fuselage: The Interior

Pat Fagan's award winning BH uses Piper Cub technology in the interior: the sides and head liner are nothing but painted Stits PolyFiber. Light and durable. A variation could be to "flock" it as original Champs were done

Interior Do's and Don'ts

An airplane is a machine designed to cheat gravity so we want to leave anything on the ground that's going to make its job more difficult. No where is that more of a challenge than in the interior. Everyone wants to make their machine unique, but do so with "light" in mind and don't hurt your useful load and performance just to have something that looks great while sitting on the ground.

This is an area where the homebuilder's imagination always kicks into high gear so anything we can say is only of a general nature, however, here are some random thoughts.

• ***Materials used***. Leather is heavy, fabric isn't.

• ***Backing panels***. Professional plastic backing panels are often heavier than .020 aluminum but much stiffer.

• ***Fabric is lightest***. Nothing is going to be as light as aircraft fabric and paint. That's the way Pat Fagan's award winning, plans-built Bearhawk "Smokey" is done and it obviously looks great. It is painted with a lightly textured gray paint that matches the upholstery

• ***Headsets are Lighter than Sound Proofing***. If using an unmuffled exhaust, the Bearhawk is noisy but trying to kill the sound adds lots of weight. Invest in a good ANR headset instead.

• ***Weather Stripping is Worth It.*** Tightly sealing doors and windows will cut down heat loss, reduce noise and even increase speed. Plus it weighs very little.

• ***Beading will reduce drumming***. If aluminum floor boards or interior panels are used, they'll "drum" with vibrations. A cheap Taiwan beading roller can stiffen them considerably.

A Fabric Interior Goes in First.

If you decide to go with an interior that utilizes aircraft fabric, ala Piper Cub, it has to be installed before any outside fabric is attached,so the over-lapping at the edges works out right, e.g., the outside fabric should always lap to the inside for better appearance. For that reason, plan ahead.

Before installing this kind of interior, which is permanent, get all of your systems in and working, remove what is necessary for access, and put your interior fabric in place and get it finished at least through silver. Install inspection panels to get at the mechanical stuff behind the fabric.

An Upholstered Interior

Tabs are provided for the attachment of upholstery panels, if they are used. Backing panels can be made of anything, but the lighter they are the better.

The head liner is problematic and some builders have fabricated one on upholstery board and attached it to the tubing with push-clips designed to go around tubes. These are available at upholstery stores. The tubing on top of the fuselage in the rear is pyramid shaped to give additional headroom over the rear seat. If you go straight from longeron to longeron, you are giving up lots of valuable headroom in back.

The Rear Bulkhead

The panel at the back of the cargo area has been treated in a number of different ways, including bare or painted aluminum, laced canvas/fabric and fully upholstered. In any situation it should be remembered that access is required to get at the flap mechanism and to inspect pulleys, etc, so the panel should be removable or at least have a sizeable

access panel in it. Tabs are provided to attach any form of bulkhead.

Some mods builders have incorporated on the back panel are:

• Bottom 12" is hinged up for foot room while sleeping in cargo bay.

• trapezoidal "ski tube" is constructed to run

Leather is heavy, but soooo good looking. Notice how the headliner follows the "cathedral" shape of the tubing, which was meant to create more headroom in the back. If you go straight across from the longerons you give up about two inches of headroom.

back down the fuselage to carry over-length, but light items. Tube is made of .020 aluminum.

• "hat rack" made of mesh is attached to hold essentials while camping in the BH.

Weight of Interior Material

One of the builders, Mike Creek, worked up the following weights. This will give you a comparison on what different interior options cost you in weight. He calculated the interior surface area to be 80 square feet.

	Lb./Ft	Tot Lb. (80 sq. ft)
Foil Bubble Wrap	0.06	4.8
Airplane Fabric (coated & painted)	0.10	8.0
Auto Fabric	0.22	17.8
3/16" Foam Board	0.13	10.2
Sign Board - (1/8") Corrugated Plastic	0.15	12.3
0.016 Aluminum 2024T3	0.23	18.4
Upholsterer's C'board-1/16")	0.27	21.8
0.025 Aluminum 2024T3	0.36	28.8

Cushion Foam

The most popular seat cushion material is the heat-sensitive foam, sometimes called Temper Foam or Contour Foam. It molds to your body and

The builder has done a neat job of forming his upholstery backing panels. He can, if he wants, paint, rather than upholster them for a lighter interior.

The interior shown with foam backing board trimmed to rough shape. Following the cathedral rear tubing is difficult with upholstery board but it's worth the effort.

compacts to 50% of its original thickness. It's available as a build up of three 1" layers bonded together with a soft layer on the outside and increasingly dense layers as you get deeper into it. It is very comfortable but not without a few caveats.

The material is expensive and heavy for its size. Further, because it is heat sensitive, after a cool night (not cold, cool) it will be hard as a rock and it takes a few minutes of sitting on it to soften up, which is only a minor irritation.

You'll need a 3" cushion of it on the bottom which will raise the seat level 1.5" when being sat on. If you want more than that, space it up with rigid foam and it's advisable you carve small hollows on the middle of the seat where your butt bones will sit. It greatly eliminates "hot spots."

For the seat backs, use any kind of upholstery foam available because it carries no load.

Remember, when deciding on cushions that this is your chance to adjust the seating to fit you and your passengers, so plan on doing a lot of trial fitting.

Fuselage: Fabric covering

Some builders have had envelops sewn up for the fuselage, but this is absolutely not necessary and complicates the process by having to worry about keeping the seam on a longeron so it isn't as noticeable

A General Discussion on Covering

First, it is beyond the scope of this manual to go through the entire covering process. However, don't be dismayed: the reason we don't need to lead you through this process is because a number of fabric/paint companies, such as PolyFiber, produce really excellent videos and instruction manuals plus they conduct hands-on forums at fly-ins around the country. In addition, the EAA and private companies put on workshops.

Here's a guarantee: once you start collecting the knowledge required for covering, you'll loose your fear of it. Most builders say it's one of the more enjoyable parts of the project.

Bearhawk-Related Thoughts

The fabric vendor programs will answer nearly all of your questions, but there are a few Bearhawk-specific items that are worth discussing and Appendix C includes random thoughts and hints from builders on covering the airplane.

Where the fuselage fabric comes up the sides of the vertical fin, right above the horizontal stab, the fabric has to be shrunk in such a way that it forms a graceful curve up to the fin. This is not difficult but often, when this is done, especially if the shrinking is a little too aggressive, there is a gap between the fabric and the bottom fin rib. Although it appears as if that gap can be ignored, it's not a good idea because it's possible that the fabric could drum against the rib in flight, eventually wearing a hole in it, so it needs to be rib-stitched to the rib.

If the gap is more than about 3/16", when rib stitching the fabric to the rib, it will be pulled down, which forms a slight indentation at each rib stitch. This is strictly cosmetic and is of no structural concern, but some builders don't like the looks and have come up with a way to eliminate it.

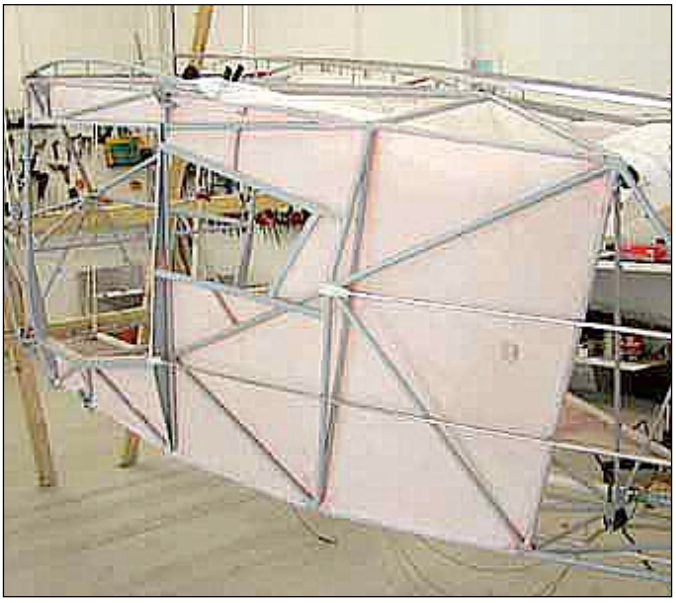
Some will make up a small, wooden rib, or shim, that is bolted and/or glued over the face of the bottom rib. The rib is shaped so it comes up

A small, wooden rib spacer takes up any gap and allows rib stitching to be tight with no puckers.

Rib stitching with the false rib produces a smooth sur fae with no puckers

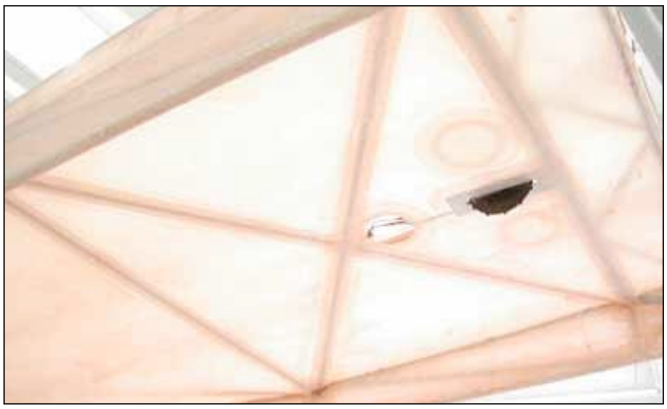
to the fabric surface and supports it. It can be be made out of common pine and should be about 5/8"-3/4" wide. Epoxy it to the rib and run a few #6 machine screws through it.

A pattern for the rib is floating around amongst the builders, so just go on the e-group and ask someone to send it to

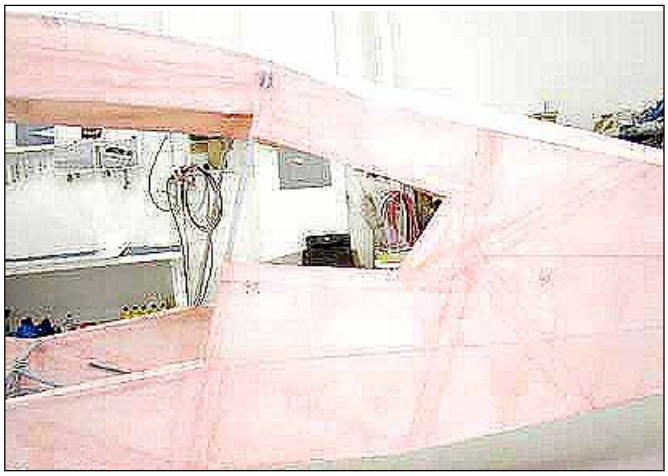


This is how you build a very light airplane: pass up heavy inte - rior materials in favor of painted Dacron fabric. When doing this kind of interior, the interior fabric goes on before the outside fabric so the laps go the right direction.

you. This rib gives a solid base to rib stitch to, but is unnecessary.



The headliner: a fabric interior requires rings to be glued to it in appropriate places to afix inspection panels.



Reinforcing tapes are glued over all possible wear points.

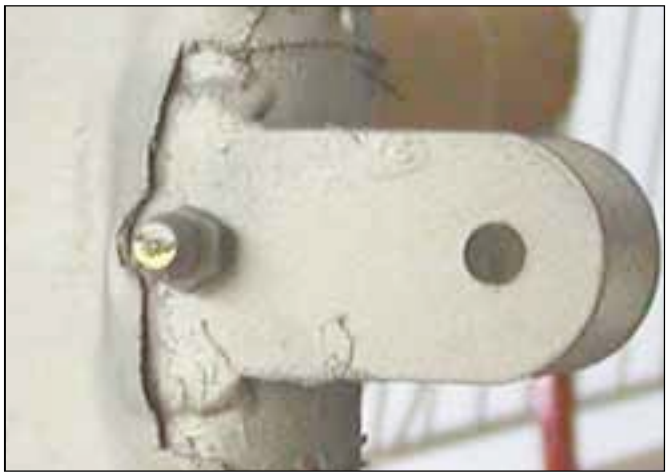
POLYFIBER COVERING MATERIAL LIST

Heavy Duty Fabric (belly, landing gear, stab)	13 yds.
Medium Fabric -	23 yds.
Light Fabric, Uncert (98 x 98, 1.7 OZ)patches	1
Med 3" x 25 yd. linear tape, roll	1
Med 2" X 50 yd. linear tape, roll	3
Med 1" x 25 yd., linear tape, roll	1
Med 4" x 25 yd., linear tape, roll	1
3" bias tape, roll 25 yards	1
Poly -Tak, Quart	4
Poly-Brush, Gallon	6
Poly-spray, gallon	7
Poly-brush untinted, gallon	1
RR 8500 reducer, gallon	5
3-2300 Conversion coat, quart	1
E-2310 Etch and brighener, quart	1
EP-420 Primer/white, gallon	1
EP-430, Primer Catalyst, quart	2
E-500 Epoxy reducer, gallon	1
C-2200 metal cleaner, quart	2
Std. rib lacing thread, 8 oz. spl.	1
_" Reinforcing tape, roll 50 yds	1
Thermometer/Iron calibration	1
H.S silicone, oz	1
Inspection hole reinforcing ring	24
Cloth adhesive (anti-chafe) tape	1
12" straight tip rib needle	1
Invisible gloves, pint	1
C-2210 pint sure cleaner, gallon	1
Paint strainer cone	12
Paint paddle	6
Poly-fiber System Manual	1

Fabric included for interior, NO PAINT INCLUDED

Lawlor Aeronautics, 800-608-5235

In many ways, when doing small areas, doing it in fabric is easier than fabricating and attaching upholstery panels.



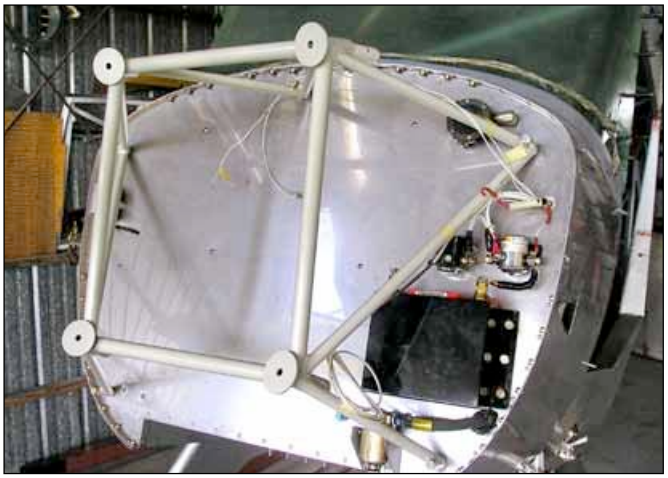
With this kind of elevator/rudder hinge, getting a neat, tight fit is a real challenge. some builders have fabricated "U" shaped pieces to go under the fabric to give the fabric something to glue to right at the cut edge shown here which cleans up the appearance considerably.

Fuselage: Installing the Engine

Fortunately, installing the engine has only a few factors that are unique to the Bearhawk. Otherwise, it is a fairly typical engine installation and applicable information is available from several sources.

Like covering, installing the engine is another of those areas where there are so many other information sources available that for us to go into detail would be redundant. We'll hit each of those areas that are unique to the Bearhawk and give references for the rest of the information.

One of the Tony Bingelis books *"Firewall Forward"* will become your bible. It does an excellent job of covering all the necessary details and procedures.



Expect to have to work to get the last bolt in. Motor mounts move around while being welded and, if all the bolts drop into place, count yourself lucky.

Installing the Motor Mount

Run a 3/8" reamer through each of the motor mount bushings to bring them up to size and clean welding scale out. The middle, top one will require running a drill bit through it.

Like all motor mounts, when welding it up, the legs will displace slightly, so it is unlikely you'll be able to just put it up in place and slide the bolts through. You'll have to spring as least two of the legs into position.

Put the mount up in position and slide a bolt into the top, right leg. Then grind a slightly rounded point into a 3/8" hardware store bolt and slide it into the top, left fuselage bushing *from the rear*. By springing the motor mount leg, you should be able to push, or hammer, the pointed bolt in far enough from the back to the hold the leg in position. Then put the permanent bolt in from the front and tap the temporary bolt out.

Repeat the process until all the bolts are in position. Don't forget to put washers under the bolt heads and you may need several in the back to get the bolt length exactly right. Use Nyloc nuts in the back.

Notes on Motor Mount Isolators

0-540's have two different diameter holes in the mount lugs, which are bolted to the case. If you have a 2" hole , then you need the Barry PN94011-02 isolator AND THE TYPE II AVIPRO MOTOR MOUNT. The Lord number is J3804-20.

If you have a 1 3/8" hole on your engine, then you need a Berry 94110-01 AND THE TYPE I AVIPRO MOTOR MOUNT. Lord J7402-24

On the 94011/10-02 isolator, there is a top and bottom. (hard and soft half per mount) Also, pay attention to the installation directions that will come with the rubber units. These isolators are directional, meaning that one pad is much stiffer

than the opposite pad. The stiffer pads are meant to go in the back, against the engine mount, to take the weight of the engine when the aircraft is sitting on the ground. The stiffer ones are easy to pick out, they have a "ridge" that is molded into them. If they go in backwards, your engine will sag quickly.

0-320/360's use the Type I mount and Berry 94011-20 or Lord J7402-24

Continental 0-470's use Berry 94110-40 or Lord J6545-1.

Making the baffles

Although it is absolutely possible to make your own baffles from scratch, using poster-board templates, many builders shortcut the process by starting out with baffle kits from Van's. Pick a set that matches the engine you are installing, with the RV-10 kit being for the 0-540.

If doing them yourself, study Bingelis's *Firewall Forward* suggestions closely.

Thoughts on Oil Coolers

The different engines use different oil coolers with the Positech P10634C, being popular. These are available from a number of the normal sources.

When locating the cooler in the engine compartment, go look at a similar installation in a certified airplane and the process will make much more sense.

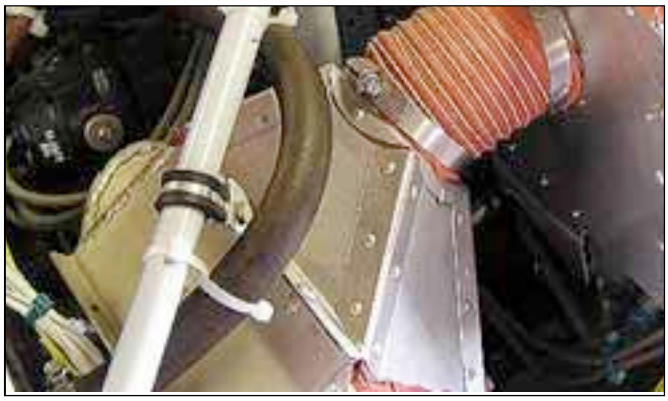
The designer, Bob Barrows, prefers the cooler be mounted directly in the right rear baffle.

Other popular methods involve fabricating brackets from hardware store 1" x 1/8 aluminum angles and mounting the cooler behind the engine as shown in the photos. Then a large diameter (4") scat hose is run from the rear baffle to a hand-fabricated plenum that's attached to the cooler. It is important the plenum be deep enough that it gives the air an opportunity to spread out and slow down before going through the cooler.

Cabin air ducting using a readily available box from one of the hardware suppliers.

This is a good example of mounting the oil cooler, but efficien - cy would be improved with a longer plenum, which would give the air more time to slow down. See below picture.

When bolting the cooler in place, put tubing spacers that run between the two flanges of the cooler so the mounting bolts engage both flanges and don't compress them together.



View from above: notice how deep the plenum is so the air can slow and transfer heat better. Inlet is 3" scat hose on the right, rear baffle. It's even better and simpler if the cooler is simply mounted right to the baffle.

Exhaust Systems

The prototype Bearhawks had hand-fabricated exhaust systems made from thin wall, electrical conduit and have served the designer well for years. However, there is a ready source for custom BH exhaust systems, for those who want a stainless system and can't, or don't want to, fabricate it themselves. Some of the suppliers include:

Larry Vetterman
Vetterman Exhaust
605-745-5932

(straight and muffled systems w/heat)

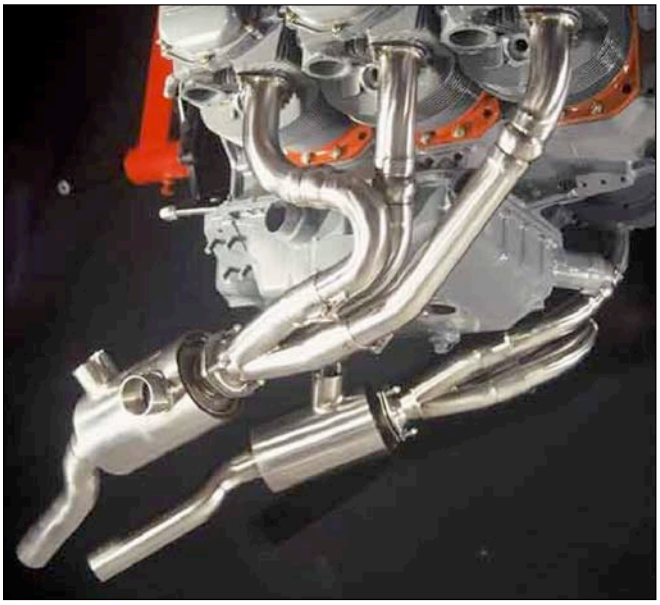
A Note on Baffling Theory

The goal of a good baffling system is to move as much air as possible through the cylinder cooling fins as efficiently as possible. This is accomplished by baffling in such a way that there are no leaks and the only way air can leave the plenum on the top side of the engine is by going either through the cylinder fins or the oil cooler. This maximizes cooling and minimizes cooling drag.

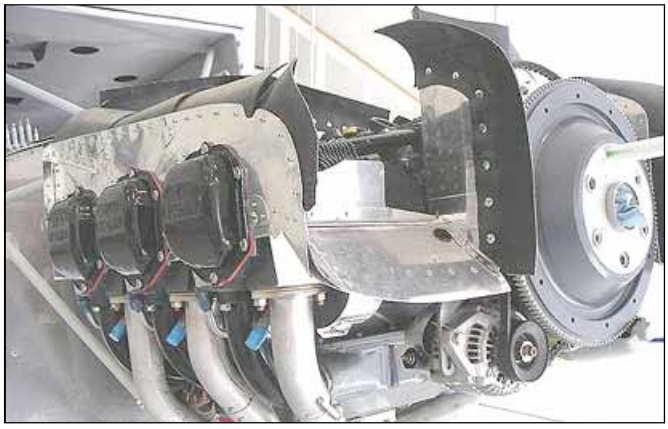
view from above, left, forward, showing left, rear corner of engine compartment.

View of rear of spinner area: A nose baffle, as shown, stops circulation and leaks around the nose case/

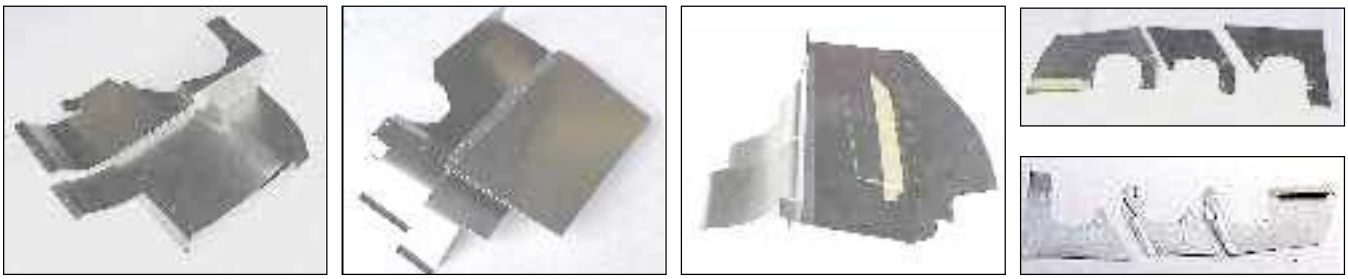
Note the relationship of the rear baffle to the string, which stretches from the nosebowl to the firewall. Van's baffles are too tall and using strings will establish the proper height.



∏Vetterman's muffled exhaust system with heat muffs gets great reviews from those who use it. A straight pipe system is also available.



When trimming the baffles enough room must be left between the baffle and the cowling for the baffle seal.



Van's Aircraft makes a complete baffle set for their RV-10 that is an excellent start for 540 Bearhawks.

APPENDIX A
Bearhawk Hardware and Materials Required

The following is a list of items that will need to be purchased to complete the AviPro Bearhawk Quick-Build kit. The vendors for many of the items are listed on the following pages as well as being mentioned below. Virtually everything listed can be purchased at Wicks Aircraft, Aircraft Spruce or similar aircraft supply houses.

Starting from the front of the aircraft back:

o All bolts, cables, pulleys and miscellaneous hardware as listed on the following pages.
o Spinner
o Propeller
o Engine and all engine related items including but not limited to:
    -baffles
    -motor mount rubbers, motor mount is included.
    -control cables
    -exhaust system
    -oil radiator
o Windshield
o Aluminum sheet - .025 for use in making flat fairings at wing and tail roots and covering doors. .032 for the floorboards.
o Instruments
o Tools for cutting instrument holes (fly cutter or Matco punch, panel is left blank)
o All electrical equipment and hardware
o Pitot Tube
o Wing Tips (for aircraft purchased prior to August 16, 2004 only)
o Fabric
o Paint and fabric finishing materials
o Brakes and wheels (right brake pedals are an option)
o Tires
o Spring for inside landing gear struts (for aircraft purchased prior to August 16, 2004 only)
o Landing gear 0-rings (for aircraft purchased prior to August 16, 2004 only)
o Seat suspension material (upholstery straps, aluminum or plywood)
o Seat and cabin upholstery material
o Side window Plexiglas
o Fuel tank caps (vented thermos bottle type, two for standard, four if aux tanks are installed)
o Quick drains
o Tailwheel springs (for aircraft purchased prior to August 16, 2004 only)
o Tailwheel (must fit 1 5” spring)
o Trim Wheel (available from AviPro Aircraft)

REVISED 23 Aug 06

The bolt lengths represented below may not be exact in all areas as they were determined by measurement.

Some variation is to be expected

FOR ORDERING, USE THE HARDWARE LIST IN APPENDIX "B" AS IT IS SUMMARIZED, MORE SPECIFIC AND INCLUDES A MARGIN

Parts	Source	QTY.	part #
Landing Gear			
shock strut springs	Dayton Progress 937/859-5111	2	EH 200-800
shock strut O-rings & snap rings	R & B Aircraft 540/473-3661	1 set	Included
Cleveland wheels and brakes kit	Wicks	1 set	not included
tires	Wicks	1 set	not included
axle nuts 1 1/2 x 16	Wicks	2	MS21025-24
cotter pins 2"	Wicks	4	MS24665-360
axle shims 1 11/16"	AviPro	2	included
AN5 Bolts, nuts, washers to bolt brakes to axle assembly	Wicks	To be determined by customer for brake type chosen, low profile nuts recommended	MS 21042
rod end bearings for shock struts	AviPro Aircraft	2	XAM-7M, not inclded
jam nuts for rod ends			
filler plug 1/8"NPT shock strut	Wicks		Included in later kits
Trim Wheel	AviPro Aircraft	1	Not included-
BRAKES			
master cylinders	B & B Aircraft Supply "Gerdes long shaft or short shaft w/clevis" Phone: 913-884-5930 Fax: 913-884-6533	2	not included
1/4" aluminum brake line	Wicks	16 ft.	not included
AN fittings for 1/4" AL brake line	Wicks		not included
flexible hi pressure hose	Wicks		not included
fittings for hi pressure hose	Wicks		not included
Adel clamps to secure hoses	Wicks		not included
AN3 bolts/nuts for Adel clamps	Wicks		not included
poly tube/fittings for supply side	Wicks		not included
of master cylinders	Wicks		not included
brake fluid reservoir	Wicks	1	not included

PULLEYS

Ailerons

On wing tube support	2	MS24566-4B
front spar pulleys	2	MS 20220-2
fuselage side by wing strut	2	MS24566-3B

Flaps			
at wing root-top		4	AN210-3A
FUSELAGE Bottom		6	MS20220-1
TURNBUCKLES			
flap system		2	AN 130-32S
aileron bellcrank cables		2	AN 130-32S
aileron bellcrank to bellcrank (cable to cable)		1	AN 140-32S
rudder cables OPTIONAL		2	AN 140-32S - cable to cable aft of baggage compartment
elevator cables		2	AN 135-32S
trim system (1/16" cable)		2	AN 130-16S
ROD END BEARINGS			
AILERON Bellcrank BEARINGS		4	R4FF
pushrod-sticks to bellcrank		2	GMM-3M-570
aileron pushrods		4	GMM-3M-570
flap pushrods		2	GMM-3M-570
trim pushrods	2 or 4 (depending on pushrods)		MM-3
aileron/flap rod ends for hinges	AviPro Aircraft	10	Aurora special
CABLE - 1/8 7 x 7 or 7 x 19 Stainless		140 ft	
- 1/167x7 or 7x19 Stainless		30 ft	
Cable Shackles		14	AN 115-21
		2	AN 115-32
Cable Thimbles		100	AN 100
		6	AN-3
Nicopress Sleeves		100	18-3-M
		6	18-1-C
Fairleads 3/4" small hole		25	PN40701-00

BOLTS AND FASTENERS

Application	**bolt size**	**Qty**	
Stick and Flap Assemblies	AN3-6A	6	
	-7	3	
	-10	8	
	AN4-16A	1	
	-23	2	
Rudder Pedals and Brakes	AN3-5A	4	
	AN3-12A	2	
	-6	2	
	-7	4	
	-11	2	
Brake Pedal to Rudder Pedal	AN4-22	4	Rev. 23 Aug 06
Wing Attach/Landing Gear			
	AN4-24A	16	AN4-24A Requires 3 washers

	AN5-14A	2
	AN5-21A	2
	AN6-15A	2
	AN6-21A	2
	AN6-22A	2
	AN6-23A	2
	AN6-26A	4
	AN7-11A	2
	AN7-12A	2
	AN7-16A	2

Note: no bolts included to attach brake assemblies, see note at top of chart

Inside Wing		
	AN3-5A	12
	AN3-7A	6
	-10	6
	AN3-13A	4
	AN3-21A	2
	AN4-10A	2
	AN4-20A	2
	AN4-27A	2
	AN5-6A	2
Aileron and Flap Attach, etc.		
	AN3-5A	40
	AN3-13A	4
	AN4-13A	10
Tail Surfaces		
	AN3-5A	4
	AN3-6A	2
	AN3-7A	4
	AN3-11A	4
	AN3-14A	2
	AN4-6A	2
	AN4-10A	10
	AN4-14A	2
	AN4-15A	2
	AN4-17A	2
	AN4-24A	2
Clevis pins	MS20392-2C49	4
Motormount Attach		
	AN6-46A	5
Door Hinges		
	AN3-6A	8
Clevis pins	MS20392-2C67	4
Pulley Bolts		
	AN4-11A	2

	AN4-20A	4	
	AN5-24A	2	Rev. 23 Aug 06

Nuts

AN3 NyLoc	135	
AN3 Castellated	30	
AN4 NyLoc	70	
AN4 Castellated	12	
AN5 NyLock	8	
AN6 Nyloc	17	
AN7 NyLoc	4	

Thin check nuts (jam nuts)
Assorted uses

AN316-4R	20	Rev. 23 Aug 06
AN316-5R	20	Rev. 23 Aug 06
AN316-8R (shock struts)	2	Rev. 23 Aug 06

Washers two thick and one thin washer for each bolt type supplied.

Cotterpins for general use 100 MC24665-7 Rev. 23 Aug 06

Screws for Floor Boards Not Supplied, depends on floor board material used 75 screws and Tinnermans Required

Rivets

MS20426AD4-4	1/4 lb	
MS20426AD4-5	1/4 lb	
MS20426AD3-3	1/4 lb	
MS20426AD3-3.5	1/4 lb	
MS20426AD3-4	1/4 lb	
MS20470AD3-3.5	1/4 lb	
MS20470AD5-16	1/4 lb	
AD41ABS	200	

Nut Plates (wing/tank panels)

MK1000-06	475
MS21051-06	4
MS21073-06	8

Nut Plates for aileron/flap hinges AN366F-1032 22
MS21080-3 22

VENDORS

Wing Tips Ed Stimely
7930 US Highway 522 South
McVey, PA 17051
(717) 899-6038 Included in quick build

Transfer Fuel pump w/check valve
The pump number is 40171.

	www.ppavionics.com/FacSolidState.htm Pillar Point Avionics (Sales & Information): 541-350-2683 www.ppavionics.com		
Motor Mount Biscuits (4 or 5 each)	Lord J3804-20 or Barry equivalent. Use AN7-27 bolt with two washers		
Windshield	Available through AviPro		$265 clear $318 tinted
Seat Belts	Jim House Aero-Tuff Seatbelts Tuff-Tow, Inc Box 38 Saginaw, AL 35137 Phone/fax (205) 664-8578		
master cylinders	B & B Aircraft Supply Phone: 913-884-5930 Fax: 913-884-6533	2	
Baffles	Craig Lefever. 520/603-0768. or Vansaircraft.com	$500	
Exhaust Systems	VETTERMAN EXHAUST (LARRY VETTERMAN) 605-745-5932		
Gas caps	AviPro Aircraft, Ltd	2	As per Barrows' drawings
Tailwheel Springs	AviPro Aircraft, Ltd.	1	Included in kits ordered AFTER 16 August, 2004
Instrument panel insert (optional)	Seth Hancock 512/864-5529 (cell) Six gauge grouping, can be floated	1	

Appendix B

Hardware Kit

this listing has all the hardware in Appendix A totalled up.
If Ordering From Wicks Aircraft, Ask for "BEAR-AIRFRAME" kit

REVISED 30 Aug 06

Parts	part #	QTY.
axle nuts 1 1/2 x 16	MS21025-24	2
cotter pins 2"	MS24665-360	4
	MS24566-4B	2
	MS24566-3B	6
	MS 20220-2	2
	MS20220-1	6
TURNBUCKLES		
	AN 130-32S	2
	AN 130-32S	2
	AN130-32S	1
	AN 140-32S	2
	AN 135-32S	2
	AN 130-16S	2
ROD END Bearings		
	R4FF	4
	GMM-3M-570	8
	MM-3	4
CABLE - 1/8 7 x 7 or 7 x 19 Stainless		140 ft
- 1/167x7 or 7x19 Stainless		30 ft
Cable Shackles	AN 115-21	14
	AN 115-32	2
Cable Thimbles	AN 100	100
	AN-3	6
Nicopress Sleeves	18-3-M	100
	18-1-C	6
Cotter Pins	MC24665-7	100
Fairleads 3/4"-small hole	PN40701-00	25
Clevis pins	MS20392-2C49	4

	MS20392-2C67	4
Nut Plates	MK1000-06	490
	MS21051-06	6
	MS21073-06	10
	AN366F-1032	22
	MS21080-3	22

Bolts

size	**Qty**
AN3-5A	65
-6	3
AN3-6A	22
-7	10
AN3-7A	16
-10	16
-11	3
AN3-11A	4
AN3-12A	2
AN3-13A	10
AN3-14A	2
AN3-21A	2
AN4-6A	2
AN4-10A	14
AN4-11A	2
AN4-13A	10
AN4-14A	2
AN4-15A	2
AN4-16A	1
AN4-17A	2
AN4-20A	8
AN4-22	4
-23	2
AN4-24A	20
AN4-27A	2
AN5-6A	2
AN5-14A	2
AN5-21A	2
AN5-24A	2
AN6-15A	2
AN6-21A	2
AN6-22A	2
AN6-23A	2
AN6-26A	4

AN6-46A	5
AN7-11A	2
AN7-12A	2
AN7-16A	2

Nuts

AN365-1032	145
AN310-3	35
AN365-428	75
AN310-4	16
AN365-524	10
AN365-6	20
AN365-7	6

Thin check nuts (jam nuts) Assorted uses

AN316-4R	20
AN316-5R	20
AN316-8R (shock struts)	2

Washers two thick and one thin washer for each bolt type supplied.

Rivets

MS20426AD4-4	1/4 lb
MS20426AD4-5	1/4 lb
MS20426AD3-3	1/4 lb
MS20426AD3-3.5	1/4 lb
MS20426AD3-4	1/4 lb
MS20470AD3-3.5	1/4 lb
MS20470AD5-16	1/4 lb
AD41ABS	200

Appendix C
Random Covering Tips

The following are notes from builders that include useful hints that we thought should be passed along.

We had a local upholsterer make "envelopes" for our fuselages--$75 labor each.

The seams basically follow the stringers to the V in front of the vert stab and then a single seam goes up the leading edge of the vert stab. The top and rear of the stab were left for us to glue with poly tac.

If you don't have an envelope sewn, make a seam down one of the top stringers and up the vert stab, then have a stitched, glue joint where the two pieces of fabric come together.

BTW, the heavy that I applied to my belly extends up the sides into the bottom of all door frames. This will be more durable for PAX climbing in and out. I left the heavy unglued and un shrunk for about 3 inches at the pilot's door aft bulkhead--just the 12" or so below the door frame, so that the med fabric on the side of the fuse could be glued to the bulkhead first. Then I glued the heavy and shrunk that last little bit. Probably not req'd but I wanted the overlap to bee the ways the air flow ("cept when in reverse thrust!!!").

I fabric'd in three phases--tail, trim tabs and gear legs; then interior and exterior of the fuse; then flaps and ailerons. I liked the first phase, didn't mind the second, but was very glad to have that last phase complete.

Like BD, I learned the first day that I don't react well to inhaling or getting MEK or other paint like products on my skin. I wear a respirator from the time I open the can of paint and wear invisible gloves as well as latex medical gloves.

Another tip I found helpful--I used a bondo spreader for "pushing" the fabric onto the poly tac covered tubes, etc.

Getting the area where the top of the fuse rounds up to the vert stab looking good was very important to me.

At the curved tube at the forward and bottom of the vert stab--where it joins the top of the fuse--I glued the fabric and threw in a few stitches around the tube prior to gluing anything else on the top/sides of the fuse. It all shrunk very well in that area. I remember Pat F telling me that his needed a little heat gun to get it right--and if you/ve read the manual, you know how PolyFiber feels about heat guns!!!!

Another tip, get the video or DVD and follow it and the manual exactly. Make each step right and you'll have lots less to do to get it ready for final paint.

Cal Brubaker