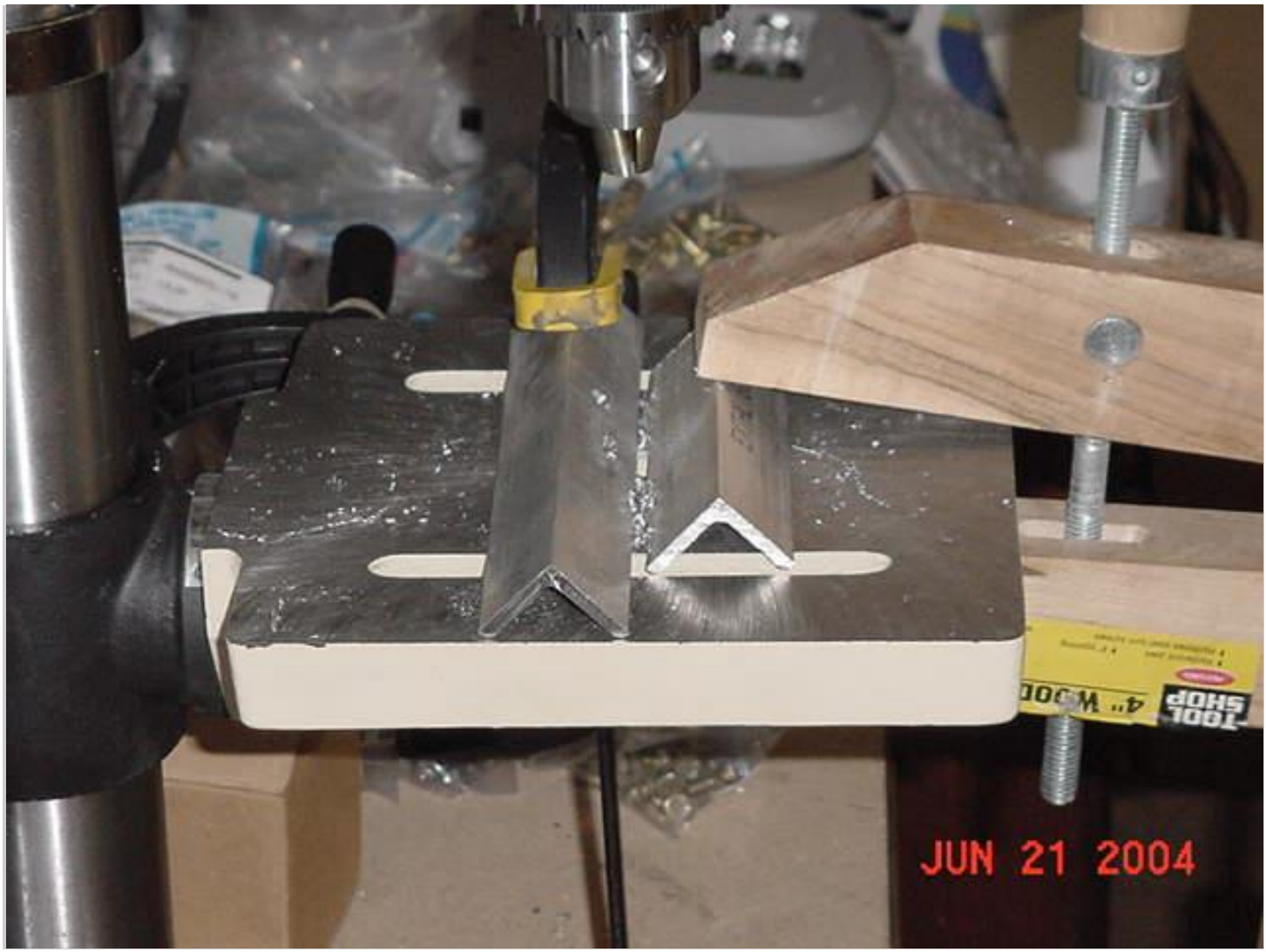
Tailwheel and Tailspring

I removed the fuselage from the engine stand I used to support the tailspring. I put two aluminum saw horses with mega foam covering them under the bulkheads in the tail area. I pulled out the tailspring to measure it. The idea here is to get a 1/4 bolt centered in the tailspring socket and the tailspring. You have to back the spring out about 1/16 away from the actual bulkhead and center drill the parts. Starting with a 12 inch bit, going through the socket and scoring the mark centered in the "knob" on the fore end of the spring. Well, it makes more sense to measure from the aft end than it does from inside that narrow area above the tailspring socket. But you'd better be sure and measure REAL careful to get everything centered and positioned. A lot will be riding (and bouncing) on this whole process. That tailspring takes a beating in service, so you want to make it just right.

I'd be able to finish this entire part of the project, but I was waiting for EVO parts that were deleted from the kit as delivered. Hurry up and Wait! And so on to other stuff...

You get to drill a 3/4 inch hole in the bottom of the empennage. You can see it in the pic with the tailspring bolted temporarily in place. It turned out very nicely (so far). There is no slop with the bolt in place, and the hole through the spring and the bottom of the airframe are very centered and vertical.

I was able to get the round surface center drilled by taking two identical sized aluminum angles and clamping them to my drill press table. If you lower the drill bit perfectly between the angles, you will center drill any round item that sits squarely in the "jig". So you put the bit in, lower the press, center the bit, clamp your piece in the angles and viola! Worked very nicely. Cheap and effective.



It's a little hard to see the press, but you can see the aluminum angles positioned on the press table. Not glamorous, but effective.

I reinserted the tailspring into it's weldment on the airframe, and temporarily bolted it into position. I leveled the airframe at the canopy rails, then leveled the tail at the empennage deck, then leveled the tailwheel mechanism on the tailspring and mark drilled it in place. The idea is to get that tailwheel perfectly vertical so it doesn't wander off track, which could be dangerous to say the least. So great care has to be taken to level, align, drill and then assemble the tailspring and tailwheel assembly (assy) in place. I bought a digital level a long time ago to help set the alignment of the wings on my Citabria. I consider a digital level essential! They are pricey ($100 when I got mine), but well worth the expense. You can use this tool many times during a build project like the F1.

Some fuselages have a bit of twist built in at the factory. My fuselage is within .2 degrees between the canopy rails and the empennage deck. The tailwheel mechanism is supposed to be leveled with the ship by the canopy rails. Mine is very close across the board. There is more than .2 degrees of slop in the tailwheel mechanism. Maybe now that they are making the EVO models and have assemble over 140 fuselage kits they finally have it right. Then again, maybe I was just lucky to get a straight airframe.

After drill marking the tailspring for the assy, I removed the tailspring, and drilled it on my press using the centering jig I cobbled together. It worked pretty well again! Then I put the spring back on the airframe and finished drilling through the backside of the tailwheel assy bracket. While I was drilling one side hole, I stuck a drill bit in the other to keep the holes aligned. After drilling through with a 30, I drilled both holes up for an AN3 bolt. I used a drill bit again to keep the holes aligned. All that's left now is to prep, prime and paint the spring and the assembly for installation.

Every once in a while I get an opportunity to go back and work on an "old" project. My buddy Bruce Dallman, RV6 builder, brought his torch over to my house, and we tack welded the front seat back support parts together in position in the cabin. His plan is to finish weld the support for me using a TIG unit at the local university. Once that is done, then I can rest assured that the canopy rails will have dimensional stability. That support fits in there REAL tight.

The front seat back brace is now welded and painted... ready for installation. I don't want to put it in yet, but it has to be done before the canopy is started. It does not fit perfectly, and since there is a long span front to back and side to side in the cabin, the brace can influence the position of the canopy rails.

A few months later many components are coming together nicely. I'll be ready to mount the tail, the engine mount and the canopy soon (this Winter 2004/2005), so I need to get back to the fuselage and get a few things finished. It' really hard to work in there with the canopy on, especially. Although my bubble will be removable, there still is some restriction. At this point, I could take off the windshield bow and the canopy tracks to make it easier to get in the fuselage and work.

The pilot's seating area looks to be a bit low for me, and pretty far back from the rudder pedals. One big consideration is going to be building up the seat height with a frame, or just get myself up and forward with padded upholstery.
The EVO F1 engineering has resulted in some necessary changes in the engineering of the plane. I will move the battery to the front, near the firewall. With the taper wing change also came a W&B change and a CG change. Now the plane will be tail heavy. It can be very dangerous to be outside the CG envelope, so we'll have to certainly address that. Mark said one possibility is to get a heavier engine and use a standard starter and a metal prop. Well, another EVO builder did some calculations and found that moving stuff out of the baggage area, specifically the battery, makes a tremendous difference in the CG. I plan on having two batteries in front of the CG, so my weight change should allow me to stick with the standard IO540C4B5 engine, flyweight starter and MT composite prop. I'm glad I didn't complete my battery installation. I'll now figure out where to place the battery up front, probably under my knees. There's lots of dead space under the floor available, so this should work out fine. This will also make the wire runs shorter.
After considerable time off from working on the fuselage, I came back to finalizing a couple things. I realized as I was working on the canopy that once I was ready to install the Plexiglass, it would be much harder to paint inside the front of the cockpit. I figured out that I should paint inside here and then finish installing some of the interior parts such as the rudder pedals and brakes.

Brake and Rudder Pedals

It's good to have flying buddies with access to neat services. I gave my friend John Watler my rudder pedals some time ago. He was going to have his brother, Glenn, laser cut them at his work. The plans say you are supposed to put lightning holes in the pedals. We figured we could do something just a little more interesting.

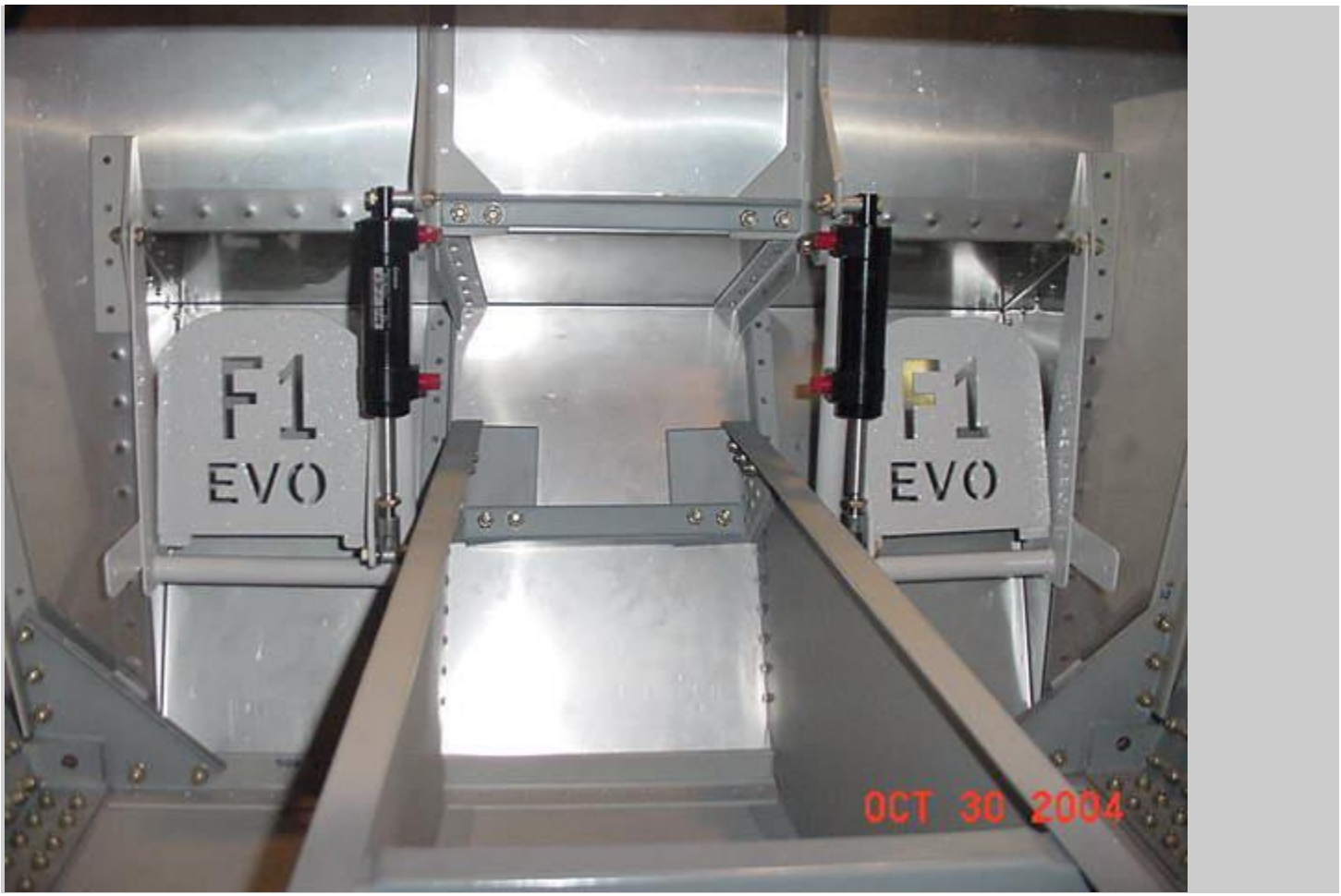
I had measured and drilled these parts a while back. Since there is so much symmetry in these parts, I was able to match drill each flat pair. I.E., I drilled the pedal plates and the actuator plates that rivet to the side of the angle pieces together.

Assembling the pedals was fun. I drilled and countersunk for #4 flush rivets, and riveted the pieces per plans. The only thing you have to watch out for here is that some of the measurements are metric dimensions converted to standard in thousandths (ten thousandths?). Took me a while to figure out that .3150 inches was 8mm. Wish they would have just put it in the plans as 8mm, but I guess they wanted to be consistent with English measurements (even though it really isn't English in a few places).

At this point I decided to stop working up in the front of the fuselage until I had a chance to paint some parts. I have a bunch of prep work to get ready to do some painting. I went to the local PPG store and bought some Concept series paint. I chose to paint the interior a light "military" gray. Turns out that PPG doesn't have a clue about military colors. Well, not in gloss, anyway. So I finally had to go through the book and chose a 1999 Toyota gray. Concept is a single phase paint, but there are three steps to getting it laid down. As in you have to wash prime, then seal or color prime, then shoot the color over it. I think you could get by without the middle step of sealing/color priming, but that's what PPG recommends, so I'm doing it on the heavy wear parts: landing gear and tail spring.
I bought enough materials to paint all the interior metal parts and then some. Two quarts of color are probably more than twice what I need, but better too much than not enough. Some parts I've already painted are getting refinished. I tried rattle bomb paints, and they just suck. There's a nice NAPA self etching primer that I used in the spray can that is pretty good, but all the finish coats I've used are just lousy. They chip too easily and they don't hold up well to solvents. So I'm using the cancer causing good stuff that should wear like Imron, but is easier to handle. Harbor Freight was selling touch up gravity fed HVLP guns for about $40, so I decided I need one. I used it to repaint my parts. It worked great! Perhaps it's not a true HVLP gun, but it certainly ran well on about 30 pounds pressure and didn't fog me out of my garage. It in fact wasted very little paint. Well, primer, in this case. Money well spent for the little HVLP jewel!

I sanded or stripped and primed the parts all over again. It was kind of a pain, but hopefully the slightest bump won't peel this stuff off. If PPG concept is anywhere near as tough as Imron, I hope to not need to repaint for a long time. Especially on these heavy wear areas. I went ahead and painted a bunch of parts with my PPG Concept Urethane. The tail spring and rudder pedals are now "warm gray". Next step is to shoot some of the harder to get to places under the boot cowl and behind the panel. Once the canopy goes on, it's going to be much harder to get in there. After I paint a few things, I'll get back to mounting the pedals, cables and the back seat. Hopefully the flap motor and mechanisms will be here by then so I can install those, too.

Well, I decided not to paint the cabin just yet. I went ahead and installed the rudder pedal/ brake assemblies in the fuse. That was pretty easy, and a fun little project. Most of the assembly was done on the bench, then I had to drill some AN3 and 4 sized holes in the ship's weldments. After that, it was just a matter of shims to get everything lined up and freely moving.



****Service Bulletin: 8/05** a service bulletin was issued by TR to ensure adequate clearance between the outside lower brake pedal to rudder pedal attach bolt. It seems there have been problems with the bolt head hanging up on the firewall and disallowing full travel of the pedals. This could be an extremely dangerous situation in the air, and especially on the ground. It is recommended that you have at least 1/4 inch clearance between the bolt head and the firewall. Some builders have simply ground the bolt head down or used a pan head bolt, as well as taking a ball peen hammer to the firewall footwell junction and knocked it back. It has also been recommended that prior to pedal assembly that the rudder pedal cross tubing (horizontal part) be cut from the upright thin hangar, and reduced 1/4 inch. Then you can insert a spacer and shift the outboard part of the mechanism away from the firewall footwell and gain adequate clearance. It has also been recommended that if you cut this part to shorten it, when you re-weld the part it's a good idea to slightly rotate the flat upright so that the horizontal cross tube of the left and right rudder pedals are parallel.

I think I am going to leave out the AN bolt and use a pan head bolt. I think there is enough clearance as is, but I think I might roll the AN head a bit, or get a high strength pan head. As you can see in the pic above, there is not much clearance. If you assemble the rudder and brake pedal assemblies trying to bias everything inboard, you should be able to get at least the amount of clearance shown. Mark recommends perhaps twice this much, which would mean cutting and welding the pedal and perhaps reshaping the brake pedal. If that bolt hangs up, you can get in some serious trouble!

Rear Seat Back

Another project in the cabin was the rear back seat. I still didn't have the flap mechanism from TR for my EVO. The flap mechanism sits next to and under the back seat. With the latest F1, you do not have to box up the back seat on the floor to get over the flap guts. I think I'll wait until I have the parts in my hands before completing the seat, but I can at least start to assemble the some of the seat back parts.

The plans basically suck for the back seat. I went to Pflanzer's site and got some nuances, then ducked my head and dove in. One of the first things you do after you figure out what parts to use is to trim the bottom of the F-33 channels to match the angle of the corrugated seat back panel. I used a dremel and cut off wheel then trimmed it down. I also used my dremel to square up the fiberglass arch that sits on top of the seat back. You have to grind through the fiberglass cloth into the flox and get a nice inside corner so the arch sits in the back rather flush. Once you get the arch to sit between the channels squarely, you more or less establish the seat back width. Then it's a matter of sitting it in

the right place and getting it to swing in and out without interference.

The angled pan at the bottom of the seat back gets a piece of angle attached to it. I thought that having that part hinged could make the whole seat back kinda flimsy, so I decided to cut and bend a doubler. I got some .032 and cut a 24x2 inch strip. I sat it under the flange and marked it to bend. I used my break and put two nice bends in the piece. I used the cut angle of the side channels to mark the doubler for cutting, so the piece would sit nicely under the flange and hug the side channels.

That back seat assembly has to go back and forth a bunch of times to the fuselage, and it's a little hard to handle all the loose pieces, so I guesstimated where it would end up and drilled a few holes so I could cleko the thing together. I also drilled two holes in the fiberglass arch so I could get it all pretty close. I can always fill the fiberglass holes later, if they are in the wrong place, or if I have to

change the dimensions of the top where the arch attaches to the seat pan. If the back seat sits on the floor, I have the whole thing REAL close to it's final dimensions.

The rear seat pan attaches to the floor (or a raised box in some F1 models) by #3 piano hinge. The plans tell you to reverse the floor section of hinge and rivet it to the rear most stiffeners on the floor panels. The plan measurements appear precise, and sure enough they are. If you put the hinge pin on the measurement (4.250 from the bulkhead face), it puts the hinge right over an angle stiffener in the two side floor panels. Pretty slick! It doesn't, however, go over a stiffener in the center floor panel, which sits under the side panel. This also leaves a gap at the center panel under the hinge. I suppose a nice way to have done this would be to just make 2 smaller hinge sections and only hinge over the outer floor panels, then there's no need to be concerned about the slight gap under the seat pan/hinge due to the staggered floor panels. As it turned out, this was not an issue for me, because I did NOT put the rear seat back in the "factory" position..

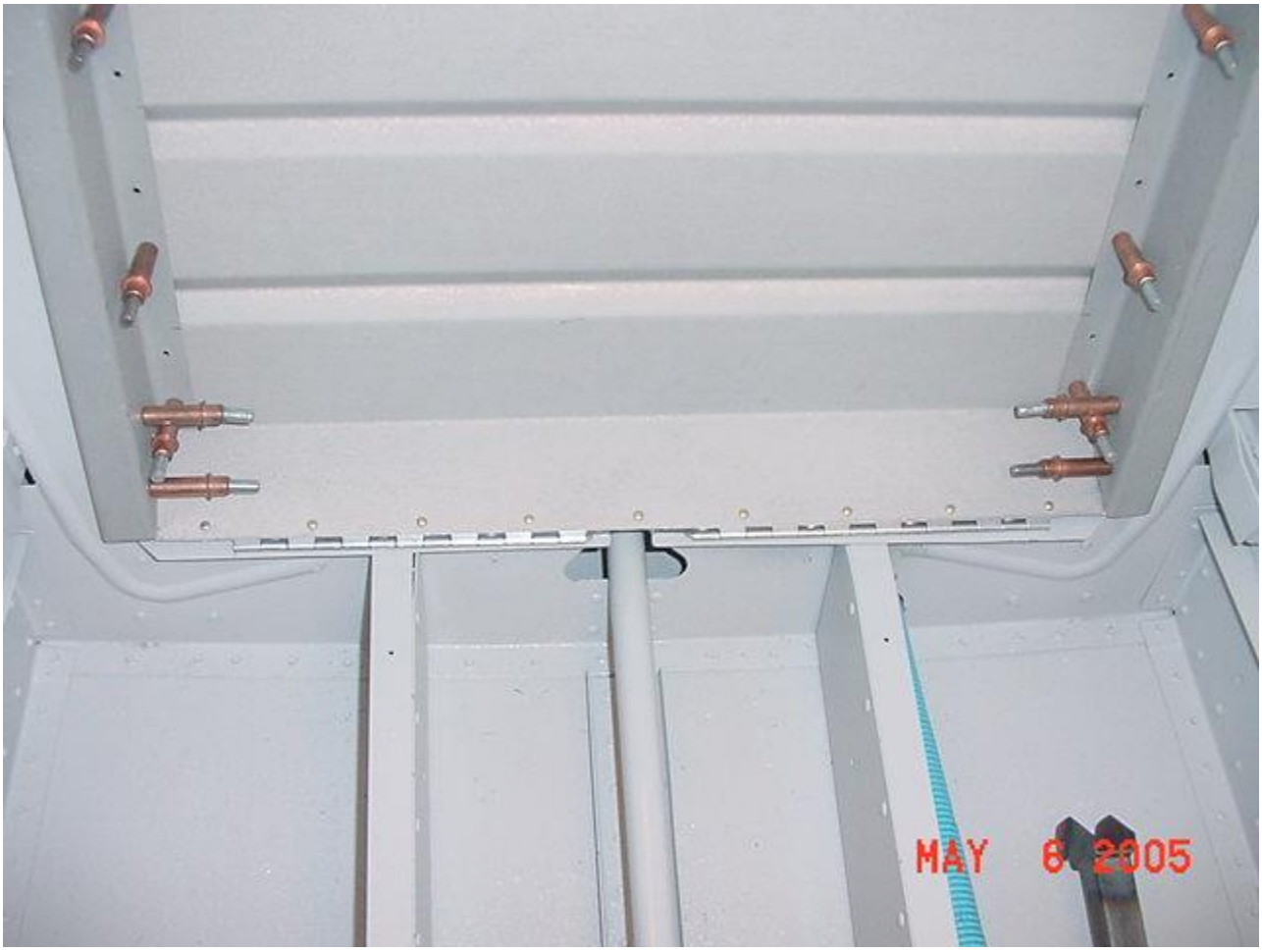
I'm going to use #8 screws in the rear seat back hinge just like I did in the front seat back. I think I can easily get 4 each #8 screws to hold the back seat down on each side. If it doesn't seem adequate, I can always double and stiffen the center panel and add 3 more screws. The back seat is certainly better supported and less likely to come loose compared to the front, so 8 screw total should be more than adequate.

Seven months after starting this project, I'm back to work on it again while I'm waiting for parts to install elsewhere in my F1. I finally got the Mark III flap mechanism for my EVO wings and installed the mechanism under the floor. No boxing up of the rear seat is necessary, so the rear passenger will be seated right over the floor panels without having a torque tube directly under their butt. I will have to build up some "arm rests" on each side to cover the motor, but that's another story for later.

I decided to not follow the plans on locating the seat back hinge. Instead of building the hinge of the rear seat back out from the #7 bulkhead about 4+ inches, I decided to hinge mine right at the #7 bulkhead "floor flange". The plan change was to accommodate making the floors removable without unscrewing the seat back hinge. The only complication you have with this setup is the angle and position of your passenger's back. I am going to have my upholsterer compensate for the change by making the seat back cushion wedge shaped. It will be probably 5 - 6 inches wide at the bottom and 2 - 3 inches wide at the top. The cushion may also have to be somewhat beveled at the bottom so that you can move the seat back forward without removing the cushions (that's not THAT important and is low priority).

Placing the seat back hinge was pretty straight forward. I just put the corrugated seat back fully back in place and marked were the hinge goes on the floor. I did have to reverse the hinge that screws to

the floor in order for the hinge to be more out of the way and at the same time make it clear the screw heads. There is quite a lip at the bottom of the #7 bulkhead. You can essentially center up the hinge and seat back on there, mark it and drill it. I didn't put a lot of thought into it. Because of that, I had one place (out of 8) where the nutplate interfered with the longeron in the floor that runs front to rear. No biggy, I just used on of those one sided nut plates and moved on. I attached the #8 screw nutplates in with #3-4 c/s rivets, then screwed down the bottom hinge. I cut the hinge pin, tapered the ends, now I'm ready to attach the seat back to the floor.



This worked pretty well. The seat back sits against the bulkhead quite nicely. Later on, I'm going to cut the lip of the flange on both the bulkhead (as little as possible) and the seat back (as much as needed) to improve how it sits. Making it sit more "flush" will actually set the seat back at a bit more of an angle. It will also allow some clearance to attach some rubber channel on the lip of the seat back to cushion it on the bulkhead.

The fiberglass part at the top is going to need a bunch more work. With the change in the seat back position, the "tilt" of the fiberglass arch is useless. In fact, it's in the way, and I'm going to cut it off. Not yet, though. I'm still playing with the seat back and floor panels.

I've always thought you should be able to take up the floors with removal of as few parts as possible. You have to be careful doing this because if you take off too much, or you try to make them too easy to get out, you might reduce the support and weaken the panels. Essentially, all I did was cut the floor panels around the screwed down hinge of the seat back. Other than that, I trimmed the left and right rear floor panels around the channel of the seat back. Now I can get the floors out with the seat back in position. I have to do some bending, and it's tricky, but if I bow up the rear and get the very aft

edge of the floor out from under the seat back, then I can take the floor panels out the way I normally would.

Heck, I was thinking that since I'm making the rear passenger floors removable that way, I might as well do the baggage floor that way, too. So I did! The only problem here is that if you aren't real careful how you butt the baggage floor against the screwed down hinge section, you could end up with quite a gap, and small things might sneak under your floor through the gap. If you choose to do this mod, be very careful shaping around the hinge. If you blow it, of course you can always install an extension to run from under the screwed down hinge back under the lip of the baggage floor. A nice long piece of .020 under the hinge would work very well. In fact, you could make one long nifty piece and close the small gaps on BOTH sides of the #7 bulkhead around both floors if you really felt the need. My parts fit pretty well, so I'm not going to bother. I'm also counting on carpet taking up some of the slack.

Now that the floors are modified, it's back to the back. I'm going to cut the channel on either side of

the seat back to taper it to the very top of the channel. That will sit the fiberglass arch back as far as possible, and give me more uniform support of the seat back. The flange that holds the hinge is not all that sturdy (not *that* weak either). Fortunately, the way I am finishing the seat back, most of the weight on the back will be distributed along the sides of the channel from top to bottom, not just near where the arch attaches. I ended up trimming the outboard sides of the seat back side channels to the point where the seat back actually rest on the #7 bulkhead lip (or flange). This gives the seat back a very solid feel when it is closed. Again, I may end up putting some rubber channel over the lip to give the seat back some cushion, perhaps cutting down noise and vibration for the rear passenger.

The fiberglass arch needed some trimming and shaping. It also needs repaired because weeks ago I was grinding out the glass arch backside so it would sit back against the channels in the "corners" on the seat back and I cracked it where I trimmed the glass too deep. I also drilled a couple holes for rivets right where the seat back rests on the lip of the #7 bulkhead, so I had to move those and fill the mistakes later. I went ahead and trimmed the sides of the arch flush with the side channels, and then I tried to trim the arc of the arch nice and uniform. I don't know how successful I was, but it looks a darn sight better than it did.

The seat back sits quite nicely in place now, and I like the way it's shaping up. I have to take it apart and clean up the cuts in both the aluminum and the glass, drill more holes, then rivet the seat back components together. Man, this little project is taking a BUNCH of time!

Rudder Cables

One of the other projects I'm working on is the rudder cables. I want to run them to the front pedals through all of the bulkheads. The plans have you skip the two bulkheads closest to the rudder pedals. That means cables are sitting along the floor more or less hanging out, and they are right next to the pilot and kind of in the way. Not a very clean operation, but it works.

One problem is that the TR supplies TWO cables per side, essentially splitting the entire run at the back seat pedals. There's a long cable from the back end of the pedal all the way to the rudder. There's a short run of cable from the front of the pedal to the front seat pedals.

The trick here is two fold. One, make the cable shift to the outside and curve along the outer fuselage as it travels to the front pedals. Two, hook the back seat pedals to the cable, but make them so you can remove them.

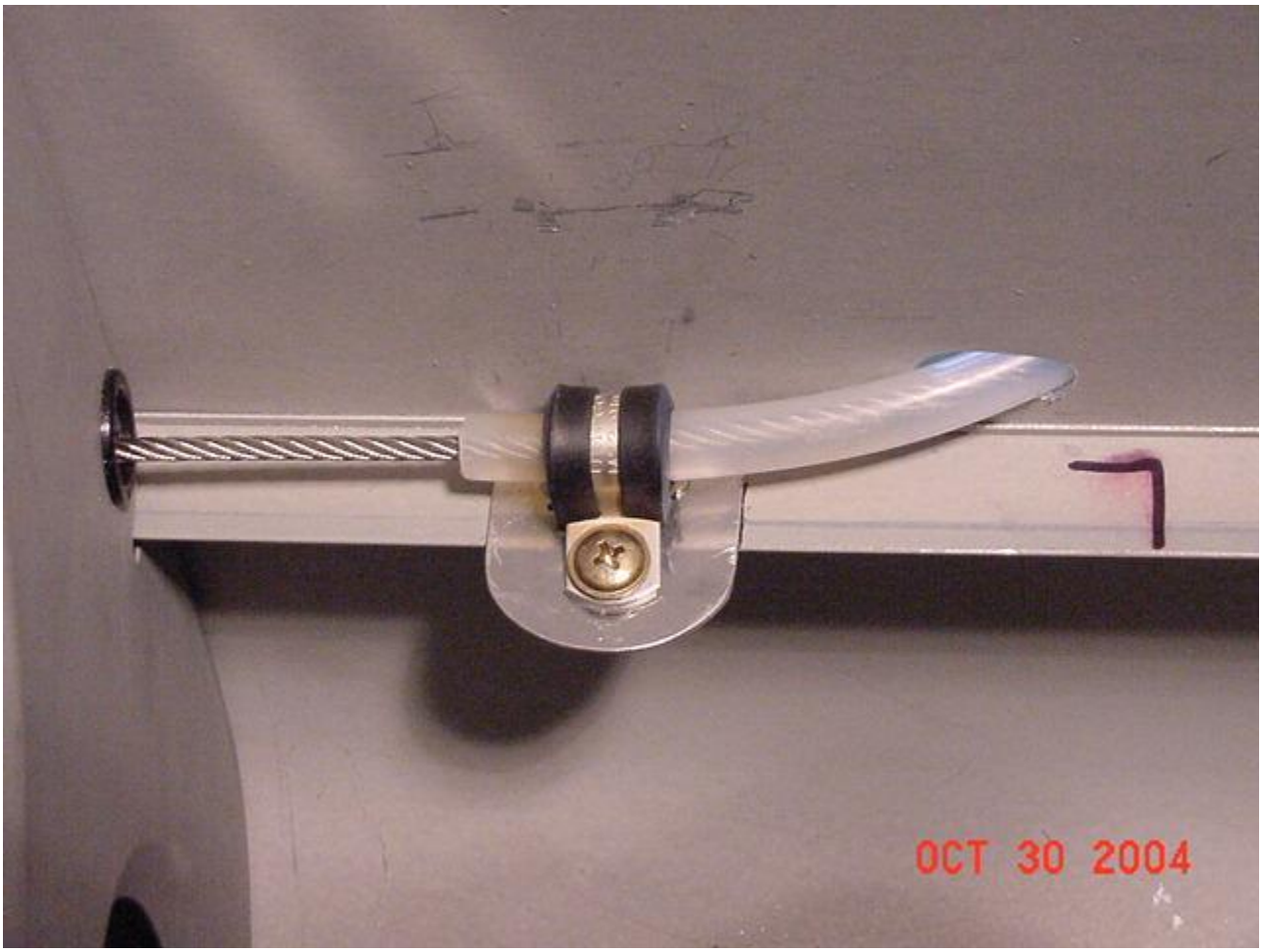
I'm trying to figure out if I can just use a piece of bar stock aluminum to link the two cables. Essentially, I would be mimicking the original set up, substituting bar stock aluminum for the chunk of rear seat rudder pedal (basically a 2x2 cut piece of angle). The only problem might be clearance at the bulkhead closest (VERY) to the pedals. I think a chunk of bar stock might bang into the bulkhead and obstruct free movement of the cables.

A solution to this might be to use a steel rod between the cables. I might have to make the bulkhead carry through holes for the cables a bit bigger, but I think I could get them to move through there without hanging up. This would also make it VERY easy to hook a short extension cable, or link of chain to a temporary set of rudder pedals for the back seat.

Another solution to the problem, especially with regard to clearance would be to reverse the cables. Put the short one at the rear, connected to the rudder, and then have the long one go all the way from the back of the tail to the front pedals. I've looked at it, and near as I can tell, the cable ends could move each direction for a total of about a foot in between bulkheads in the aft area of the empennage.This seems to be the best solution using what I already have. The only problem would be hooking onto rear rudder pedals. I think this could be solved by swaging on an attachment or putting a screw down type fitting. I may just decide the rear pedals aren't worth it and skip them. I sure don't want some passenger spoiling my flight, or have some attachment block the cable travel.

Yet another solution to the problem is to just make up new cables. Then I could use clamp on stops to located the passenger rudder pedals. I could also run Nylaflow tubing over the cable before assembling it and routing it through the bulkheads. Nylon tubing makes a great substitute for a pulley, allowing the cables to glide nicely in function, including around the curvature at the front most bulkhead. Of course, you could split the tubing and slip it over the cable, too. But if I end up swaging new cables, I'd want to make them nice and clean, with the nylon tubing installed prior to attaching the clevis ends.

This topic bares some more investigation. I know that Jim Winings has made a nifty set of pedals that disconnect and drop out of the way. He simply bent some round steel rod into a boxy figure "S" and hinged it to the floors. The cables just hook to the pedals by a clipped on chain. When not in use, the "S" pedals merely lay flat on the floor, completely out of the way.
My rudder cable slot at the rear of the ship is about 1/2 the size recommended by TR, so far. I made the measurements per plans and then used a step drill and started at the center of the dimensions in the plans. Then to get a slot just enough to get the cable end hardware through, I step drilled about 1.5 more diameters aft of the first hole. Then I took a dremel to cut and join the holes and then a file to clean up the holes.



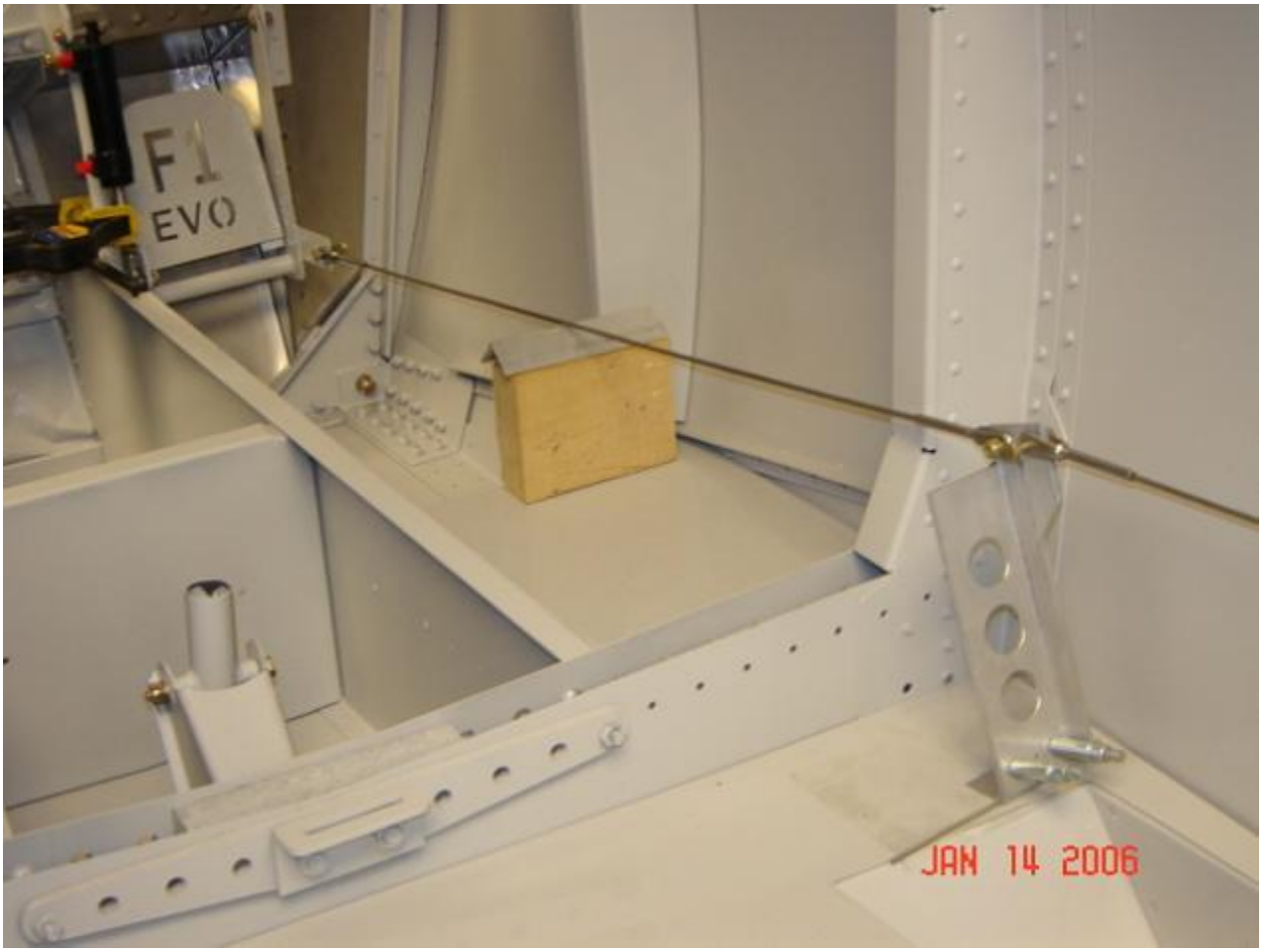
Later on, I'll take a razor blade and trim the tubing flush with the side of the fuselage. I may substitute nylon tubing for the poly, or use both. Once I get the tail mounted and the cables hooked up, I'll determine if the angle out the slot warrants some changes. Perhaps the slot will end up wider, or perhaps I'll just make sure I have some wear resistant tubing to guide the cable, just as it is now.

I'm using the poly tube that came on the cable and I made a cushion clamp and bracket assembly to hold the tubing in the slot. I got some .040 and made a plate similar to in the plans. I just used pop rivets to put the plate in. I used the TR supplied cushion clamps, screws and nuts to hold the tubing around the cable in place just ahead of the slot. I used some GOOP to seal the slot around the tubing, which nearly perfectly fills the slot, but not quite. The tubing protrudes from the slot, too, out in to the open air.
I went back to clean up a couple things before getting in and painting the cabin, and putting down the windshield skins. I had dimpled all the holes for the boot cowl. Unfortunately, at the aft lower corners, I couldn't use a countersunk K type anchor nut. I had to use a one lug anchor with the two rivets on the same end. That's the only type that I know of that I could fit there. I searched for a one sided countersunk nutplate to no avail.

I took my hand squeezer and flattened the one dimple on either side of the ship. I then took a #40 machine countersink and trimmed out the un-dimpled hole. I put in the screws and made sure about all of the head that stuck out was the thickness of the boot cowl. Then I riveted in the nutplates. Now those screws should sit in there nice and pretty. I still need to roll the lower edges of the boot cowl to eliminate the puckers. It's REAL close, but still needs work. I'll come back to that later, probably in conjunction with the windshield skins.

The rudder was hung by the VS with care, in hope that stainless cables and rudder pedals soon would be there. Over a year later, and I'm finally back in the cabin finishing up the controls. My big concern with the next part of project was whether or not I could use the TR supplied parts to run the rudder cables down the side wall. The plans have you terminate the cable run through bulkheads when going forward you reach the passenger rudder pedals. I wanted to run the cable all the way forward behind the bulkheads, and perhaps later on even behind trim panels.

I attached the rudder cables to the rudder horns and then slid the cables through the holes drilled per plans about a year ago. I went ahead and inserted the rear pedals between the short front cable and the long rear cable. I hooked both front rudder pedals up and played with the rudder. It moved stop to stop quite easily. Next I looked at the cable to estimate how I would run through the bulkheads to the steel tab on the front rudder pedal. What I did was run the pedal full left, then full right, then centered and transfered that to a piece of tape on each of the two bulkheads I was going to penetrate. Then I went to the opposite side and ran the rudder and checked the cables to the lines marked on the bulkheads.



At this point, I decided two things. First, the front bulkhead (a single panel) really needed the hole lower than what it looked like. I determined this knowing that the vast majority of the time, the rudder will be centered. So I hedged toward the center mark.

The second thought was that the height of the double bulkhead cable hole was going to be determined somewhat by the rear pedal. The pedals are supposed to be mounted inboard of the bulkhead without regard to having to penetrate a hole. As I choose to set up the pedals, they will be

almost completely outboard, and when the pedal is full forward, the swag of the cable has to go deep into the grommet in the bulkhead hole.

From the beginning I new that I could not just run these steel cables and expect the plastic grommets to hold up. Therefore, I also bought some NYLAFLOW 1/4 inch tubing. I slit the tubing and more or less spiral wrapped the forward cable completely. That material glides on the plastic grommets beautifully.

In addition to running Nylaflow over the steel cable to help it slide, I also bent the steel tab on the rudder pedal to help the swag have a straight run at it. I was sure to test the entire setup for full travel and clearance at the firewall footwell. So far no problems.

There will be at least one pitfall to the manner that I used setting up the rudder pedals and cables. Because the cables are effectively shorter by running them outboard, the rudder pedals have to go rearward more to meet them. For me this is a blessing because I'm short and it brings the pedals closer to me. However, it also raises them off the floor farther as they go full travel. I may end up having to build the floor up so I can stay on the pedals. Well, that one bulkhead under your knee or calf usually gets into most pilots legs since you sit so low and your legs are so straight. Raising the seat and perhaps the floor will help my reach, and perhaps keep me from getting bit by the corner of that bulkhead/compartment under my legs.

While I was blistering my fingers trying to get the Nylaflow over the forward cable, I remembered that I have poly tubing at the rear of the empennage where the cable exits the skin. Ah yes, there's a picture up above here showing that. Well, I had some scrap Nylaflow that just happened to be about the right length, so I slit a piece and put it over the cable outside the cabin! Sure enough, it was the correct diameter and slippery enough that it just slid right into the poly tubing around the cable. I tried my best to get the slit at the top. I figured it would be least likely to wear through there.

Cabin Paint

I finally got around to painting the interior of the fuselage. It took longer than I thought. I used a touch up gun through the first top coat. I was trying for a textured effect, but didn't really like the results. The color looks great and the material is tough as nails, but it certainly could have turned out better.

This AM I put on a second top coat using a full sized gravity fed HVLP gun. I tried to be really careful with the 4/2/1 mix of components. I went ahead and tried to smooth out some of the texture, which was a heavy orange peel, and of course I ended up with several runs. And a hole broke in the air line. And the cap on the gun started leaking. It was not a good morning.

Several places are going to need sanded and rubbed out. Many places are going to be covered, and I'm certainly not going to worry about cosmetics there. I still have a lot of finish work to do in the cabin, but at least all the nooks and crannies are painted, and I can move on with the canopy.
Now that the fuselage interior is painted, I've moved the "canoe" from my garage into my walk out basement. I borrowed a dolly with 4 rubber wheel casters on it. The casters all rotate 360 degrees, and that made the move very easy. The dolly is about 2 wide by 3 long. I just loaded some foam (still have most of what came from the kit shipment) and held it on the dolly with a ratchet strap. It was then a one man operation.

I measured my basement and seemed to have plenty of room. Now that the fuselage is in there, it sure takes up a bunch of the main room. The canoe is 17 feet or so long. Once I get the engine mount, engine, then cowl and maybe even the prop on there, it's going to fill the space. I think I'm going to have to rearrange my shelving and furnishings again to get some more working room down there.

I hope to be working on the engine and cowl at least down there this Winter, but I still don't have an engine. The prop can actually wait until I take the plane to my hangar in the Spring (hopefully).

I've been eager to get my F1 "on the gear" since I started. I think it would make it seem like an airplane more than a collection of parts. Plus it just looks cool. Having seen Winnings, Pflanzer, and Frazier's planes on the gear was just cool.

Now I've come to my senses. Well, a bit, anyway. I have the fuselage in my basement sitting on a saw horse and a couple storage tubs. Being a short guy, it's actually at a very good (low) height for me to work on. I'm thinking canopy work, here. So I think the plan now is to leave the landing gear assemblies in the bathroom (yes, the bathroom!) for now and get the windshield skins on, the plexi in place and cut the boot cowl before getting the gear on. I have to remove all that before I roll the fuse back out anyway, so why get in a big hurry. I also don't have an engine yet, so more than likely it will be after Christmas before I can work firewall forward.

So off the gear it stays.... for now. And all the parts on the interior that I removed for painting are being left out of the cabin.

I'll button down the instrument panel frame "permanently" and put the canopy track back in, then go back to work on the canopy. I still need to put in arm rests, the throttle quadrant and cables, and do other interior stuff. Therefore, even when I get the windshield ready for final installation, I may wait a while so I can get back in there and lean into the forward cabin area. Looks like lots and lots of things are going to be "finalized" at the very last. Ohhhh, I have a LooOoooOong was to go!

I've got some down time while I'm painting the canopy slider parts prior to assembly, so I'm going to go back and work on some things that still need completion.

Elevator Bell crank

Here we go again. Once the elevator bell crank/steering control mechanism was ready to finalize, I heard about a mod to improve the feel of the elevator stick forces. So toward the end of this section, you'll see how I remade the bell crank to move the push tube attach hole closer to the center of bc rotation to reduce the travel and increase the leverage on the elevator. The big debate is whether or not the EVO needs this change. With the CG change of the EVO wing, it might not be as important to try to improve the feel/force of the elevators. In fact it has since been determined that the EVO model of the F1 probably does NOT need the bell crank changed, and ***I have since gone back to the stock configuration of the bell crank.

One of the things I needed to do was re-install the (stock) bell crank for the elevator. I removed it while working in the baggage area. I've re-drilled the holes for the #4 rivets that hold the hand made extruded angle brackets for the bell crank and autopilot servo. I put the angles on the scotchbrite wheel and dressed them up a bit. Then of course I demurred them. I don't think I am going to paint them, just rivet them in with universal rivets and then attach the bell crank and servo. I think I'll work on the baggage floors, too, before I final install that. It's a pain to work over that assembly sticking up from the floor about 5 inches.

The rear seat cabin floors are set back in place, and I have some non slip carpet material over the top of them. I'm probably going to be crawling around in there a lot, so I cut some to shape. That will protect the finish a bit and give me some traction and cushion.

Notice in the pic above that I used Vince Frazier's idea to use cable lights for some decent, low heat lighting in the fuselage. doesn't look like much, but it's just enough to get the job done. You can string 'em up or lay them out, and make it so you have good lighting without shadows. And very little heat. Nice! I may get some 12v LED units and put them back in the baggage area permanently!

I riveted down the angle brackets for the bell crank (bc) and put the bc and TT (TruTrak) servo into position. Since I have an EVO, and the battery is going need to be moved forward, I thought I'd take a hard look at the baggage area. This area was about the first place I worked, and the baggage area is all but finished. However, things have changed in the last 6 months since I worked on those parts. I wonder if there is a need for more baggage space? Since the battery is out of the way, all I really need to do is work around the bc. I've measured the limits of the bc armature movement and based on what I find, I should be able to move the front baggage floor back 3.5 inches. I should also be able to lower the rear baggage floor and the "hat rack" area about 4 inches. Now the questions are: Do I need the extra baggage area and can the loading envelope take the potential weight increase. Well, if I'm hauling bubble pack, it's probably not an issue, but anvils might be more of a concern!

Jim Winings had the audacity to make the bell crank (and elevators, and many other parts) himself for his straight/stock wing F1, with changes he thought would improve the flight characteristics and operation of the F1. And evidently they did! Mark F. (TR) is picking up on a couple of them, and recommends changing (remaking) the elevator bell crank to accommodate a push tube attach hole that is located 7/8 inch closer to the center pivot point. You can't really mod the stock bracket to do this. I went ahead and ordered some .063 2024-T3 sheet from Wicks to make new bell crank halves. In the mean time, if you have an EVO model F1, don't change the bell crank!

If you are going to mod the bell crank for your stock wing F1, one thing to keep in mind: you have to locate the TT servo arm rod end in the same location, and therefore you need to be careful where you make the bends. In order to get minimum elevator tube attach distance. The bend for the attach flange will have to barely clear the rod end for the servo. There are two spacers in the factory bell crank. I reused them both. I put the lower one (short end of bc, large spacer) in the same location and drilled it. For the top spacer, I'm thinking of doing what Randy did and put it in the servo attach location. Randy had some rivet interference problems doing this, so I think I'll use a flush rivet on the aft end. The forward hole will just be a bolt hole that attaches the servo rod end.

You have to make step bends in the bc halves in order to attach the tube rod ends. I'm not too good at measuring for bending things like this, so I'm just copying the original part. The lower bend was easy to mark, just lay the flattened half over the top and transfer the center of the now flattened bends on to the edges of the new pieces. Locating the top bends was a little trickier, just in that you have to make sure the bends clear the spacer. The .063 material tends to crack on bending. When I take the parts to my bending break, I'll use some scrap .032 over it to increase the bend radius and help prevent marking of the parts. I'll just mimic the bend angles of the original bc half. After that, prime

and paint the parts, assemble and install.

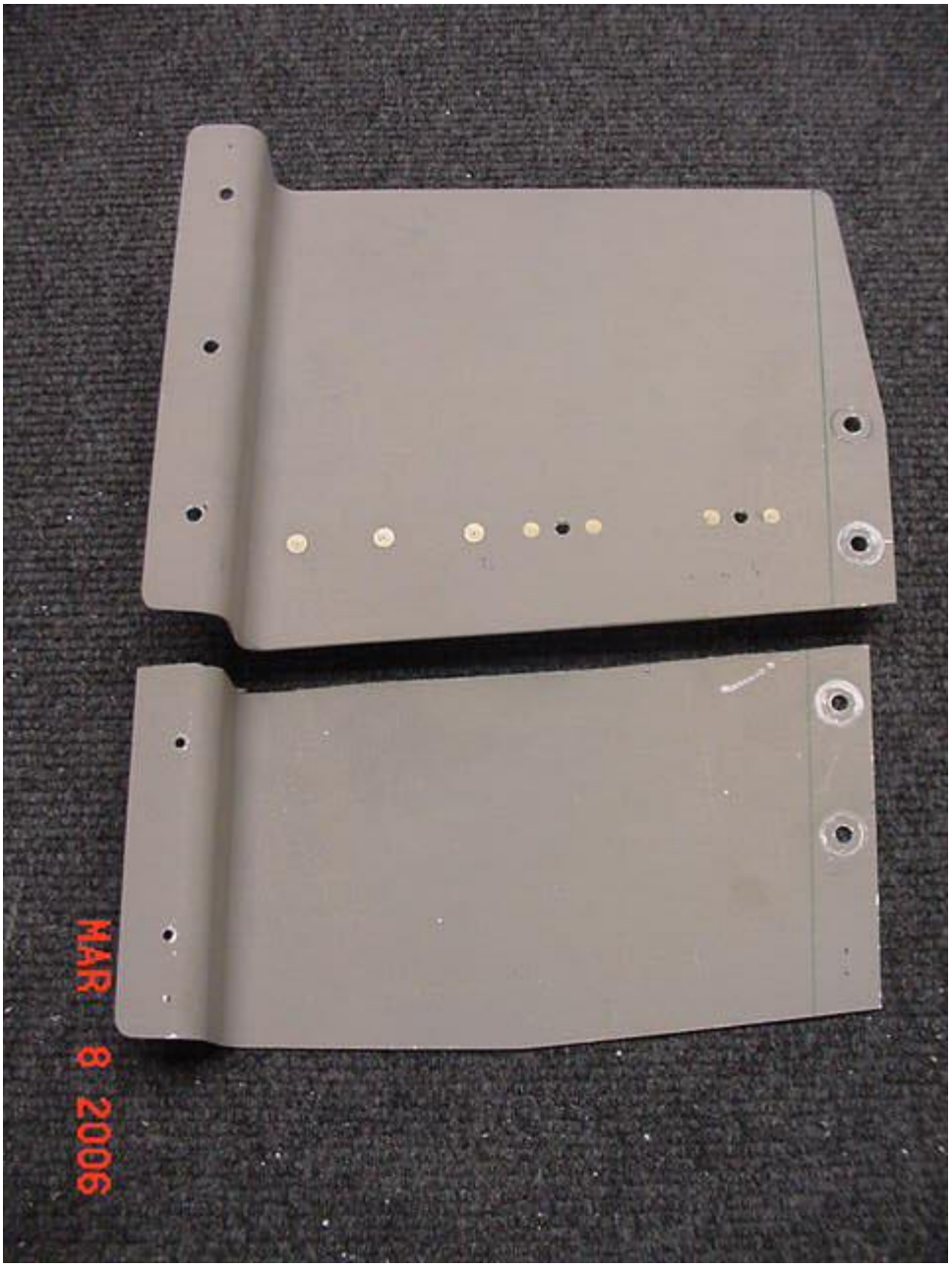
This mod is kind of a pain in the ass, but it doesn't take that long, and Randy, Jim, and even Mark F. all say the improvement in the stick forces will be more than worth the trouble. I guess the stock elevator stick forces are a bit out of sync with the aileron forces. Hopefully, this bell crank mod will balance the forces a little more and eliminate the need to remake the elevators. Jim Winings made his own elevators with a rolled trailing edge instead of the standard riveted strip. I can tell you that his stick forces are extremely light because of all his mods. Keep in mind, I'm not used to flying an RV4. I'm used to flying a Super Decathlon which takes arm force, not finger force. So I think if my elevators are a wee bit heavy (for an F1/ RV), that's probably OK.

Yes, I did make the bell crank mods, but never assembled the halves. I found out before I re riveted and installed everything that the EVO model should NOT have the bell crank modified, so I actually went back and remade bell crank halves to stock specs and am getting ready to re-assemble the stock bell crank and reinstall it in my EVO F1.

ELT & ELT Tray

In the EVO model of the F1, the battery is relocated from next to the bell crank up to the floor by the pilots right knee. Therefore, the battery tray next to the bell crank is not needed. Originally, when I got the battery move news, I decided to move the ELT to the left side of the bell crank to make it easier to wire. Since then, I have decided to move it back to the right side and set it back quite a bit. Without the battery, the baggage floor pan can be extended rearward about 4 inches, back to the forward most throw of the bell crank. So I decided that the ELT should be moved back until it was flush with the bell crank throw.

There is plenty of room to move the ELT rearwards back on it's original tray on the right side of the bell crank (the factory/plans location). The ELT needs to have a pretty strong mounting surface to survive a hard impact in tact. Basically, it needs a sturdy mount so that an impact sufficient to set off the ELT isn't cushioned by it's mounting structures. The TR factory ELT tray is pretty beefy. But I don't need it. Not in it's original form, anyway. I moved the ELT and it's mounting tray rearward on the tray, and noted that the aft pair of mounting screws was off the back of the tray. That's fine. I decided that those two rearmost screws should be attached to the lip of the bulkhead instead of on the tray. That bulkhead is about as sturdy a mounting location as you can get. With the ELT moved back to that location, there is about 4 - 5 inches of ELT tray sticking out forward that is doing nothing. So I decided to cut the tray back to the forward edge of the ELT and it's mounting bracket.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With the ELT and it's tray set back, I can now remake the baggage floor and the "hat rack" "battery cover" and gain 4 inches of storage space behind the back seat!

The ACK ELT is a neat little unit (albeit soon to be obsolete). You use off the shelf Duracell MN 1300 D cell batteries (8 of them). The expiration date (actually the "best if used by" date") is the date that you use for replacement. I bought my batteries from Wally World 9/07, and the batteries are best if used by March 2007. The batteries cost about $12.

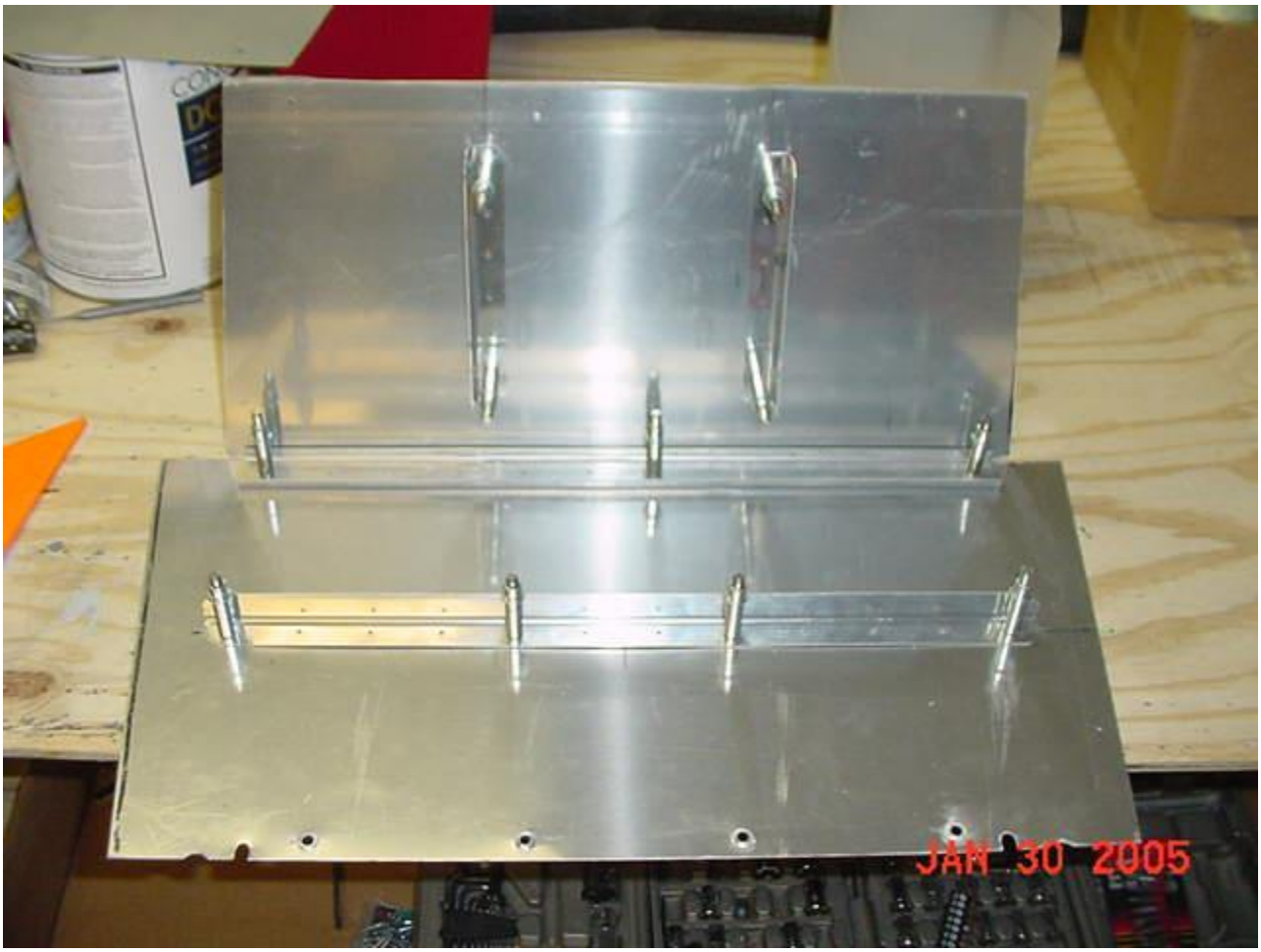
The ACK unit also has a remote annunciator. That thing takes a battery too, which I did not know. So I made another trip to Wally World (there's a new one less than a mile from my hangar!) and bought a 6 volt PBX28L. You can get these in lithium and they last a lot longer (about 7 years), but Walmart didn't have any. So I bought the alkaline type which are good for 4 years.

The Baggage Floor Pan & "Hat Rack" (battery cover)

Here's a pic of my baggage floor pan moved full forward against the #7 bulkhead:

Mark says the gaps at the front of the forward baggage floor (vertically along the sides of the floor pan) are supposed to be there (behind the bulkhead), I didn't like them, and I knew I'd drop stuff down in there. I know you're supposed to have some gaps for air to move through the plane. I figure I'll have more than enough gaps to do the job (I actually made some air vent holes in the baggage close out). Originally, when I installed the baggage floor, I had it screwed down completely forward anyway, contrary to plans. I just left it where I had it, and made the top ("hat rack" or "battery cover") over to take up the slack at the rear (#8 bulkhead).

I made the whole part out of .025 that I bought from Wicks (about the cheapest I've found). The piece is about 1/8 wider at the top to allow for taper of the ship, and I extended the top to about 11 1/8 inches. Trimmed to fit, match drilled for the #10 screws, countersunk the brace of the rear floor, dimpled the hat rack, screwed it down with 10x6 cs ss screws ET VOILA, FINI! Easy when you have a little rolling/bending/shear machine.



The new hat rack was not that sturdy feeling, so I'm going to put a piece of U channel under the bend (the *only* bend), then a stiffener angle mid way back on the top (laterally), and then two vertical stiffeners on the front. If stuff starts banging around in flight back there, I'll feel a whole lot better about it holding up. I probably should have used thicker material, or stiffer aluminum. I had thicker, but the factory piece was .025. I didn't have any stiffer aluminum. So I went with what I had.

Now that I've remade the hat rack to compensate for moving the baggage floor pan, I decided to remake the baggage floor pan and extend it aft about 4 inches. Since my EVO battery was moved up front, there is wasted space under the hat rack and behind the floor. I thought I should take advantage of it, even though with the EVO CG a little farther aft than the standard F1, I may not be able to use the extra space as I would like. But anyway, now to remake BOTH parts.

The baggage floor pan is made from .032 T-6. I got out a piece of scrap that was about 44 x 24, which is what it takes to make the pan. I measured the factory pan, then extended the dimensions 4 inches aft. I transfered those measurements to the sheet and started cutting. I was able to cut and clean up most of the floor pan with my break, but some of the cuts were made with a drill bit and dremel cut off wheel.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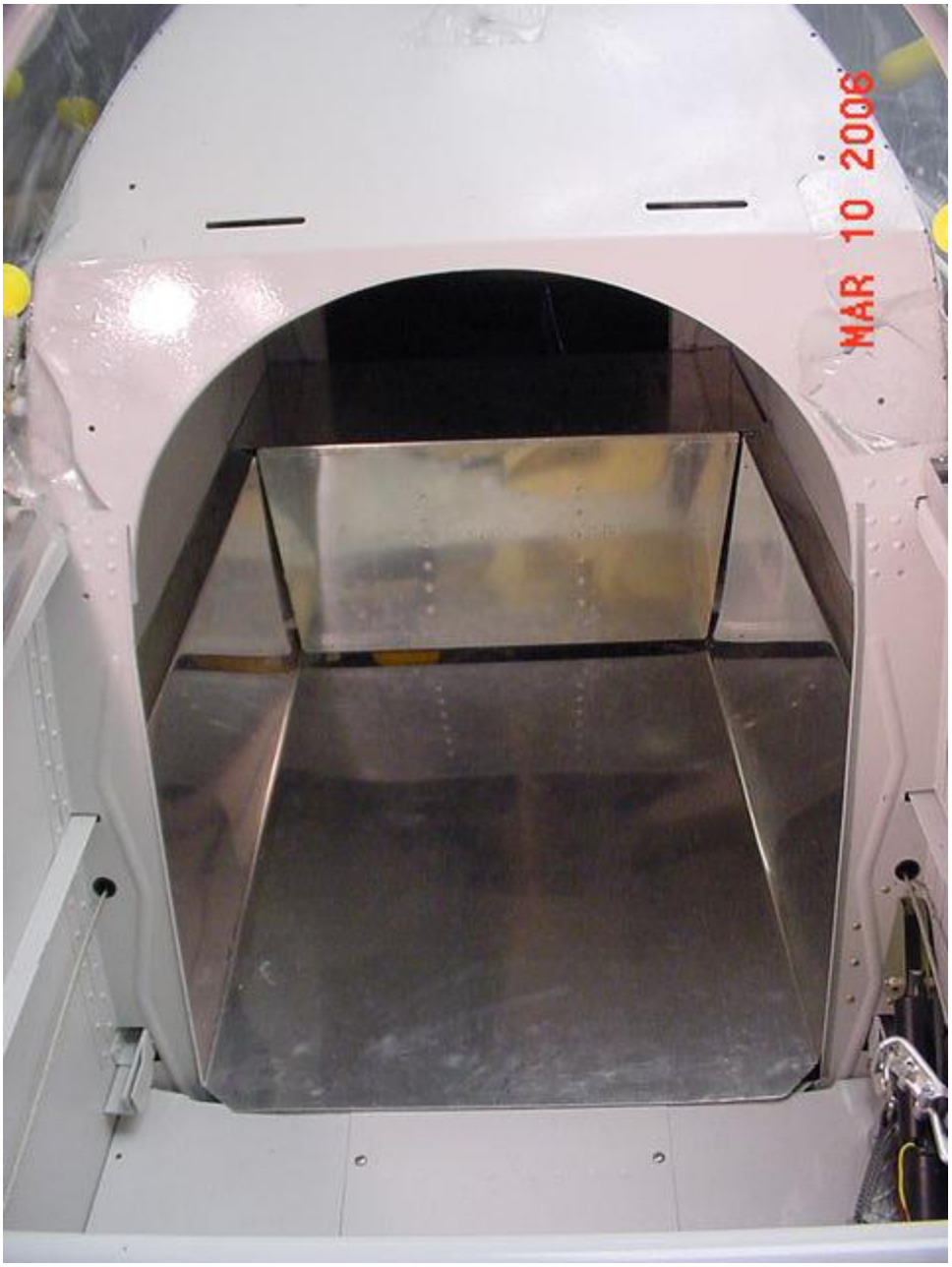


Bending that sheet was not as easy as it seems. I don't have access to a deep throat bender, so some of the bends were made by hand. My friend and fellow builder (RV6) Bruce Dallman came to my aid again. We bent some of the easier bends on a large machine at his university. Then we took the part to another shop and used a bunch of C clamps, quick carpentry clamps and hard maple strips to fold the part even more. After that, I brought the roughed out part home and bend it some more using a similar wood and clamp technique.

After about 3 test fits and trimming the flange that screws to the longerons twice, I finally go the baggage floor pan to sit in position. I match drilled the two longeron holes I already had, and then drilled 6 more for tinnerman nuts and #8 machine screws.

I was able to trim my already remade hat rack to fit the new pan.The hat rack screws to the baggage floor with 7 each #8 machine screws along the front face (into nutplates riveted to the baggage floor pan flanges), and I match drilled and countersunk the top aft edge for 4 each #10 machine screws to attach to the aft baggage shelf. It's not screwed down in the picture, just set in place for the photo.

It may be hard to tell, but the baggage area is now 4 inches deeper. The sides are a bit more vertical, too, but not substantially so. The floor pan sits beautifully along the longerons and the floor joists underneath. All that is left to do is match drill the forward edge of the floor pan. I will try to slip the edge of the floor pan under the cabin floors and the rear seat hinge, making it the lower most part over the bulkhead.

Aft Baggage Floor and Closure

I didn't exactly go by the plans on my aft baggage floor back in the empennage. I was going to drop the deck to get it as low as possible. Now that the elevator push tube is under there, I see that dropping that floor wouldn't be worth the trouble.

The aft baggage floor is a nice trapezoid sheet that is suspended along the longerons. At either end, you fashion extruded aluminum angles to support it from side to side, and well as by installing stiffeners like all the other floor panels. I didn't like the results of my first attempt of installing the forward support angle and pitched it out. I think you are supposed to somehow put these angles on the top of the floor panel, but I chose to install them on the bottom. When I made these angles and installed them on the bottom, I also added a formed angle to support the hat rack (battery cover) at the same level. Therefore everything lines up nicely and there are no obstructions above the floor, except the hold down screws along the sides.

With 2 pieces of .063 angle holding the floor at each end, the sheet tended to sag in the middle where it rested on the longerons. I decided to shim along the sides with a pair of .032 strips along each side. I double flush riveted the shims to each side, trying to insure that the rivet heads don't interfere with the longerons. After drilling the attach holes based on the factory holes along the side of the floor, I measured for the shim rivets, drilled and verified that I really didn't need to worry about countersinking the rivets on both the top and bottom side of the floor, but I did it anyway just for fun.

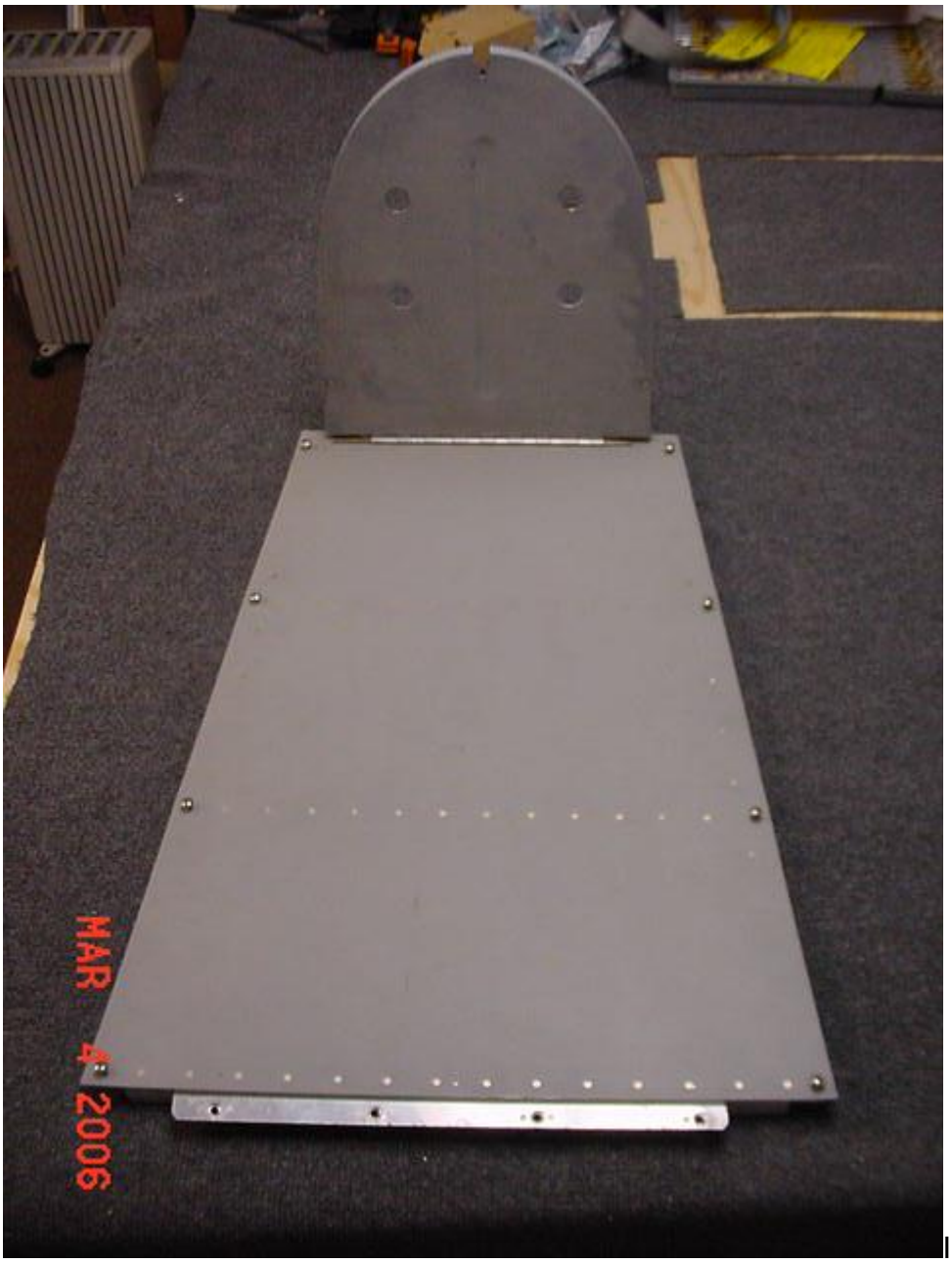
The floor has to be notched at the rear to go around the lip of the aft bulkhead. Also, note that the

angles are trimmed to fit inside the longerons. This piece is pretty hard to get to set into position, so being a little liberal with all the notching is a good idea. However, trimming the factory cut piece of flooring is NOT a good idea. As it is, there is barely enough meat to get screws into the longerons.

This was a fun little project to work on almost two years ago when I started it, and it was pretty fun to work on this time, too. Except for the fact that you have to get back in the empennage. The reason I went back to finish this project was so that I could begin the final installation of the mechanisms in the empennage. As of this writing, I am trying to complete as many chores inside the ship, from the tail forward, so I can get ready to move the plane from my basement into the garage, and hang the motor. So I need to get these deep empennage chores finished. The last time I got back in this area to work, about 1.5 years ago, I dislocated my shoulder and it has never been the same since. I'm trying to be VERY careful getting in and out of there.

Now that the aft baggage floor is ready to install, I have to something about that pesky aft baggage floor closure, that arch shaped door that covers the bulkhead opening at the very back end of the aft baggage floor. I've worked on that thing twice, trying to figure out how to attach it, and how to make it easy to remove, just in case there is a remote chance I need to get some skis, go fishing, or decide to take up pole vaulting and need to run something long back there for transport. It's not likely that I will ever need to put something through there, but I want to TRY to make it relatively easy to open.

Finally, I decided to hinge the closure door at the bottom. That was easy enough. I used 3 hinge on the floor and 4 hinge on the closure. I left the pin straight and "loose" in the hinge. It's so long, there's no way it can come out, without removing the baggage floor (unless it works a hole in the side of the ship.... yikes!). I trimmed the closure door to go around the lip of the aft baggage bulkhead and made it to sit relatively flush against the bulkhead.



I drilled four lightning holes in the closure door. That gives me a couple finger holds on the closure, but the biggest reason to install the holes was to promote airflow through the ship. When I made the hat rack, I closed the "vents" that were built in it from the factory so I could keep things like pens and small items from getting under there. So I had to compensate by opening airflow vent holes somewhere else. I decided they should be up high were things rolling around aren't likely to go through there.

Along the side of the aft baggage floor, I only used 4 screws each. Instead of trying to rivet in nutplates, I chose to use tinnerman nuts that clip onto the longeron and then use #8 stainless sheet metal screws to hold the floor down. The KISS rule applies here.

I ended up using a Hartwell latch I bought from Wicks on close out for about $2. I had already notched out the top of the close out door, so I went the rest of the way and installed the rather large Hartwell. Then I attached it to the door with #6 ss hardware.

For the hasp, the first one I made was out of extruded aluminum angle. I used a piece of scrap that was already drilled for two holes and thought I'd try to make it work. That wasted over an hour. The second hasp is just made of .032 formed 1x1 angle and another pair of ss #6-8 screws and nylon lock nuts. The .032 may be a little wimpy, but it really doesn't need to be all that heavy duty.

The hasp and Hartwell latch combination holds the close out door against the bulkhead quite nicely. The edges of the door are smoothed, but not completely finished. If I run across some edge trim, I may run a bead around the door so that it sits against the bulkhead without rubbing into it and getting sloppy over time.

You'll note that the door is off center. You should also note that the bulkhead is also off center. And the floor is slightly off center. I can see now how easy it might be to get some twist in the tail, starting with longerons and bulkheads ever so slightly offset. I really can add up to some twist as you go way back.

Now all I need is a skinny volunteer with narrow shoulders and long arms to climb back in the empennage and finish attaching everything permanently. I can't hardly get back in there, and I really don't want to screw my shoulder up any more than it already is.

Mark III Flap Mechanism

As an EVO builder, I've been waiting for the final iteration of the wing control surfaces and flap mechanism. I can see light at the end of the tunnel. At Sun & Fun 2005, Mark gave me the Mark III flap mechanism. I'm not sure if it is EVO specific, but it is somewhat different than all the other flap versions on the F1 (and the RV's, too). The motor setup is about the same, but the torque tube goes on the floor about 10 inches forward of the #7 bulkhead. It also penetrates the exterior of the ship and directly operates the flaps (as far as I can tell... I still don't have the final plans).

***NOTE: We opted to make a new bulkhead/drive shaft attach bracket to accommodate the new torque tube position and the armature/ 4 inch flap motor combination. That new bracket has the same mounting holes as the original, however the drive shaft attach hole is moved up and forward quite a bit to clear the seat belt attach. The bracket works in tension, so the attach hole being an inch off the bulkhead should not be a problem. More information on that bracket is at the end of this segment.

The cool thing about this new system is that the flap actuator is almost completely hidden under the floor and outside the plane. Unlike previous F1's and RV's, there is no actuator arm protruding from the belly down to the flap. The Mark III system moves the torque tube forward and exits the ship so that an armature on the tube directly actuates the semi-fowler type flaps. Perhaps it doesn't work any better, but it should be stronger and cleaner looking.

The items that you get with the flap mechanism kit are in the pic below. Someone forgot to include a flap motor, so that is the only thing missing as far as I can tell.

The torque tube has a specific orientation. There is reinforcing tubing welded to the inside. The end with two welds has a longer tube inserted in it. This will be the left end of the tube. That is of course to reinforce the motor attach bracket area. The motor attaches to the left side of the #7 bulkhead.

Here is what I think the orientation of parts will be on the torque tube:
**Note: Don't try to get the bearings on the tube until after they are installed on the ship. You'll get a better final result that way.

You can see why this side has the longer reinforcement in the tube. The large doubler plate you see goes on the inner rib of the flaps, and actually won't be used in this part of the installation. The bearing is the middle of the three parts on the torque tube, in between the motor bracket and the flap actuator arm (which goes outside the ship). This bearing is another difference from the other flap systems, there is no plastic block to hold the torque tube. This baby has some serious all metal support for the torque tube.

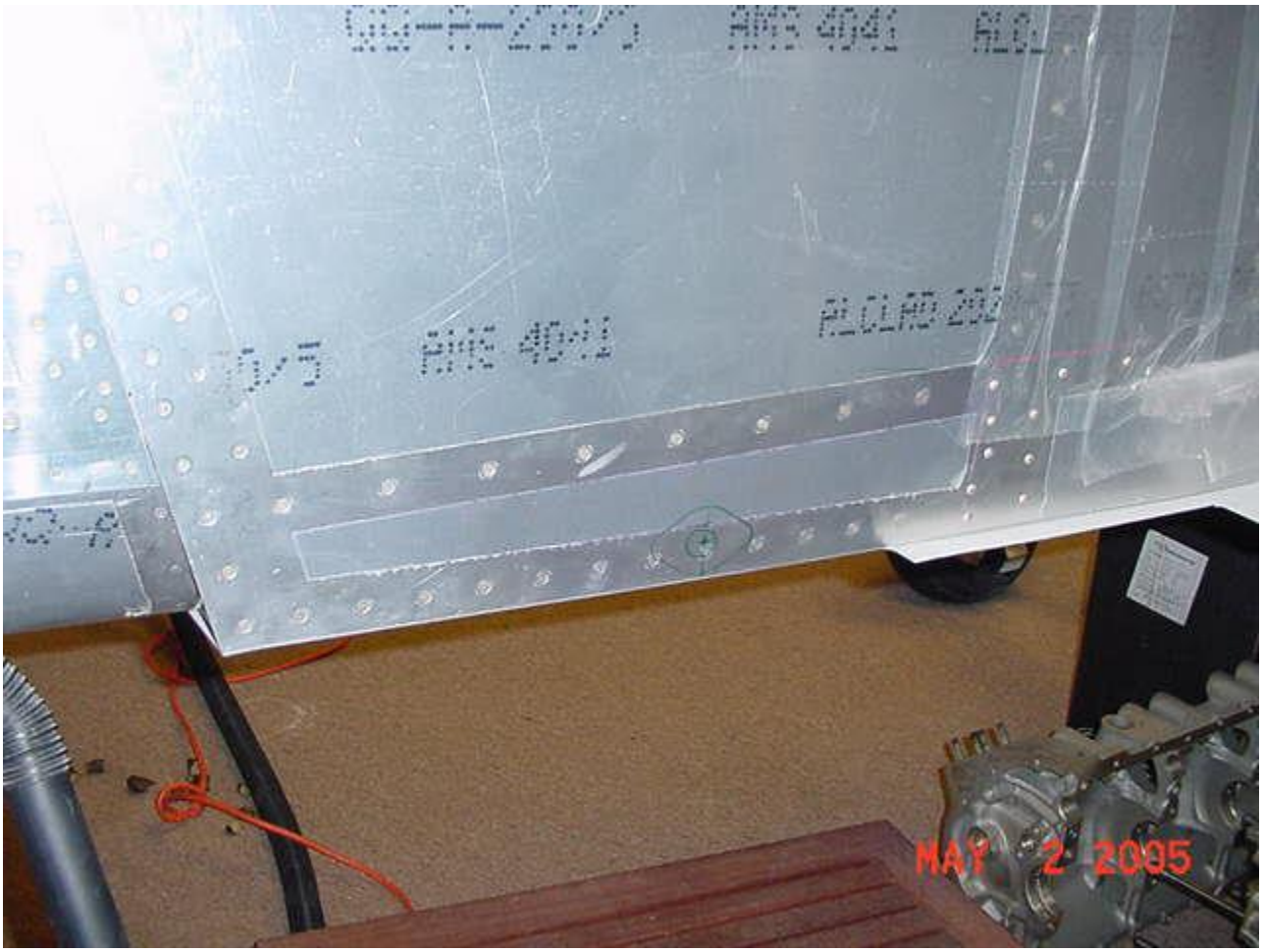
It's OK to have the actuator arm and the motor arm fit fairly snug, because they need to be tightened later with a bolt, but the area of the tube supported by the bearing needs to allow free movement without slop. Once I get the parts in place, I'll make sure the tube rotates freely in the bearings.

Notice the area provided on the motor bracket and actuator arm so that you can drill it for an AN3 bolt. I'll wait until everything is in place in the fuse, then mark to drill the parts for the least interference for the bolt head and nut. This is especially important with the actuator arm.

Supposedly the bearing is bolted to the sidewall with 1/4 inch hardware. According to Mark, the attach holes that were machined in the bearing were too sloppy to hold #10 hardware, so you have to step up to whatever size is most snug, probably AN4 bolts. I haven't begun the install yet, so I'm not sure what to use. But there are 4 bags of hardware provided with this sub assy, so I'm sure I have everything I need... except the motor and some more plans.

Mark emailed some early, initial instructions to do the install. I'm not sure of his dimensions and I don't know exactly where the tube is supposed to be located, except that it is supposed to be 10

inches from the lower corner of the #7 bulkhead. I emailed him back with several questions. I asked him to simply provide measurements for the torque tube holes from the outside of the ship. It's just a whole lot easier to get this project going from the outside, than mess with it on the inside.



The green bearing tracing on the lower rivet line of the fuse is 10 1/8 inches from the rear corner where the ship turns from the cabin to the curvature of the empennage, which is correct. Actually, I could see the forward side of the lowest corner of the #7 bulkhead through a slight gap in the corner (gonna seal that!) and I used that to measure 10 inches forward. The extra 1/8 is about how much the skin extends aft of that. The center of the bearing, as measured from the outside at the edge of the belly, is 15/16 up. That makes the bearing clear the radius of the rib on the inside of the ship, and still clear the elevator push tube.

The pic above shows the marked location of the center of the bearing and a tracing of the bearing around it. When you mark for the bearing, you have to compensate for the belly skin thickness, the thickness of the rib, as well as the radius of the bend in the rib, if you want to start this from the outside. I you want to do it from the outside, just locate the lower edge of the bearing about 1/8 inch up from the bottom.

I drilled a pilot hole for the center of the torque tube at the marked location. Then I used a step drill all the way up through 13/16. I put the bearing on the tube and inserted the tube through the hole from the outside. I marked one hole for the AN4 bolt, and drilled it with a #30 bit. I clekoed the bearing in place and aligned/centered the tube holes, then marked the other bolt hole for drilling. After I drilled a #30 pilot hole on that side, I used a step drill to take those two bolt holes up to 1/4 inch. I also had to take the bearing to my bench and drill the bolt attach holes up to 1/4 inch to accept an AN4 bolt. I

used AN4-5A bolts, with washers on both sides and a nylon stop nut.

After that, I measured for the through holed in the center floor supports, so that the flap torque tube would go through from side to side. I used the 10 inch measurement from the bottom of the #7 bulkhead. I marked the spot one inch up from the floor locate the through hole. It wasn't enough. The floor bows downward on t he belly of the ship more than I thought, and I had to ream the holes upwards a bunch. Perhaps 1 1/4 inch up would be a better starting point up from the floor on the though holes. I drilled a pilot hole with a right angle drill, then I was able to get my step drill to just fit in the pilot hole. The drill really doesn't fit in there very well for these holes, so it takes a bit of finagling to get it going. I'll need to go back with a dremel and pretty up the holes.

Don't be concerned about how much divergence there is at the sidewall. There is about 5 degrees of discrepancy between the torque tube and the side wall/bearing. The bearing is made to accommodate this difference. When you get the tube ready to insert through the bearing and sidewall, just gently tape the tube with a rubber mallet and the bearing center will shift to align with the tube. Neato, bandito!

One consideration is how to insert the tube when ready to finalize the bolt up. If you want to install both flap bearings and then slide the tube all the way through from the outside, it won't work unless you dress down the entire length of the tube (or gut the bearings). What I am going to do is bolt one bearing down, dress down that end of the torque tube a little extra, then slide the tube through the skin on the other side. The tube will have to go a little farther through the opposite bearing than necessary. Then I'll slip on the motor arm and the opposite bearing, slide the tube back to position and bolt the left side parts down to the tube and the side.

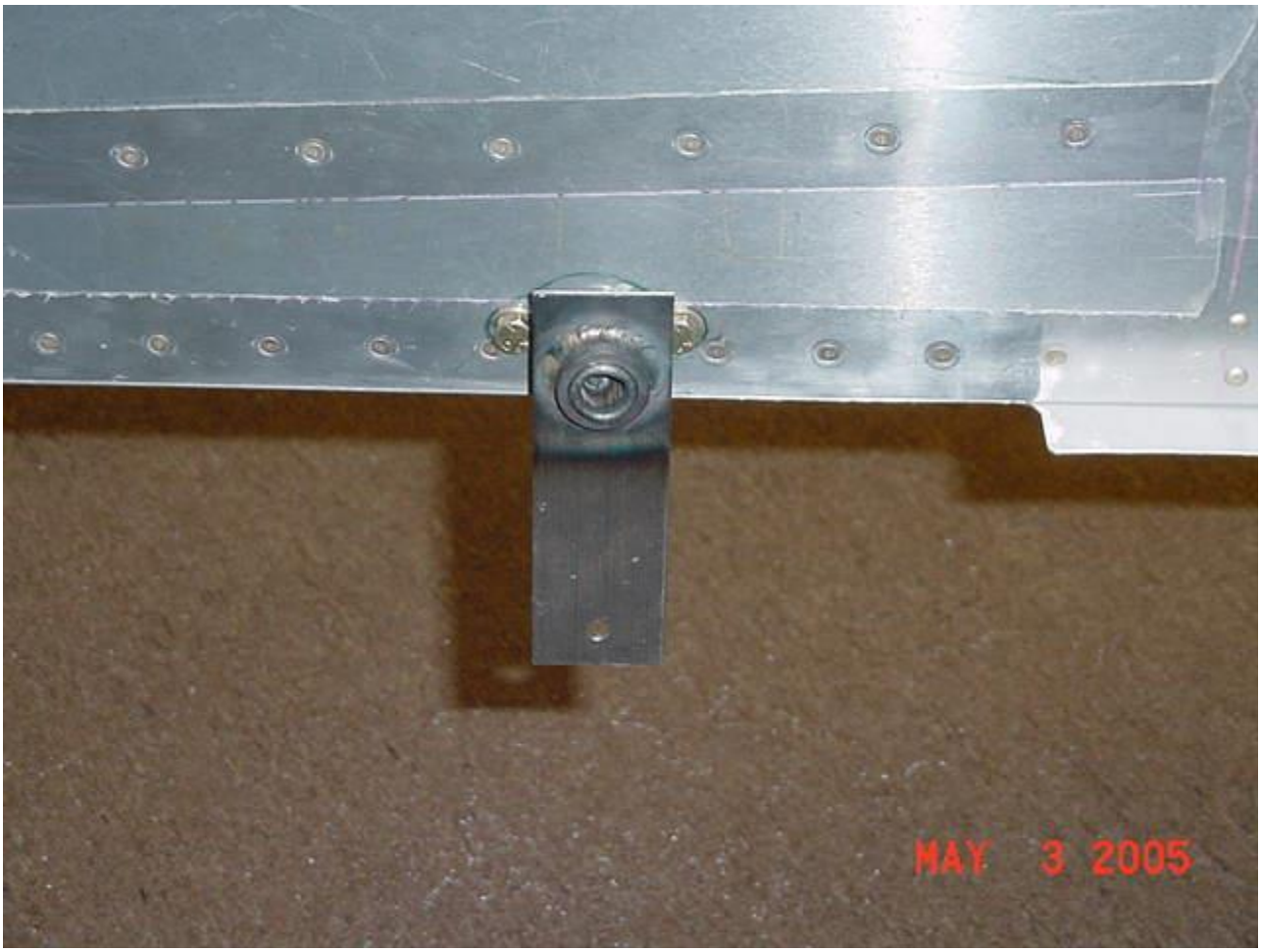
Yet another consideration is how the motor arm is going to sit against the side wall. You are supposed to build an "arm rest" to cover the mechanism. I wonder how bulky that will have to be because the motor arm as supplied is straight. By this I mean that the arm that comes off the barrel that bolts to the torque tube is perpendicular to the tube. As you can tell in the picture above, the side wall is certainly not perpendicular to the torque tube. So I'm wondering if I'm going to need to mod the arm so that it sits more parallel to the side wall of the ship, which would allow a much smaller arm rest cover. If I need to make the arm parallel to the side wall, I'm going to have to cut a wedge out of the arm and bend it over. Then I'll have to get my buddy to weld it back together for me. Right now, I don't have the motor, so I don't know how much travel the whole mechanism has, nor whether the motor arm sits forward of center on the tube. Then maximum bend you could put on the motor arm would be

dictated by the side wall behind the torque tube due to the fact that sides taper inward so much toward the rear of the ship. I just hope I don't have to inconvenience the passenger by having this big bulge on the left side due to the armature of the flap mechanism.

The flap motor armature barely clears the rib without hardware. With hardware, it's going to take some trimming. I hope the motor arm attaches with a clevis pin instead of a bolt, otherwise it's going to take some major cutting!

Not that this is real exciting, but since I'm a shutterbug, I'll show you the flap toque tube sticking out the fuselage:

See what happens when I get bored! The tube sticks out about 1 3/8 or so on each side of the ship. The flap actuator arm goes on the end of the torque tube. It just barely fits on there. I still don't know which way it goes on the shaft. I'll hazard a guess:



OK, I'm done playing with the flap mechanism for now. I'll have to wait for the flap motor to arrive so I can get that installed. Then it will be time to put the rear seat in, side panels and start making the interior look like an airplane!

The motor and some mounting parts finally came in and I started playing with how it goes together. I read the plans for the other flap motor iterations and tried to determine how this one was going to work. The armature that bolts to the torque tube is a little different, it actually appears shorter than other versions. That makes it harder to locate the motor and the foot bracket on the #7 bulkhead. That seat belt mount is just in the way. Then I also have to contend with my rear seat back, which so far is not in the stock position, and a wee bit left of center. The body of the motor is going to be very close to interfering with the seat back, especially once you consider that you have to cover the motor with a panel (arm rest) which will be covered with upholstery.

I'm still working without plans. The latest revisions are not out yet. I went ahead and ground down the motor drive shaft where it attaches to the foot bracket (according to the existing Mark II plans). Then I slipped a AN4 bolt in to hold the foot bracket to the shaft. I also put an AN3 bolt (change to AN4 later) through the actuator arm and the motor body mounting hole. Now I'm ready to try to locate this mechanism where it gives the torque tube the best travel and the mechanism the least amount of interference.

Here's what I came up with:
NOTE: As you can see by the lower pic, the supplied steel "foot" bracket does not even come close to clearing the seat belt shackle attach. I opted to make a larger bracket in order to make the flap motor clear the seat belt. Tom Martin opted to reconfigure his EVO to have the motor attach below the floor.

I'm covering the entire side with a panel anyway, so I am sticking with this configuration, just a different steel bracket.

Mark sez that the motor should be above the floor panels and above the seat belt attach bracket. He said based on the pictures I sent him, my seat belt attach brackets are probably too long. He recommended positioning the foot bracket so that the motor cleared everything and then cut back the seat belt attach bracket. Remember that the motor is to be aligned as perpendicular to the flap torque tube as possible. So far, where my foot bracket seems to clear everything the best is about 1/2 down from my rudder cable hole, which puts the top edge of the foot bracket about 3 3/8 down from the horizontal of the center longeron. I think I'm going to scoot the foot bracket over the the outboard as much as possible. If I do this, the assembly still looks perpendicular to the torque tube, and it clears the rigidity stamping in the #7 bulkhead. KISS!

I drilled the foot bracket to the #7 bulkhead with a #40 bit and clekoed it. I had already snugged up the AN hardware on the motor, so I clipped on 12 volts (9 volts will work) and ran the motor back and forth. COOL! It WORKS! Unfortunately, there was a nasty jump in the motor when it was fully extended (which will be flaps up eventually). I drilled the actuator arm up to an AN4 (1/4) and put two shims (washers) on the inboard side of the bolt. That snugged up the play on the motor attach and once the nut was snugged up, the motor ran full travel without that noisy jump. BTW, I had to grind the radius on the arm bracket to give it some clearance from the motor body.

Now to drill the torque tube. Originally, I was going to use an AN3 on this one, but as you might guess, and AN4-13 works much better. This is going to be one beefy mechanism before it's finished. I

eyeballed the middle of the cylinder on the arm and drilled through with a fairly small bit. I was slightly off center so as I stepped up through the sizes, I biased the drill for correction. I went all the way up to a 1/4 inch bit, being careful not to punch through and drill into the belly of the ship. Again, I bolted the parts up and ran the motor. No problemo!

The way I have my flap mechanism ready to install, I don't have to mash the #7 bulkhead stiffeners, but the motor assembly is probably at the outside of the play (or slop) you can have with this setup. If that bothers you, your probably better off moving the foot bracket close to the center of the bulkhead and mashing down the stiffening stamp. I'm just concerned that the seat belt attach bracket is going to be in the way of the motor body (it still is). As it was, I did trim the seat belt attach bracket to insure that I had clearance from the motor. I may even need to cut it back more later to make sure my Hooker Harness bracket (shackle?) doesn't get hung up with the motor (I didn't cut any more, there's not much meat. Leave it alone except to crop the corners)

My digital level showed that there is 50 degrees of travel on the arm. Mark says we only need 40 degrees, so there's some extra room to play.

I used some scrap .032 I had laying around for a doubler behind the bulkhead to back up the foot. I drilled up for an AN3-4 and used a stop nut and a washer on each end of the two bolts. I riveted down the doubler with 8 each #4-4 rivets in it to hold it in place behind the #7 bulkhead and the foot bracket. BTW, my doubler is about 3/4 inch longer than the foot at each end and nearly full width of the #7 bulkhead. Two of the rivets holding the doubler in place are flush rivets under the foot bracket, the rest are universal 4-4 rivets dodged around the stamping. The other #4 rivets are universal head rivets strategically positioned to clear the stamping in the bulkhead. I would recommend you make a doubler that is the maximum size you can put behind the bulkhead. Also, it probably wasn't necessary, but 2 of the 8 rivets are flush rivets and are under the bracket. The attach bolts are just attached with nuts, not a nutplate. This thing is easy to get to with a wrench.

I went ahead and snugged everything up and checked the motor again for smooth function and full travel. No jumps, clunks, binds or interferences. This baby is finito! (so I thought...)

Next thing to do is cut the floor panel to clear the motor. I plan on slotting the floor panel so it can be removed when the flap is in the down position. My understanding is that it is common to keep the flaps in the down position while the plane is parked, and I'm guessing that's the position they'll be in when I'm working on the plane. The other consideration is that the "free end" piece of the floor will be slightly larger this way, and easier to screw down to the lower longeron. First thing to do is measure the travel of the arm in relation to the longeron and the #7 bulkhead. The torque tube armature travels from about 8.5 inches from the bulkhead to about 12.5 inches. The travel is of course perpendicular to the flap tube, therefore the slot in the floor will be parallel to the inside edge of the panel.

I used a framing square to measure the position of the arm as well as the markings on the floor panel. I didn't figure it had to be that close, I measured within 1/8 inch. The arm is about 3/4 inch square, so it was easy to mark a slot in from the side wall. I essentially marked a rectangle in from the wall on the floor panel, then another rectangle perpendicular to that one for the travel of the arm to fully extended. I drilled the corners, cut the two rectangles out with a dremel and took the panel to the ship to check the cuts and fine tune it. I found I had measured too well, and the slots were too tight, so I

cut the slots again with the dremel. Finally, I filed down the edges and set the floor panel in place. Generally speaking, I have about 1/8 clearance all the way around between the floor panel and the arm as it travels stop to stop.

*****Note:** You may notice I cut the seat belt attach angle pretty severely. I think you only need to round the top corner a bit. I put myself in a position to the point where getting the belt attach centered and ensure adequate "meat" of the bolt through the attach angle was getting iffy. Also, remember, you cannot center the bolt hole in the attach bracket (at least not with a Hooker shackle). You have to allow for the thickness of the bottom of the angle. IOW, the "L" shape of the angle has a vertical and a horizontal, and you have to deduct the thickness of the horizontal from your bolt hole position. You probably knew that, but I just wanted to give you a reminder. It had been a long time since I'd worked with angle material, and certainly not like this. If you center the hole in the vertical, the belt shackle won't be a problem, but the bolt head or nut may be a problem.

Addnl Note: If you have an EVO and you cut the floor like above for the flap motor arm, it does weaken the floor. I am going to go back and reinforce around the inboard and front side of the slot with formed angle to stiffen the floor. If a passenger steps in this area, it will definitely buckle the panel.

The flap motor provided with the kit is a nice unit. Simple, small, fast, sort of quiet, and only a two wire connection. Positive on one wire, negative on the other and the motor runs one direction to it's limit then automatically shuts off. There are no limit switches external to the motor! That's a godsend because I had all kinds of problems with the limit switches in my Tiger. What a headache! Not here though. The only tough part is either using relays or a double throw double poll (I think) switch. Either

way, running only two wires forward should be a breeze. My plan is to run the wire along the body of the motor, down the arm and along the torque tube, then either feed it through the corrugated conduit down the left side under the floor, or just run it right to the control system in the middle. Probably run it through the conduit under the floor to a terminal strip at the base of the front control stick. I think it's time to ask some questions to other builders about routing wires. I'll be breaking some new ground here with the logistics of wire placement!

I went ahead and tried to put the Hooker Harness seat belt shackle in place to see if it would clear the motor shaft. It didn't, even with the bend in the shackle. I've brought this to Mark's attention and asked for solutions to the problem. My recommended solution (what do I know?!?) is to make the torque tube arm about 1/2 to 3/4 inch longer in order to raise the body of the motor up out of the way. You could also move the foot bracket up on the #7 bulkhead. It's a good thing I made that doubler behind there a lot bigger than it needed to be. It looks like I'm going to need to move the foot bracket. If Mark doesn't provide a replacement arm, I'm going to ask my trusty RV6 builder buddy Bruce to help me weld an extension onto the flap armature. I think making the arm longer and keeping the same or similar geometry will be pretty easy. Then the seat belt attach will be a non-issue. We'll see what happens. Stay tuned.

There's a fly in the ointment... The Mark III flap mechanism isn't exactly what Mark has in the company ship. What we're getting seems to be a work in progress. Remember, this is called an EXPERIMENTAL kit aircraft. Here's where we do some experimenting. As supplied, the flap motor has big time interference with the seat belt shackle. There's just no way this torque tube armature, 4 inch drive motor and foot bracket can be combined without interfering with the seat belt. So some how, the mechanism has to be changed to get some clearance. The belt shackle (mine is a Hooker) has a slight bend in it to help the clearance, but it's not nearly enough bend. And it can't really be bent out of the way, nor can the belt attach point be easily changed. Mark really didn't want to change the length of the torque tube armature to raise the front end of the motor up higher because it would reduce the length of the flap arc by several degrees. Something's gotta give.

My friend Bruce Dallman and I looked at this a bunch. We determined that a new attach bracket on bulkhead #7 would do the trick. We made some measurements and determined that the attach point of the drive shaft of the motor had to be moved upward and forward in order for the motor to clear the seat belt attach. I removed the bolts from the foot bracket at set the motor in a good position to clear the seat belt. I made some crude measurements based on where the attach hole was hanging out in space. Then over at my bench, I fabricated a trial bracket out of .040 to see if my measurements were correct, and to see if this would work in reality.

Now to make one up in steel. As long as Mark thinks that this new bracket will take the load and work properly, Bruce will fabricate a steel bracket based on my prototype. There was some concern on the attach hole being located so far away from the bulkhead, which could cause the bracket to fold over or fail in service, so we want approval from Mark Frederick before proceeding. In the EVO kits, it's possible that Mark may move the torque tube rearward, change the armature/motor combination, or simply use my bracket with the "stock" Mark III parts. we'll just have to see how it goes.

The bracket above is the raw steel bracket as fabricated by Bruce "Bludgeon" Dallman, who kindly fabricated yet another part for me from my prototype and our "tweaked" dimensions. It fit perfectly and makes the flap shaft housing clear the seat belt shackle by a good 1/8+ inch. The change required me to cut the floor panel about 3/8 inch more at the forward end due to the change in the position of the flap torque tube armature. I did not need to trim for the aft end change, and the floor panel is still removable from around the flap motor and everything else in the back seat area. It's a good thing the bracket works in tension, not by the flap motor shaft pushing against the bracket. I went ahead and ran the motor before cutting the floor, and when the motor/armature "bottomed out" against the floor panel, the push started to fold the bracket over big time! Fortunately, in the service, the force of the shaft driving against the bracket will be minimal, and the folding problem should not be an issue. Now I can get back to finishing the side and arm rest panels.

For those of you who have newer kits, or EVO kits, this new triangular shaped steel bracket should be mounted at 4 inches from the floor. That should give you at least 1/2 inch between the bracket and the rudder cable hole. There is a little room for position with this bracket. Try to maximize clearance from the seat belt shackle (you do have your belts, don't you?) and at the same time take care to ensure the torque tub arm is not close to going over center.

Side Panels & Arm Rests

Now that the flap motor assembly is more or less complete, it's time to cover it up. The plans recommend .025 for arm rests and side panels. The plans also have you put the arm rests 2 inches above the center longeron. Well, Randy Pflanzer put them right on the longeron, and that makes good sense to me. Less work for me, although more work for my upholsterer!

I have bunches of cardboard boxes, mostly from Wicks and Air Craft Spruce. I picked the appropriate one and began to cut templates for the arm rest and it's cover panel, and also a cover panel for the "triple tree tripod of bulkheads". Those three bulkheads used to be only two, and you could make a map pocket there. With the changes to the EVO model (and all others from now on for that matter), this area becomes fairly useless for storage, so I plan on insulating in there and just covering it up with a removable panel. I cut a template, then trimmed it to fit, cut a test piece out of .025 and it worked the first time. I used that piece as a template for a second piece for the other side, and that worked out great. I set these two cover panels aside and started the arm rests.

The arm rest construction began on the left side because there is less clearance between the left side and the rear seat back as it folds down. The left side also has the flap motor under it so I thought it might be a little tougher. I was wrong. It was a nightmare (due to my lack of skill).

I cut the template out of cardboard. I made some changes, then I cut another template out of .025. I made the part rest nicely on the longeron. Over at the bench, I used a #30 drill and drilled a stress release hole where the crimps for the side flanges would be. I used a dremel and notched the flanges in a sort of "V" toward the drilled hole. Then over to my 3 in 1 break to bend the flanges. Before bending the flanges, I traced the piece on my big .025 sheet so I'd have another template for the other side. Man, was that ever a good idea!

When I bent the piece, I cracked it. CRAP! Made another one, fit it up, drilled it, dremeled it, bend it. CRACK. CRAP! I made 5 left arm rests before I got one that I liked. Each time I remembered to trace the previous one before bending. Man, did I make a lot of scrap. This is the first time I've really used my 3 in 1 to do anything even close to resembling a precision piece. It took a while for me to get the feel of how the thing worked.

The right side went faster. I got that one on the second try. I finally learned how not to crack the pieces at the drilled hole. I had to make slighter bends and work the pieces into the bends a little at a time. Usually only two bends per flange to get the job done. The hard part there was making sure the part got back in the break in just the right position.

Looks simple enough, doesn't it?! NOT FOR ME IT WASN'T!!!! :-)

The sides weren't any easier. I made a cardboard template, then cut one in .032. I made so many arm rest tops, I was running out of .025, yet I still have scads of .032 and .040. So I figured I'd make it stiffer and stronger by using the .032 and save my remaining .025 for something else. I'm sure Wicks will hear from me again before my F1 is finished.

I was trying to get the front edge of the arm rest side cover flush with the trapezoid bulkhead cover. It'll all be covered with upholstery cloth, so it doesn't have to look perfect. But I was trying for a flush butt joint. I left the part about 5/8 too long at the bottom so I could make flanges for the floor attach. I had to bend these first in order to get the part fitted in the ship better. After that, again I drilled a release hole in the .032 at the base where I would bend the side panel to turn it back outboard.. I cut a "V" out of it and filed it smooth. Over to the break, and OOPS, it won't fit. This bend is the reverse of the flange on the arm rest. So I had to go back and cut about a half inch on either side of the release hole I drilled. That notch allowed the part to fit over the female die on the break with the flanges pointing down. The flanges had to fit around the female receptacle part where the fingers of the break plunge into the metal and make the bend.

The .032 side panel was pretty close to fitting. I cut a few small slices off the aft end to get it in place better, then I had to use the scotchbrite wheel to tweak the forward edge to go around the gusset at the floor/bulkhead.

This was all getting hard to fit because I didn't have anything clekoed down. So I took the trapezoid pieces and the arm rests to the bench, marked a line 3/8 from the edge (for the longerons and

bulkheads), measured what I thought might be good layouts for attach holes and drilled them with a #40 bit. Then I took them over to the ship and match drilled them to place. Clip in a bunch of silver clekos and now I have something work with!

Next I have to decide how to assemble the arm rest and it's side panel. The trapezoid panel is easy. I'll use #6 or #8 screws and nutplates there. The arm rests are another story. Randy Pflanzer riveted his arm rest top to the longeron, then made the side panel removable with screws along the top and bottom of the side panel.

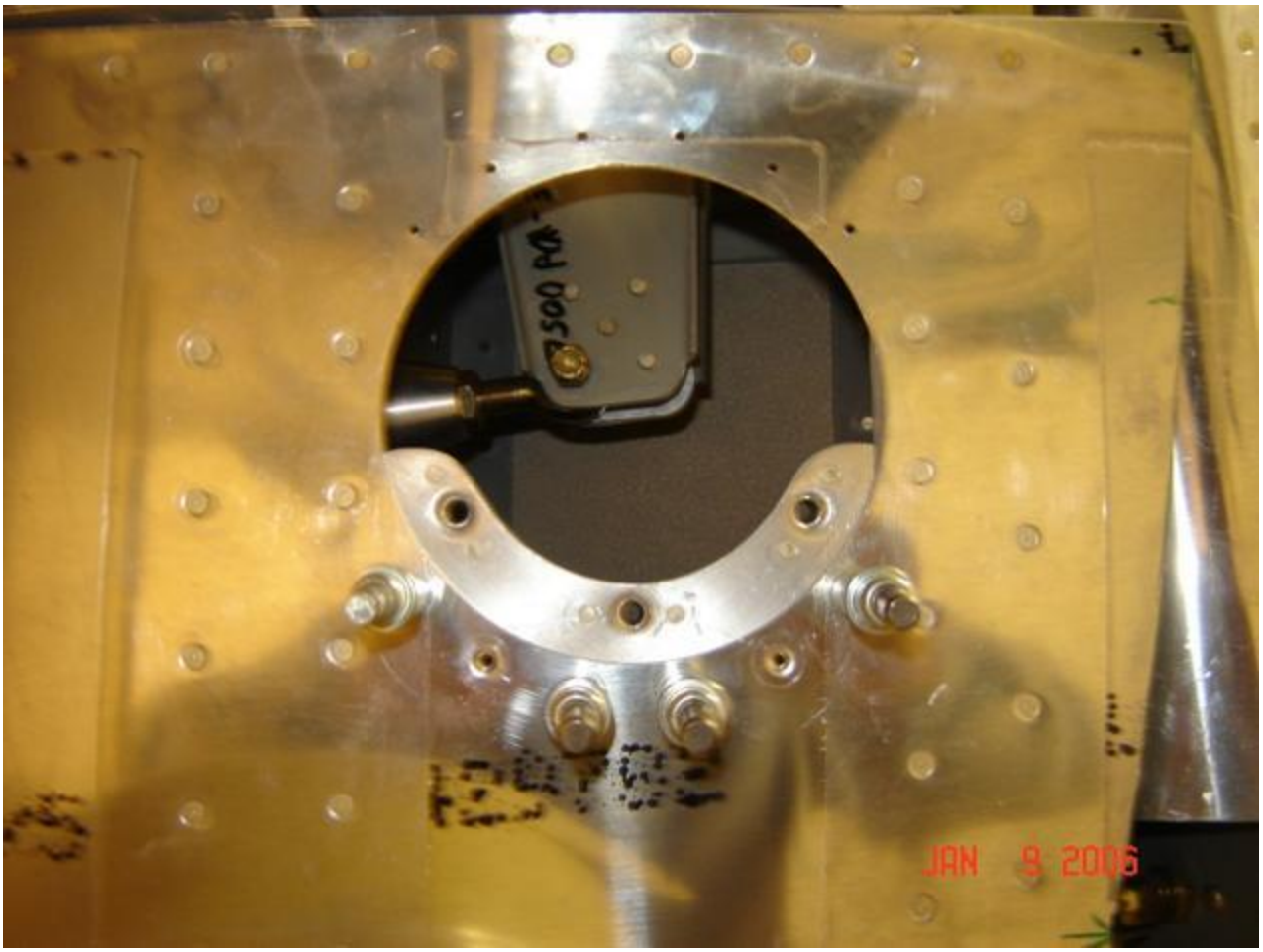
It seems that it would be tough to have screws hidden on the face of the arm rest side covers and keep them from snagging or getting in the way. Then again, if you put the screws on top of the arm rest, you'd have to make the arm rest pad removable and those screws at the back might be tough to get to. And of course it would be good to make the screws flush, although you could recess the bottom of the pad around them, too.That's what I'm leaning towards today. Perhaps it's 6 of one, half dozen of the other on screw and rivet arrangement.

I think the whole thing would be sturdier if I riveted along the side of the arm rest at the top of the side cover, then just screw the thing down along the top and along the floor. I think the side cover is kind of flimsy at the forward edge where it mates to the trap panel. I'm going to take one of the scrap arm rests that I botched and chop in up to make an angle brace and mount it along the rear most of the three bulkheads to support that edge. The aft end of the panel really shouldn't see any abuse, and the motor is in the way, so no stiffeners back there, although I had thought about running one stiffener parallel to the motor travel to support the side panel a bit. Perhaps that would keep down the dents from clumsy passengers as well as reduce oil canning. When the motor/armature/seat belt

shackle problem is solved, then I'll see about beefing up the side panels.

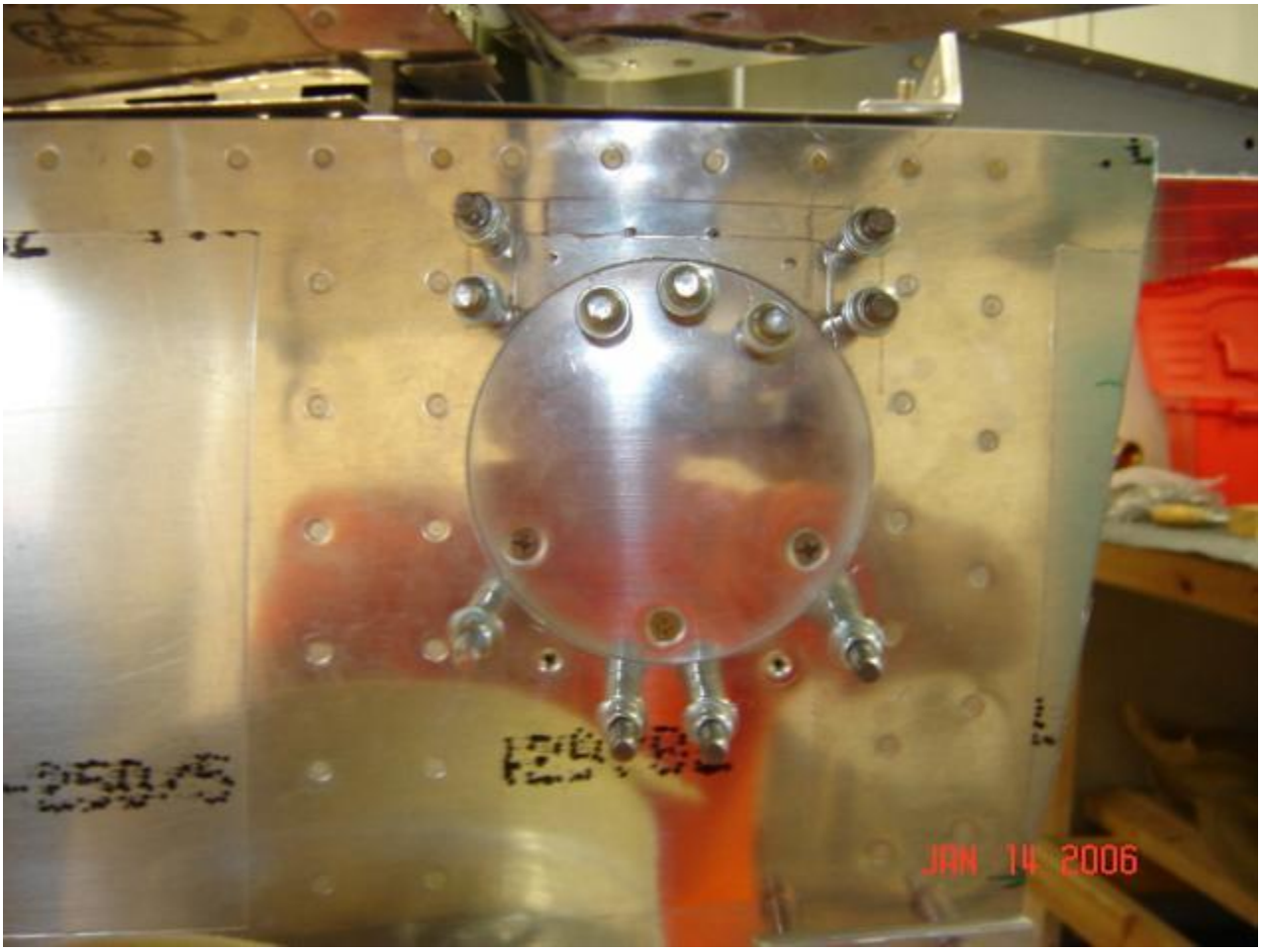
Aft Inspection Panel

Under the HS at the tail, there is an inspection hole for which you make a cover. There are parts supplied and everything here is punched. Normally that's a good thing but in this case, it's too bad. Had I had a choice, I would have left the empennage unpunched because I don't want to put the inspection plate on per plans. The hole gets WAY too small to work in there if you add both of the plate attach doublers behind there. So what I think I want to do is put ONE attach doubler in there, then add a tongue to the plate that kind of lock the plate in behind the fuse skin. It's not an original idea at all. However, what I am trying to decide right now is whether to put the single attach doubler on top of the hole, or on the bottom. Back in the emp, to get access to the elevator horns, you need to get UNDER the horns and behind them. SO it would make sense to put the attach plate at the top off the access. Regrettably, I figured this inversion out AFTER I drilled and dimpled the parts. Had I thought about it more, I would have used NAS rivets on the bottom to close the punched holes. Not that big a deal, now I'll have to use #3 rivets. But if I used the NAS rivets, it would have been easier to make a tongue for the inspection plated to go around the butts of the rivets inside the ship skin. Too bad.



Note the pre punch holes still virgin at the top of the hole. And since the horns come down from above, you have to choose whether you want it easy to inspect or easy to get your hand in there. I'm leaning toward the latter.

The 6 pre punched holes at the top of the inspection hole needed filled. I decided to use two of the holes to rivet the slot for the plate "tongue". I also drilled two additional holes. Since the plates are pre punched, too, I made a new one out of .032. Then I made the tongue out of .040. Actually, after bending the "receptacle" for the "tongue", I just used the material that snugged in between the slot bracket clekoed to the skin. KISS.



I riveted the tongue and brackets up with AD3-4 rivets. To fill the 4 remaining pre punch holes in the skins, I'll use those tiny 3-3 NAS rivets.