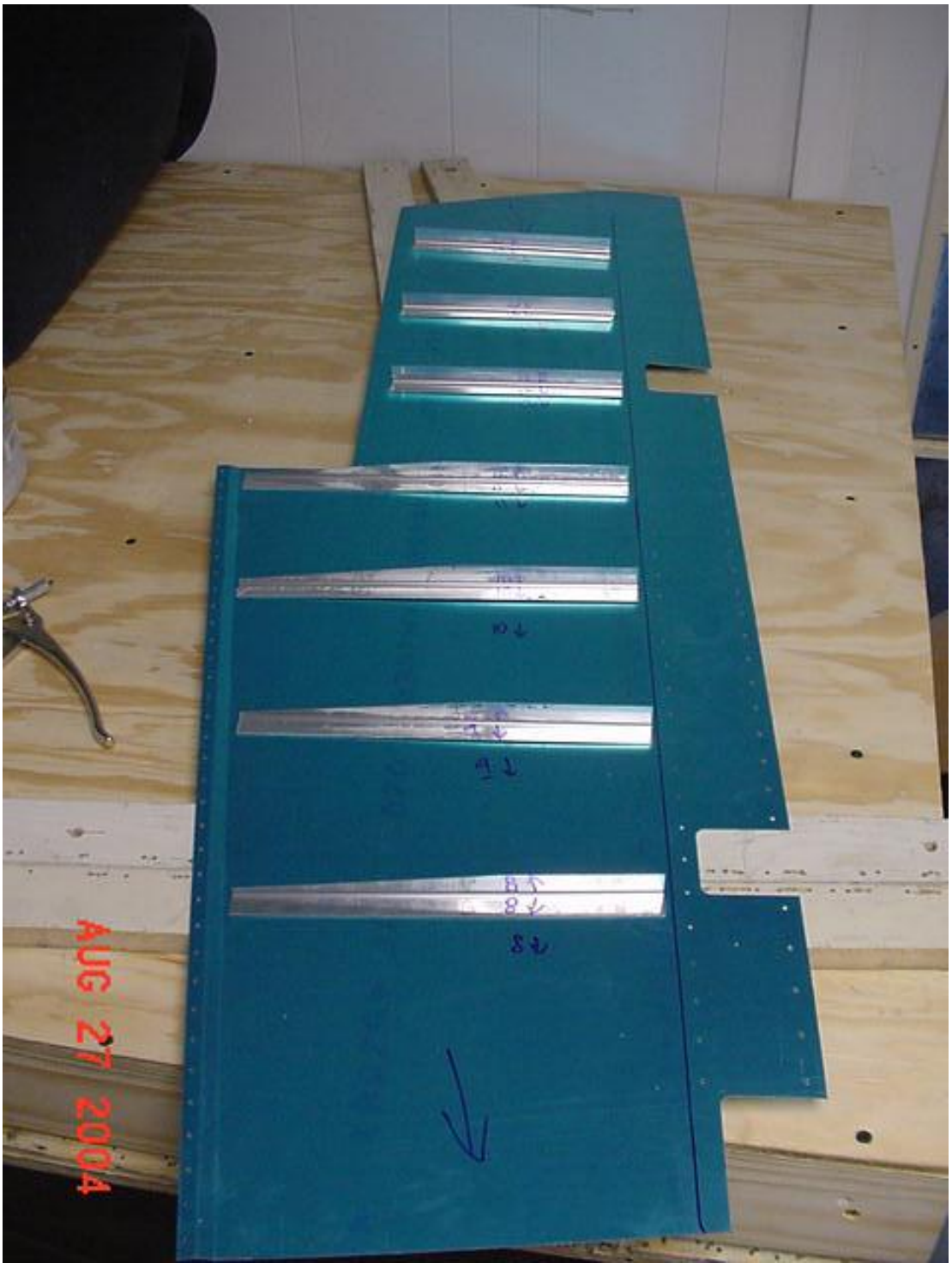
Skin Stiffeners

While the HS was near completion, I had already started the Rudder. The Elevators are constructed nearly the same way as the rudder, at least as far as the skin stiffeners are concerned. I determined that I could do a batch of skins and stiffeners at the same time, so now I'll begin the Elevators.

The formed aluminum angles for the stiffeners on the e's are precut to length. The outer stiffs are the same length on L and R, but the L elevator has the trim panel that goes in it. The stiffeners that go next to that piece in the e are all the same length and are not tapered. There are 6 of these, 3 per side.

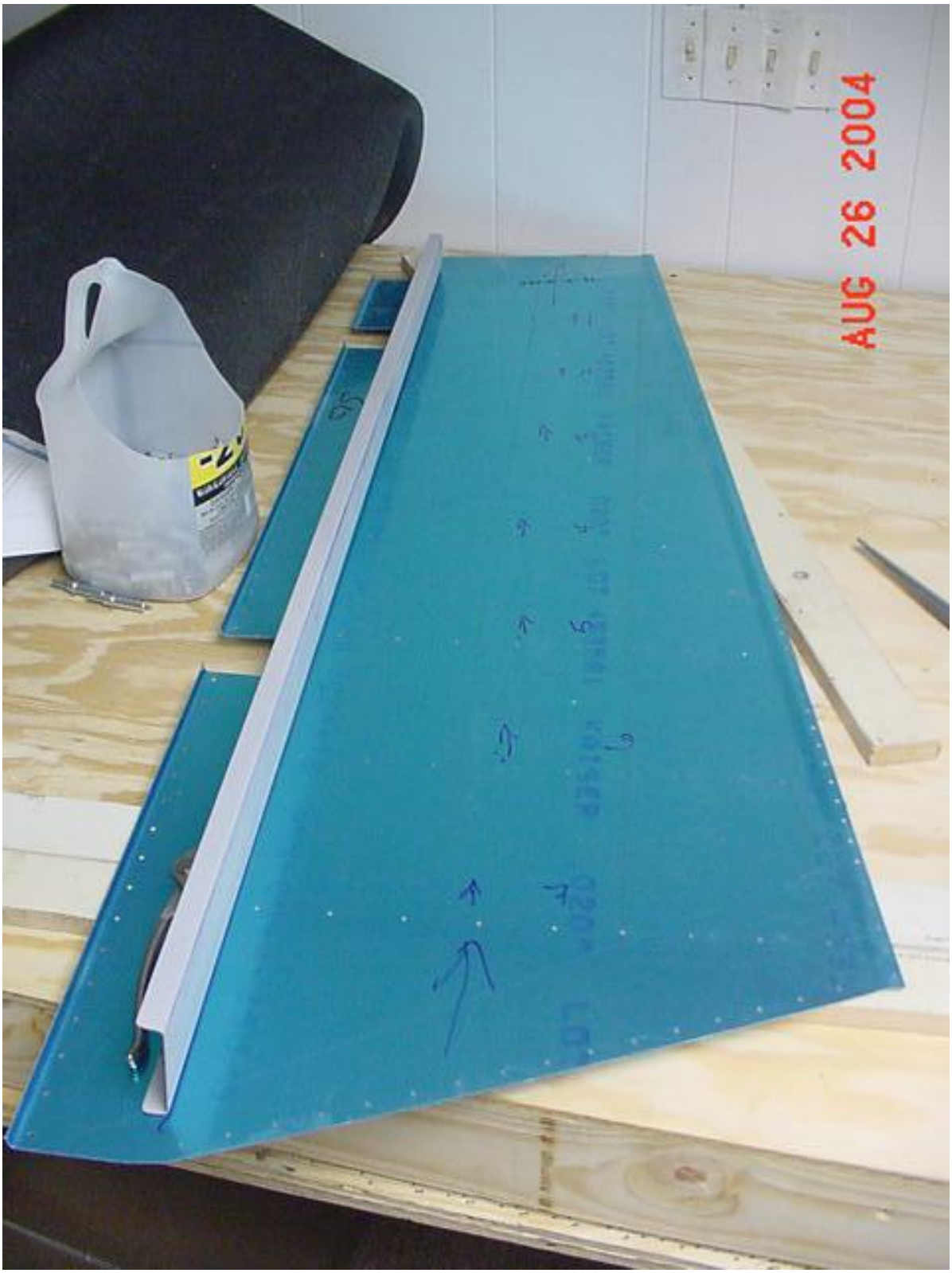


***Note: The plans do not say, but Mark F. confirmed that the taper on the stiffeners is to 1/8" at the doubler/trailing edge end, and is cut back 6 inches toward the spar.

The layout is pretty much the same as the Rudder, in that you want to keep the ends of the stiffs 1/8 from any joggle or the spar. So you cleko on the spar and mark the line. Then lay out the stiffs. When you drill the stiffs, I assumed that you cross mark the first hole for alignment, as well as use 5/16 from the flange for the drill point along the face of the stiffener.

My little 3-in-1 shear, bending, rolling machine has come in quite handy. I use that to taper the stiffeners and bevel the spar end just for good measure. The 3-in-1 cuts beautifully, with no need to sand or smooth the edges (unless you just WANT to!).

On the down side, I must admit that I wish I had a 48 inch break instead of a 36. Trimming the aft end of the VF and HS skins would require two passes on each due to the fact that they are about 48 inches wide. I chose not to do 2 passes or cut them by hand. It's nice to have friends with access to "industrial" tools!

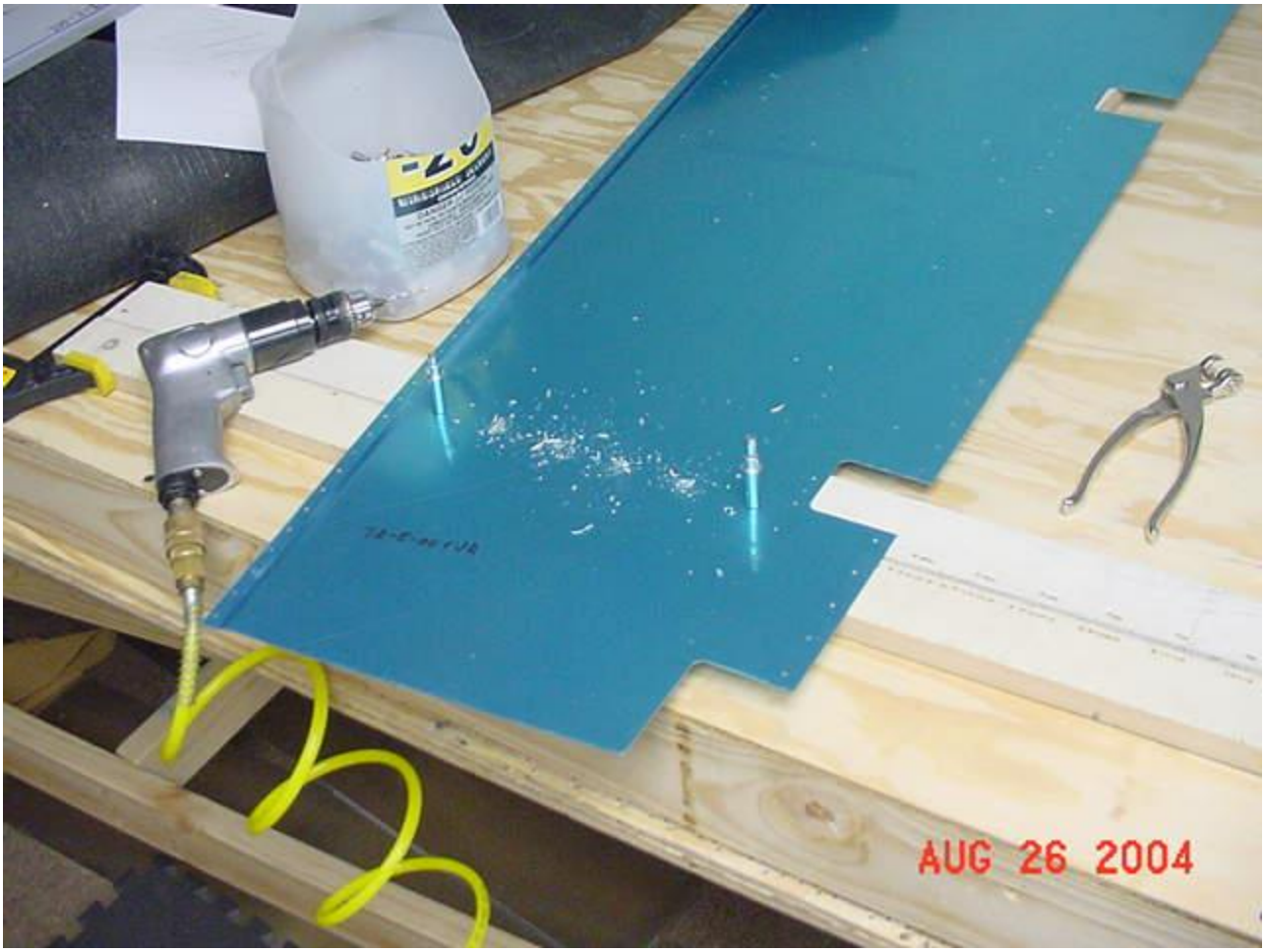


The Elevator skins have to be stiffened. They are just too flimsy. So the idea is to use formed .025 angle and cut it to length and taper each piece so that they fit the taper toward the trailing edge. You need a bit of clearance at either end of the stiffeners, so the plans tell you to leave upwards of 1/8 inch from the stiff to the spar or the joggle in the trailing edge. You have to put the spar on and line it up in position, then draw a line on the skin to locate where the spar interference could begin. I marked a big fat line along the spar, then removed the spar until later.

Notice in the pic above a barely visible green line has been drawn across the stiffener. At the spar end of the stiffener, you'll note a red cross mark. That spots the first hole at the spar end of the stiffener. You place the cross mark in conjunction with the hole in order to maintain interference clearance between the end of the stiffs and the joggle and spar. When you're actually attaching these stiffs to the skin, you can't see them. So you have to mark them along the rivet line and a cross mark at the first hole. Rather ingenious little trick. My hat goes off to all the guys and gals who have come up with handy little processes like this!

Notice above how you set the stiffener in between two boards in order to back-drill through the outside of the pre-punched skin.

The same Rudder skin drilling technique is used. Put the angle/stiffeners down in the slot between two adjacent boards, and use some other boards to support these flimsy .020 skins. They kink easily, so extreme care is necessary to keep them looking good. Align the stiffs under the pre-drilled elevator skin holes and drill to #40.



You can't see it in this pick, but the angle/stiffener is under the skin between the two boards. You spot the red mark on the green line and drill, then cleko, the first hole. Then rotate the skin until you see the green line in all the other stiffener holes and drill the trailing edge end. On the shorter stiffeners I didn't bother to cleko any other holes, just each end, prior to drilling.

While doing this procedure, all you have to do is make sure the tapered end is cut at the trailing edge end of the stiffener. Then when marking the red mark, make sure you are marking the "blunt" end of the stiffener to the spar side of the elevator skin. When you assemble the two skin sides, amazingly, the stiffeners should "automatically" box themselves together so that you get stiffener resting (if they are that close) on the opposing stiffener, not the opposing skin. If you measured the initial green drill/rivet lines properly, this should all line up for a nice sturdy component.

BABY, are these skins thin! The elevators are easier than the rudder to handle, but care has to be exerted to keep those skins from bending.

**TIP: If you want to get a really pretty skin on your F1 (or any riveted surface), I highly recommend that once you get the skin drilled and clekoed in place that you GLUE or BOND the skins down just prior to riveting. Pick the side you want the prettiest and glue that side to the skeleton and cleko it for about 24 hours. On a side that you may need to leave open until very last, you can still glue it prior to assembly and get a better than average looking surface. Just wax or use releasing agent on the mating surface of the skin and glue it down. The next morning, just remove the clekos and pop the skin free. When you go back to rivet it down, you will still get a better surface than if you just bang

rivets in bare metal parts. I'm kind of heavy handed and it shows. I have puckers and deformations that aren't particularly pretty. I wish I would have done this trick from the start. In the case of the elevators, one side is definitely the bottom. that makes it easy to choose the pretty side. Glue down those stiffeners and the spars on the top skin prior to riveting. You'll thank me later on, believe me. It sure makes a pretty and smooth result.

After I D&D the skins, I'll back-rivet the stiffeners on, and proceed with assembly of the spars and other components.

I bought a new type deburring tool that works very well. It's essentially a replacement for a drill bit. I had one of those nifty deburring tools that fits in an electric screwdriver. The hole in the bit chews off around the hole very nicely. Unfortunately I ruined it using it on stainless. So I had been twisting bits in my fingers for a while. I saw these new type tools at OSH for $7, so I figured I'd give them a try. It works for me! They fit in the electric screwdriver just like my original, and work pretty nicely. On occasion, I also use the swirling deburring tool that goes through the hole and chews more from the backside. I tend to gouge using that, though. It takes a while to get that technique down, and I find the power tools less technique sensitive.

Back-riveting the stiffeners was a fun job. I have a huge backplate and believe me, that makes this job much more fun.

I finally figured out a couple things:
1.) the nylon cap on the end of the back-rivet set is a great finger hold, not just a "squaring" device. The rivet line on the stiffeners is very close to the bend, and the backset will tend to scoot while hammering. Of course this folds over the shop head of the rivets. Soon as I started fixing the end over the rivet with a finger on either side, I started wanging entire rows of rivets without looking back!
2.) my back-rivet set does not work properly in my 4x gun. Yes, the one I sent back to the factory for repair. Turns out the gun is fine (other sets work OK), but my backset is a hair short and/or the collar is too thick. So the set doesn't spring back and knock the piston back. Rats! Fortunately, My friend Bruce brought over his 3x gun and it worked beautifully. I would use my 2x, but it is kinda buzzy... which means it tends to skate in use. Fewer, harder hits seem to do a better job.

Elevator Spars

I got back to work on the elevators after completing assy of the main bodies of the rudder and the HS. Both are out of the jig and getting closer to being finished. I'm going to roll the hinge side of the skins all three control surfaces at the same time so I can use the same process and materials in one "batch".

I gathered the pieces for the right elevator and then decided to work on both at the same time... again. I matched and drilled the doublers to the elevator spars. I measured for rivets, matched and drilled the counterbalance ribs to the elevator tip ribs. These processes were easy to do in a batch. I hand squeezed the doublers/spar/nutplates and bucked the counterbalance/rib.

I went ahead and threaded the rod ends in the spars and test fit them to the HS. COOL, it FITS!

A great little piece of engineering saved my butt. My center bearing on my HS ended up being off to

one side about 1/8". I was having kittens over this one. Then I read the plans and found out that you take the elevator spars and attach them to the hinges. Then you bolt the elevator weldments to the bearing. That process allows to you have some built in fudging, and it's a good thing, because I needed some adjustability here! I clamped the weldments (elevator horns?) to the spars, unbolted everything and went directly to the #30 drill bit. Those babies fit like a glove and after D&D, they are ready to attach!

This was the end of the Labor Day weekend '04. I still had time for a big motorcycle ride and even found time to have a few beers. It was a nice long weekend, and I got lots of building done around the festivities. Now it's back to the dull routine. And I have to find the time to build those wooden elevator fixtures!

I went ahead and rough cut the counterbalance notches in the Elevator skins. That was a waste of time and a couple dremel cut off wheels. Turns out that after I added a bracket and clekoed the counterbalance to the elevator spar, the notch was still too "shallow". Had I to do it over, I probably would just wait until I could attach the spar-c/b assy and then mark and cut it REAL close the first time.

After I re-checked the fit of both E spars with the c/b attached, I marked the E skins for notching, but decided to hold off on cutting them out. I'm real close to skinning the E skeletons, so I figured I should just wait to make sure everything fits up at the same dimensions.

Last night I ceremoniously disassembled my HS jig and got it out of the way. That took a while. Now I seem to have tons of room. I'm contemplating moving the fuselage from my garage into the basement. I'd have better lighting and more room. Better heating and cooling, too. Just don't know if I

want to negotiate my fence bringing the fuselage around the back of the house and through the French doors. No matter what I do, I can't get the tail through ANY of my doors, so I'll have to disassemble the empennage anyway. (Turns out that the fuse fit through a standard fence gate just fine!)

The other consideration is whether or not I want to mount an engine in my walk out basement. Leaving that thing mounted and trying to get the plane out and onto a truck would be a real job. It would be another disassembly job prior to transporting to the airport. Well, I have a few months to worry about that.

After clearing out some working room, and hiding the HS under my work table, I got out all of the elevator skins and the trailing edge doublers. I went ahead and clamped them and drilled them per plans. This is pretty brainless. You just have to make sure everything is flat and straight. I used lots of clamps.

The sad thing is that I can't drill a straight line for the life of me. Even with pre-punched holes in the skins, the row looks a little catywompus after I get through with it!

I left the clekos in the trailing edges and set all 3 assemblies aside. Now I have to finish the fixtures and get ready to skin the elevators.

Another thing I did was cut the tooling tabs off of the E ribs and trial fit them. I think the thing to do there is not drill them until they are inside the skins. In other words let the E skin, based on the position of the E spar, determine where the ribs are drilled in the skins. Of course alignment will be aided by drawing a centerline on the flanges of all the skeleton parts.

OK, the center bearing on my HS was a smidgen off center, As Mark Frederick likes to say: One change begets 30 others! Well in this case maybe not 30, but I thought I was in a heap of trouble!

The Elevator spars have the rod end locations preset and pre-punched. So that dimension is fixed. I have the center bearing slightly off center, but fortunately that can be adjusted by drilling the weldment that bolts to the center bearing slightly offset in regards to the elevator spar. So you have these two elevator skeletons that are slightly offset. One is slightly long at the spar and one is slightly short.

I was getting the ribs, spars and skins ready to put in the wood fixtures and drill. I decided to check everything on the bench before final drilling. What I found was that due to the center bearing being offset, I could not get the root rib of the right elevator to center up with the pre-punched holes on the skin! CRAP!

Well, it turns out that I was wrong. I was having problems with the root rib lining up with the skin holes and it had nothing to do with the offset bearing. It was the weldment. Two things were wrong. One, there was a big goober of weld in the inner angle of the weldment where the rib sits/attaches. Two, the angle of the flange bent into the weldment from the factory was off.

I hand re-bent the weldment, filed out and smoothed the poor quality weld and everything aligned beautifully.

Right Elevator

The wooden block fixtures for the elevator were easy to make per plans. I used my scrap 8 inch particle board shelving again. I removed the rudder boards from my beam and used the end set of brackets in place. I measured out 38 inches on center and screwed down the second board and verified the dimensions. I had some shelving angles laying around, and screwed everything down to my laminated beam.

I dropped the skin and skeleton in the fixture and found it a bit loose. I also scuffed the rudder when I was working with it in the fixture. To alleviate both problems I put an equal amount of DUCT TAPE on all upper corners. That cut down the scuffing and snugged up the skins.

I put the trial fit R elevator assembly on the bench and measured the counterbalance skins for rivet drilling. I made sure all the flange centerlines were visible through the pre-punched holes and made sure all the parts were properly aligned per plans. I then drilled using a #40 bit, clekoing as I went along.

I put the assy back in the fixture, double checked the dimensions and drilled the root rib to the spar weldment. The next thing to do is drill the entire skin to the skeleton. Then I need to D&D everything, rivet the skeleton parts using #4 rivets, then put everything back in the fixture and rivet the skins using #3 rivets.

I unclekoed the R elevator and removed all of the parts from the fixture. I D&D'd the bare parts, scotchbrited them and used a self etching primer on them. I filed the edges of the skins.

I woke up a tad early today, so I decided to go ahead and D&D the R elevator skins. I started using my cordless screwdriver deburring tool, but decided on these massive flat arrays of holes its just faster and easier to use a drill bit with some duct tape wrapped around it and twisting it with my fingers. I then used the trusty C frame to dimple the skins. I used the same mallet, choked up on it a bit and used about 1/2 force on the blows. It's kinda hard to ease up when walloping these things. But you have to, otherwise it's VERY easy to distort the sheet metal. Use about half the force you think you need. Around the perimeter, you might even be better off using a squeezer.

Took me about 30 minutes and a cup of coffee to get this part done before I left for work. You can sneak these little jobs in at opportune times, and if you keep whittling away, eventually you CAN get one of these planes finished. Just gotta keep plugging away, little by little!

The Elevators are like the rudder in that you have to rivet the counterbalance (c/b) skins to the elevator skins prior to dropping the assembly in the fixture. There is a row of rivets below the counterbalance rib that is not accessible to buck when the assy is together. So you have to "unfold" the counterbalance skin and back rivet it to each side of the elevator skin with all three pieces folded out all over the bench top. A little cumbersome, certainly not impossible.

After back riveting both skins to the c/b skin on the table top, I set the skins in the fixture. I went ahead and riveted the R elevator spar to the c/b rib and home made bracket. I set the skeleton inside the skins in the fixture and clekoed the perimeter in every 3rd hole.

I started riveting at the 4 rivets on the leading edge of the c/b and worked back to the trailing edge. I used my Main Squeeze and the thin nosed yoke at the apex of the trailing edge. It was hard to get in there because of the flare of the outer edge of the elevator, but I was just barely able to get these rivets set.

I then quick changed to my 2.5 inch reach yoke and started setting the rivets along the elevator spar, beginning in the center. Then at the root rib I riveted from the spar to the trailing edge.

The trailing edge doubler is best riveted on the bench. Instead of alternating the rivets like in the rudder, I determined which surface was the top and set the manufactured rivet head on top. I used two cup sets so that the shop head would be slightly rounded. This works well on the elevators, but not so well on the rudder.

During this process I clekoed every other hole and checked the trailing edge repeatedly with a straight edge - my 4 foot metal ruler. Earlier, I drilled the holes and clekoed every hole as I went along, always making sure the edge was straight. As I riveted, the trailing edge wanted to bow, and got to the point where I thought for sure it would stay that way. I stopped and tried to coax the edge straight, and had some success. But what I found was that after the final run of rivets were set in the elevator trailing edge, the pieces wanted to assume the drilled position. At least *I* assume that *they* assume the drilled position. Anyway, I was happy that the end result was quite straight.

The R elevator went back in the fixture and I stared at it a bit. I have to roll the leading edge of the skins and rivet them together in a curve (where the rod ends bolt/swing on the HS). Plans say to us duct tape or cleko a 1" pipe to the skins and roll them until the pre-punched holes line up. I didn't have

any 1" pipe, but I did have 3/4 PVC and copper. I decided that PVC might be too flimsy, so I used the copper.

On the elevator, the weldment that bolts to the HS center bearing gets in the way, so I cut the copper pipe just short of the big weldment flange. That way I could get that skin rolled right down to the center of the spar if necessary. And it was necessary, and worked very well.

I set the pipe up along the edge of the skin and used a #40 bit and drilled a hole at both ends. I clekoed the pipe in place and proceeded to drill every 2nd or 3rd hole thought the pre-punched skin and copper pipe.

One side of the e skin has a 90 degree bend along the edge to give it some rigidity when the rolled edged are attached. The other skin is just a flat straight edge. I rolled the bent side first. I think this was a mistake. Next time I roll an edge, I'm going to start with the straight edge, not the flanged one. It's just easier to manage the metal that way after the first side is already rolled (in your way doing the other side).

I ended up drilling and clekoing every hole. I used two pairs of Visegrips to grab the pipe in the area where the rod ends are screwed into the spar. The rod ends get in the way, so I removed them. I started at the outer edge and only clekoed one of the three segments at a time. That makes it much easier to roll.

The little outer segment was easy to roll and was good practice. I left that area clekoed, then moved to the center segment. That took a lot more coaxing. Then I moved on to the inner segment and worked it all by itself, but left the pipe inside the rolls of the other segments.

Every hole on the flat skin side has to be clekoed. the skin would buckle and bow if they weren't completely attached. It was a bear to roll the second skin, mostly because the first side (flanged) really gets in the way. I finally used my bare hands and rolled the flanged side out of the way so I could really get in there and roll the flat side all the way to the spar.

After rolling the skins most of the way, the holes still did not line up. I removed all the clekos and massaged the rolls the rest of the way by hand. I had to press the skins together and coax them almost completely down to the spar. Unfortunately that scratched the flanged skin as the holes in the flat skin scraped along the surface. Next time, I'll debur the holes, and maybe tape the underlaying skin to avoid the scratches.

All that's left is to shoot some pop (blind) rivets in the now passively aligned holes and then modify the shape of the rolls when against the HS during mounting.

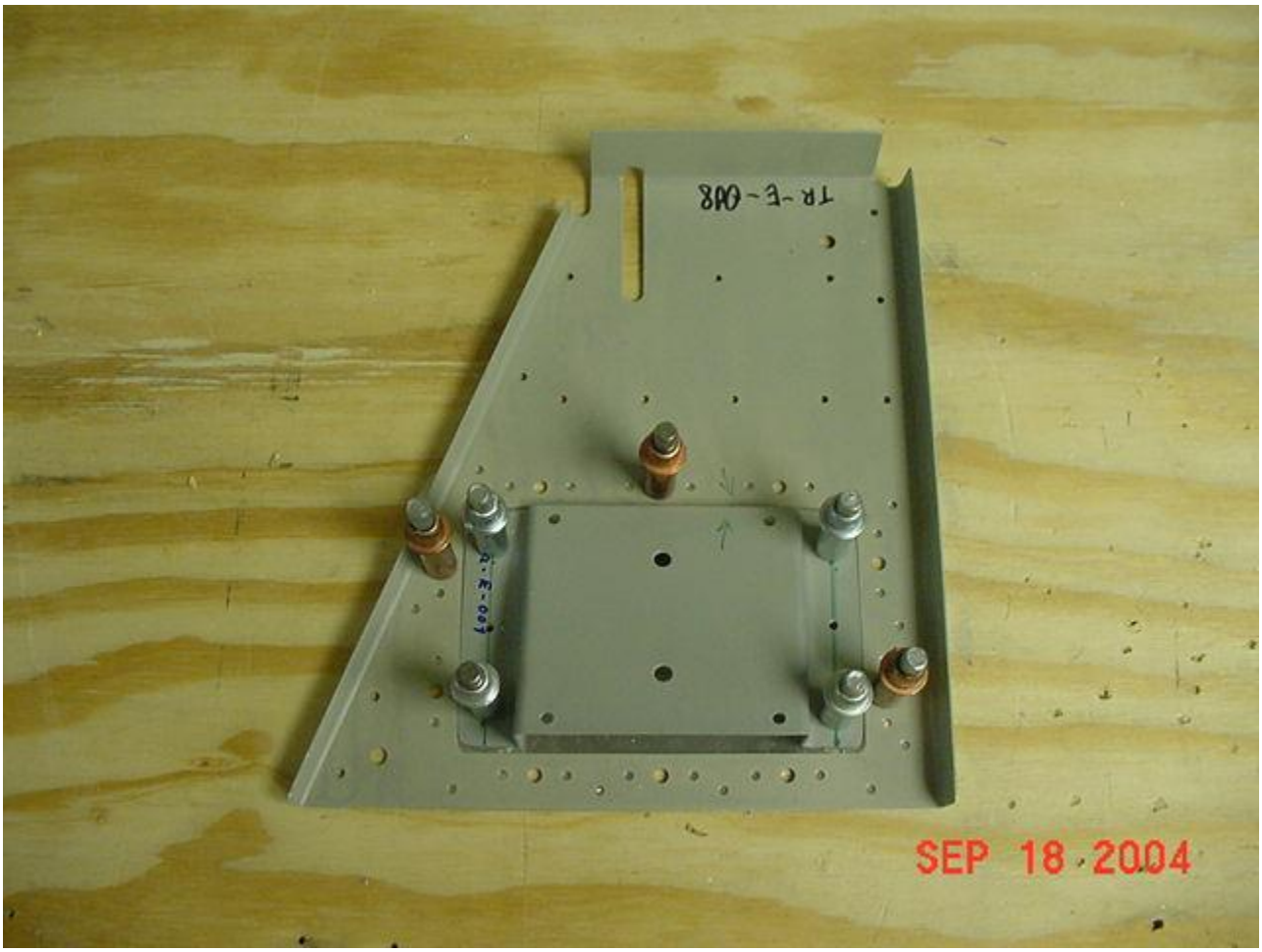
The Right elevator is completed!

The Left Elevator!!!

The plans seem to be missing a few pages or something at this point. All of a sudden we jump to the access panel and doubler for the electric trim. So be it!

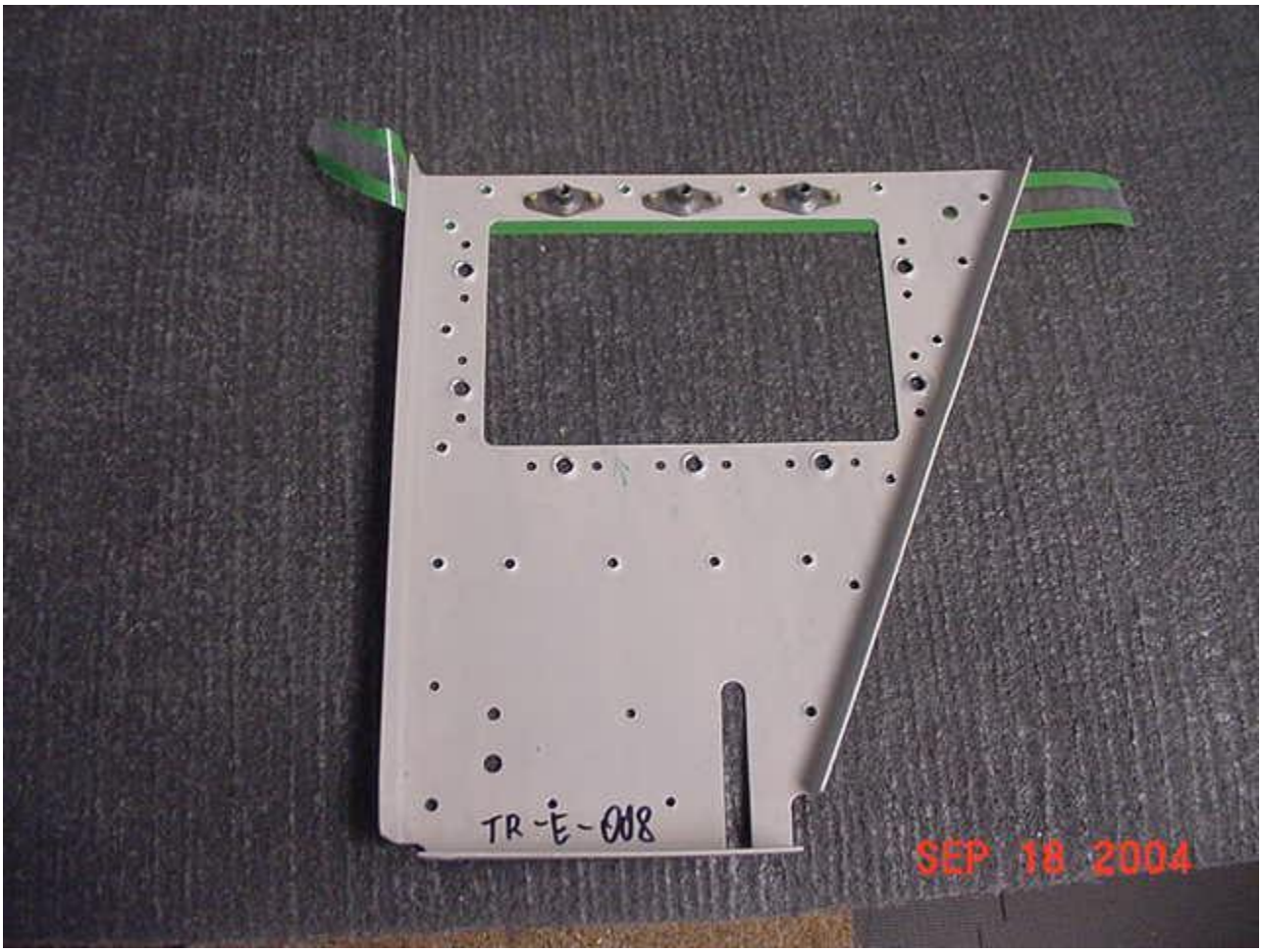
I gathered up the parts for the access panel/ doubler for the bottom skin of the left elevator. I aligned the holes on the doubler that fits inside the skin and drilled it to my table. What's going to happen here is we are going to flush set some nutplates on that puppy and then rivet it to the skin (so that the rivets on the nutplates don't show on the outside.

I set the servo bracket in the opening and drilled it to the table. I then set the access cover under everything and clekoed it to the table. Now I have the bracket on the access cover under the skin and doubler. I drilled the bracket to the access cover and unclekoed everything. I set the cover and bracket aside and concentrated on the doubler.



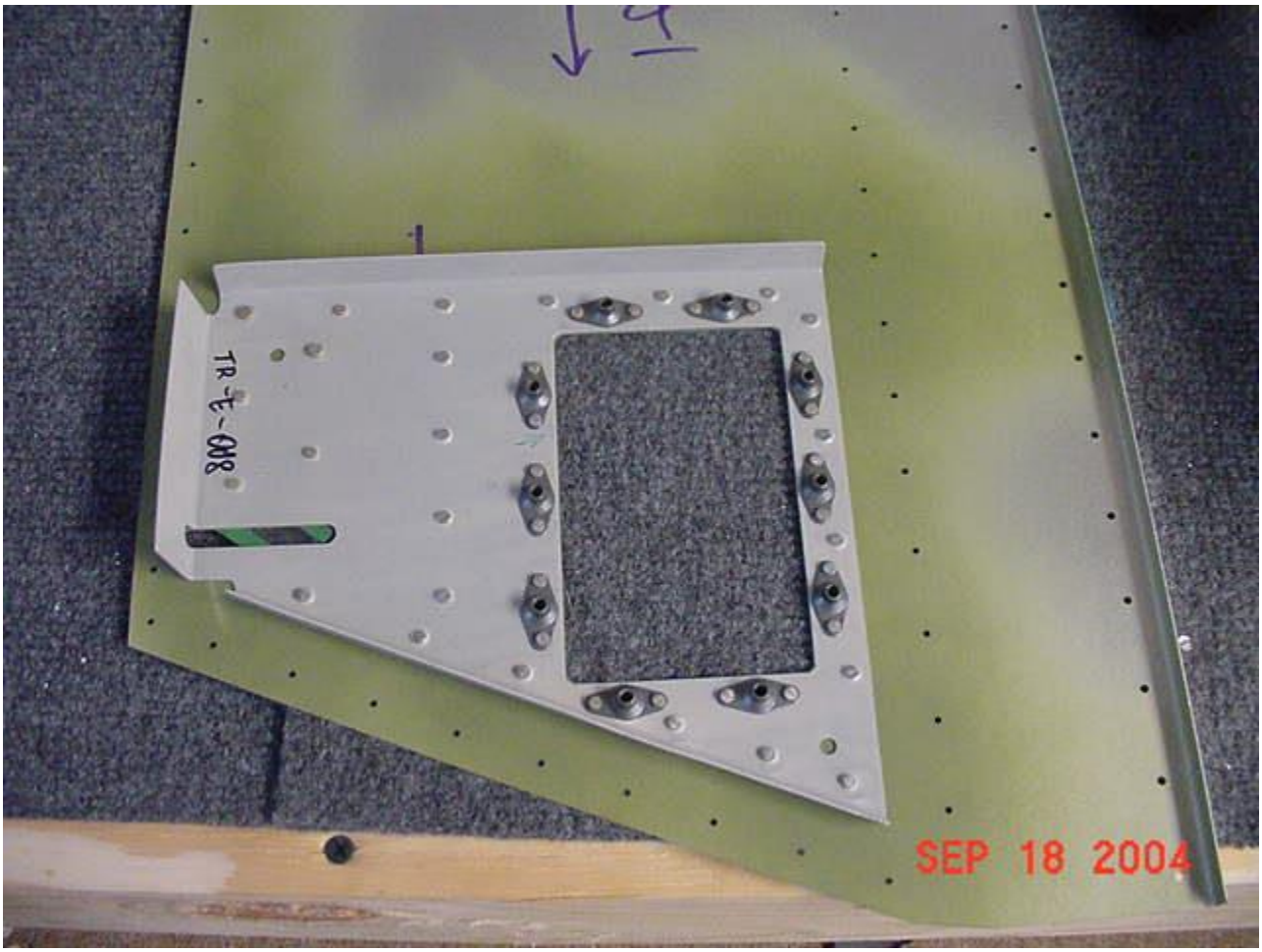
I drilled all of the attach holes on the doubler through the skin. Then I took everything apart and deburred it. I dimpled all the holes in the skin and I tried to dimple the doubler. I ended up countersinking a wee bit in the dimples on the doubler to get the rivets to sit flush. And of course for the nutplates you have to machine countersink the rivet holes.

Dimpling everything prior to riveting on the K1100 nutplates is important. It would be difficult to work around the nutplates with a dimpler. There are MANY holes in these parts and some are VERY close together.



I went ahead and used my Main Squeeze and set the #3 flush rivets to hold down the nutplates. I went ahead and primed the skin where the doubler will attach. Then I clekoed the trim servo doubler to the skin. I hand squeezed all of the attach rivets for the doubler.

I set the bracket and access cover aside. Do not rivet these parts at this time.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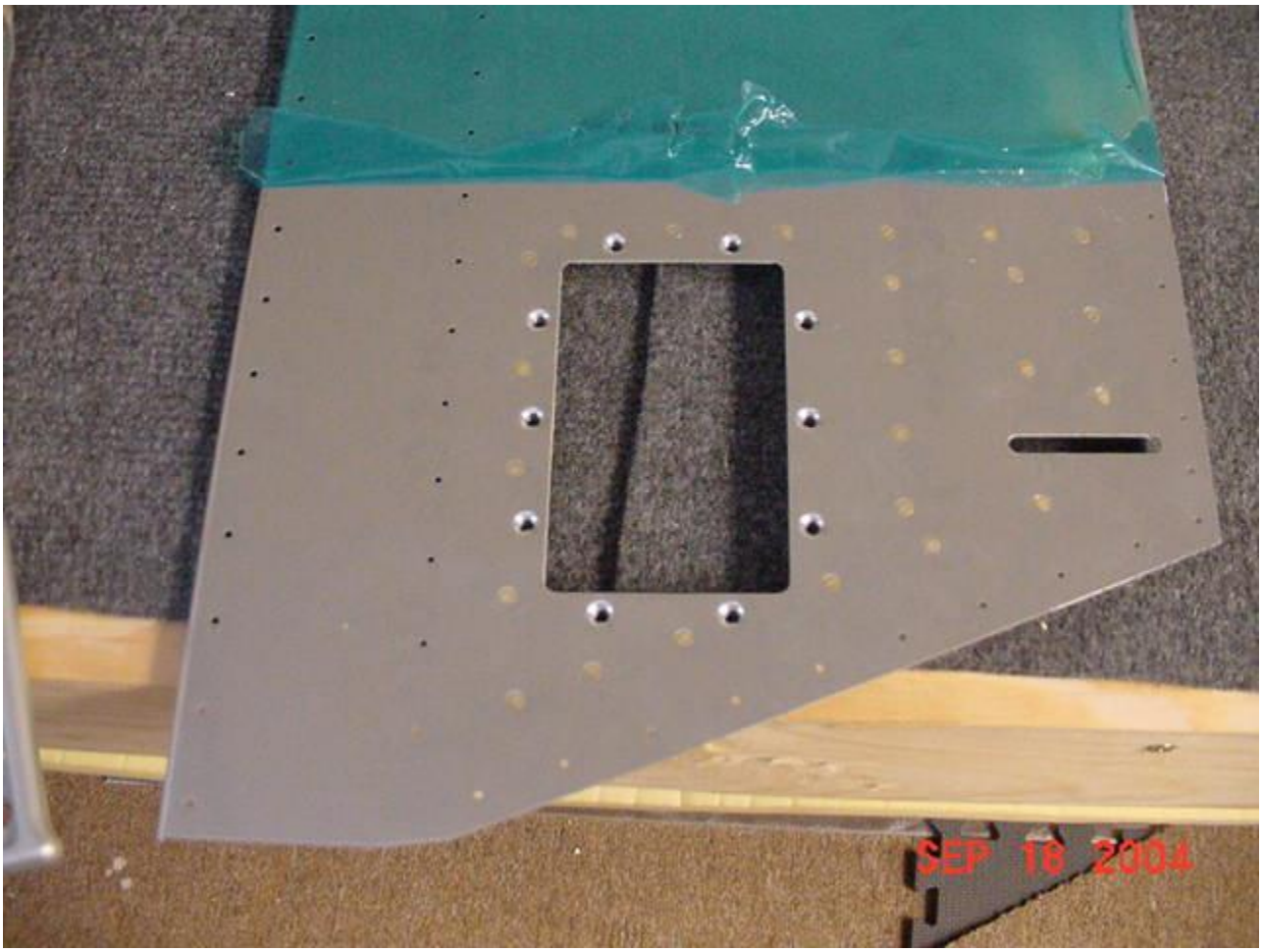


I took the Left elevator spar with the weldment clekoed to it and set it in the skins. I had already set up the counterbalance and the c/b skin, as well as the hand made bracket to hold it to the spar. I already primed the bracket, too.

Wooden fixtures are used again to better hold the parts together while working on them. I made the wood "blocks" and screwed them to my beam.

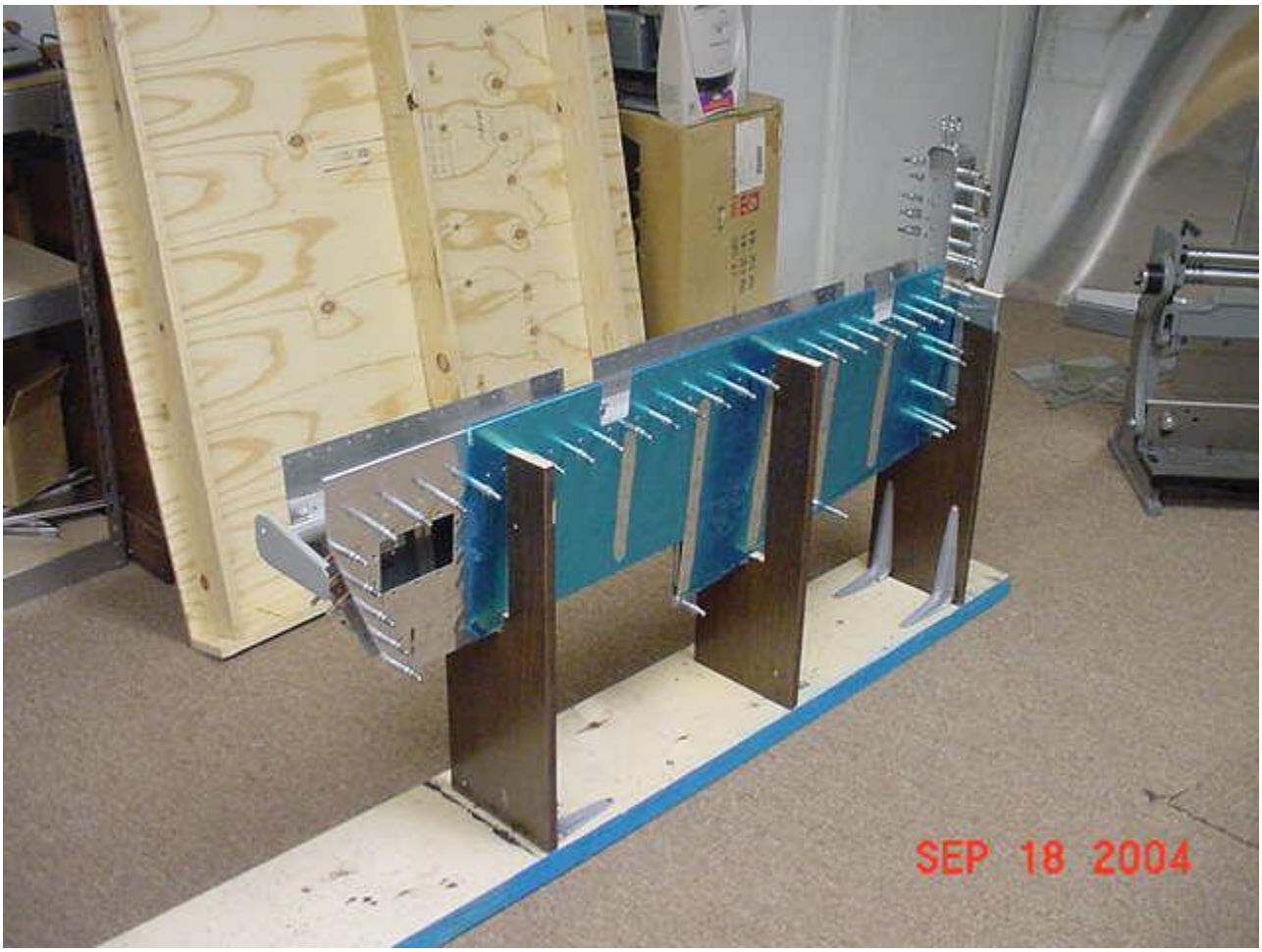
I set the skins and skeleton in the fixture. SWEET! Snug as a bug in a rug!

Getting the counterbalance to set right is a little tough. I would move one area, then of course it moved another area. I used a dozen or so cleko clamps to hold things tight, and it was still a minor battle. But I finally got the skeleton, with centerlines already drawn on the flanges, to sit the way I wanted in the skins. I drilled a few holes to cleko the parts together.

Now, up on the bench again to mark and drill the counterbalance to the skin and skeleton, clekoing as I go along. Then back into the wood fixtures, recheck the alignment of everything and insert the root rib. I drilled it to the weldment @ #30 and clekoed it in position.

At this point the E-006 trim tab/hinge spar is not in place. I worked on it all by itself after the left elevator was completely drilled and clekoed.

PS: I had already drilled the trailing edge doublers for the elevator and trim tab when I was working on the right elevator.



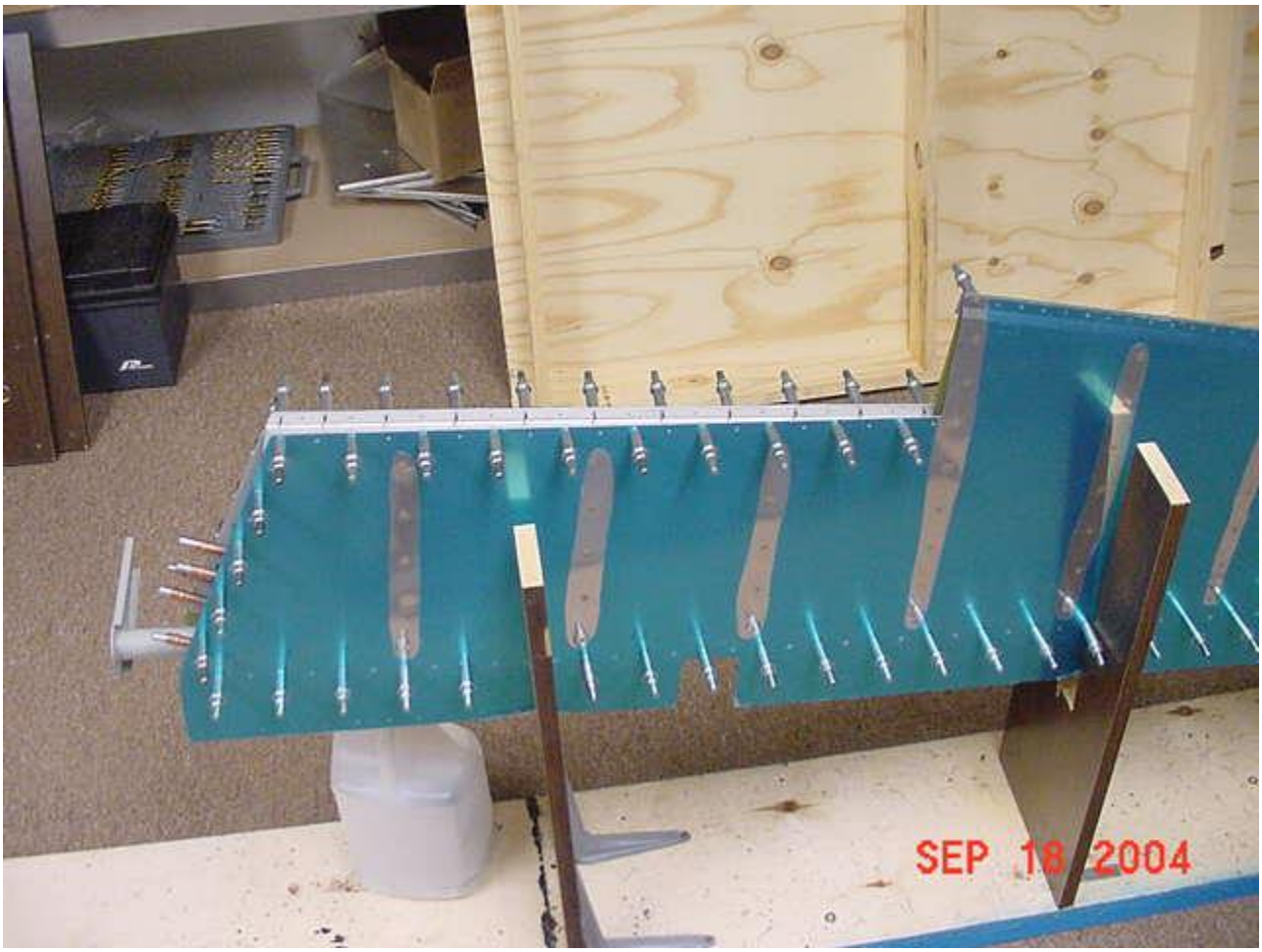
Finally the perimeter of the left elevator was all drilled @ 40 and clekoed. At this point I did things a little differently.

I went ahead and flipped the elevator over in the fixture. It sits there pretty nicely, and it's easier to work on the trim tab/hinge spar.

I set the spar in place and cleko-clamped it in position. I did not draw a centerline here. I merely lined up the ends and edges and clamped it down. I went ahead and drilled and clekoed @#40 on both sides of the spar.

I took the E-006 spar out of the assy and took it to the bench. I got out the appropriate hinge material and rough fit it to the spar and the corresponding area on the elevator.

I used the tack rivets as per plans and tacked the hinge to the spar. Now I took the spar/hinge back to the elevator and clekoed and clamped it back in position. I carefully drilled back through the pre-punched holes in the skin, through the hinge and back through the spar. The first hole was dead nuts on, and all the holes were nearly perfect. Not bad for a blind shot. That's the beauty of lining up the edges (and clekoing the opposing side of the spar).

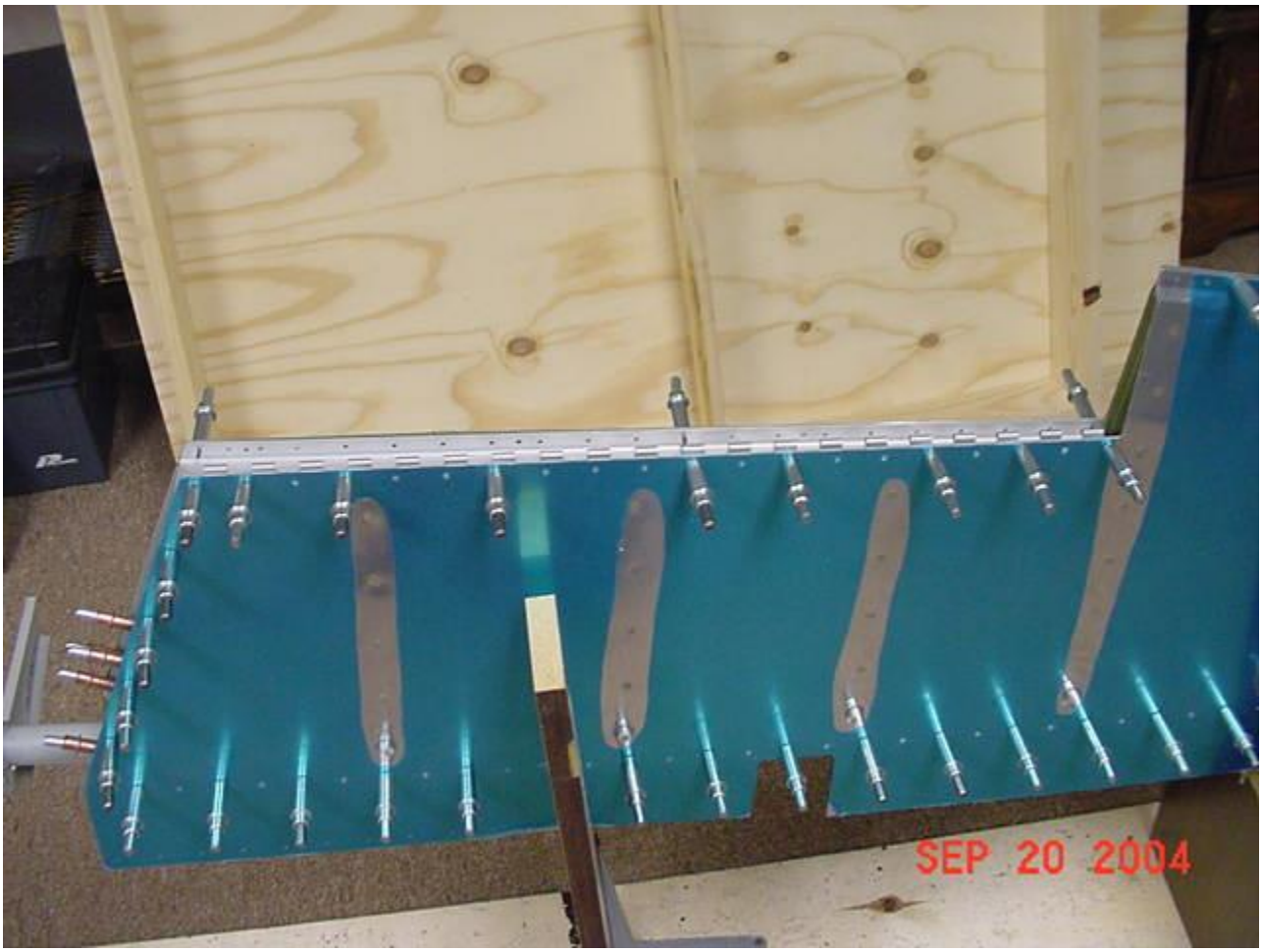


ELEVATOR TRIM TAB

Now that the left elevator is ready to D&D and rivet, I decided to go ahead and construct the trim tab.

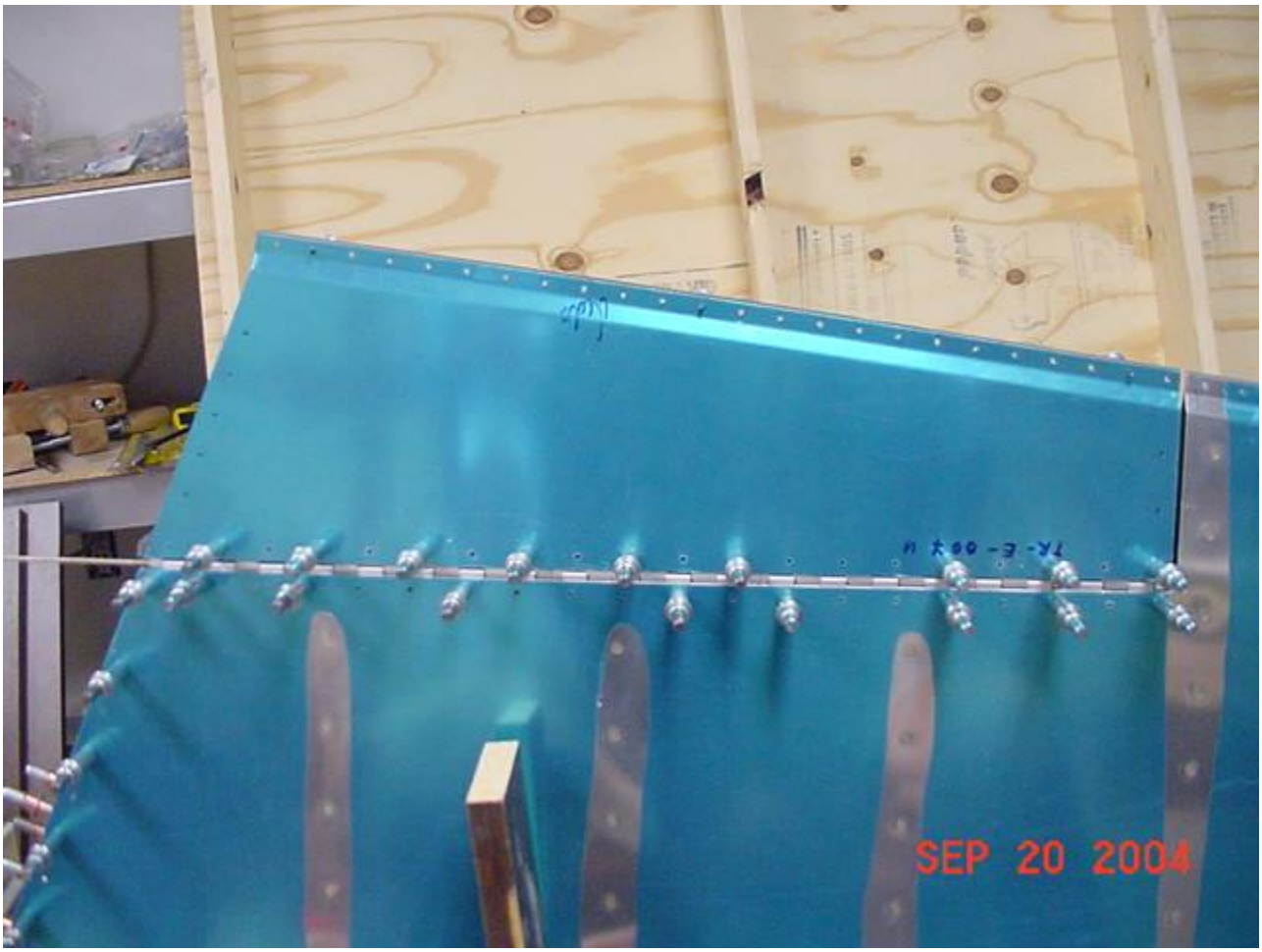
The plans aren't very specific on the location of the hinge, and I ruminated over the location of all of these parts. What I ended up doing is consulting Pflanzer's Pflying Pfactory and got some ideas on how to proceed.

The beauty of the TR F1 parts is that they are engineered so well that they pretty much only go together one way. And if you trial fit everything with clamps, you can get it right, even if there's no details in the plans (or if the pictures are blurry).



After tacking the trim tab hinge to the elevator spar, I cut it to size and smoothed it off. I then pinned the other half of the hinge to the trim tab skins and eyeballed how they would look in place. I determined that the hinge goes on the spar (and the skin) precisely as they look like they should. The round part of the hinge is below the level of the skins and the edge of the spar goes right to the edge of the flat part of the hinge. Easy. Turns out both sides just need to be set so that they look clean and flush.

My 4 foot metal rule came in handy again to line up the trailing edge of the tab with the elevator. I went ahead and clamped it, then pulled the pin and drilled it over on the bench.



The trim tab is actuated by a rod from the servo on the bottom of the elevator. You have to put a bracket consisting of two pieces riveted together and riveted onto the trim tab. Both pieces are supplied and cut very close to shape. I used one existing skin hole and one new hole for the small piece. For the larger actuator bracket I had to drill all new holes that also go through the root rib. You also put one rivet in where the tabs of both brackets mate together.

The Trim tab was fun to assemble. After D&D'ing the entire left elevator parts pile, I clekoed the trim tab components and set various sizes of #3 flush rivets, and one #4 rivet in the actuator arm brace. I set all these rivets by hand with my new Main Squeeze. So far, that thing works VERY nicely. And is more kind to my delicate hands/fingers. And the quick change feature using pneumatic type yokes is great. Anyone want to buy my Tatco squeezer?

The left elevator main body is riveted like the other control surfaces. There is an area of rivets that is not accessible after you close the skins over the skeleton. Therefore you have to rivet a partial row of rivets on each skin to the counterbalance skin.

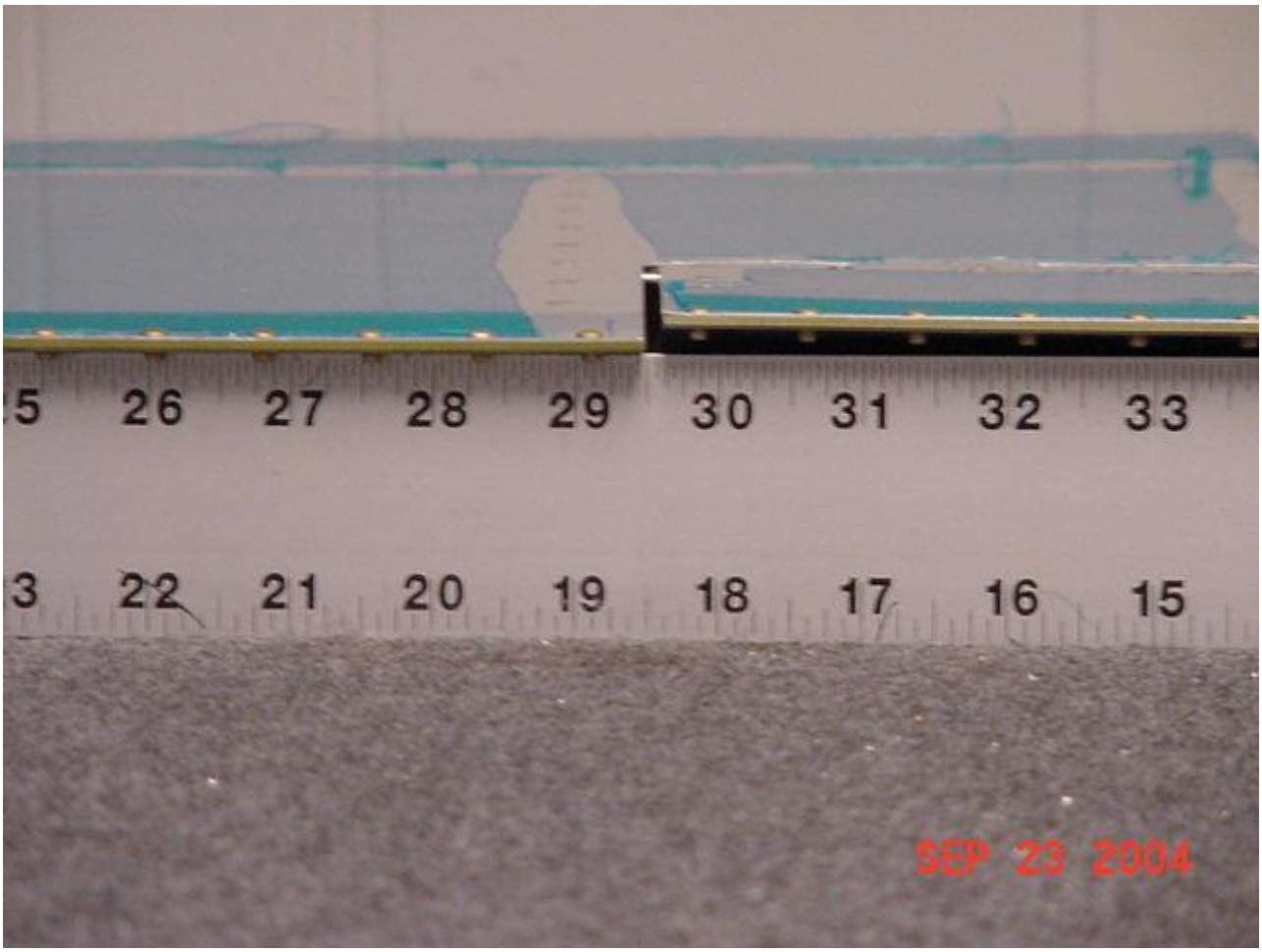
The only tricky part to the left elevator is dealing with the trim tab hinges. Squeezing rivets around the loops takes a wee bit of planning, but isn't that hard. As usual, having the right tool for the job is paramount to success.

This time when riveting the counterbalance skin to the elevator skin, I used a hand squeezer instead of back riveting. I clekoed EVERY hole common to all three parts and flipped the assy with the stiffeners face down just off the edge of my table. I removed each pair of clekos and squeezed the one rivet in the bottom row (the top row goes into the skeleton.

I could not get my 2.5 inch yoke onto one rivet on each side, so I had to end up back riveting anyway.

Riveting the skeleton to the skin assy is pretty straight forward. I used a hand squeezer for this process, and consequently the chore took about 1 hour longer. I was trying to see if I could get the skins smoother. It does look a little better, but I don't know if it was worth the extra time.

I used 3-3.5's most places, but at the hinge and where the c/b/skin goes on the skeleton I used 3-4.5 flush rivets.



After completion of the riveting on the elevator, I couldn't wait to trial fit the trim tab. I tried to slide the pin in and it wouldn't go all the way through. Manhandling with my palms was useless. I put the hinge down against the table top and "coaxed" it a little to line the hoops up better. That got the pin all the way in fairly smoothly. Then I found out that the trailing edges did not line up very well.

It turns out that each of my trailing edges are straight, but they didn't line up together. I was able to "coax" the trailing edge down a bit, but it's still off about 1/8 inch. And it looks like crap. And it will induce a turning tendency. So I have to either coax it some more, or drill out the rivets and set it all straight. Stay tuned for the results.

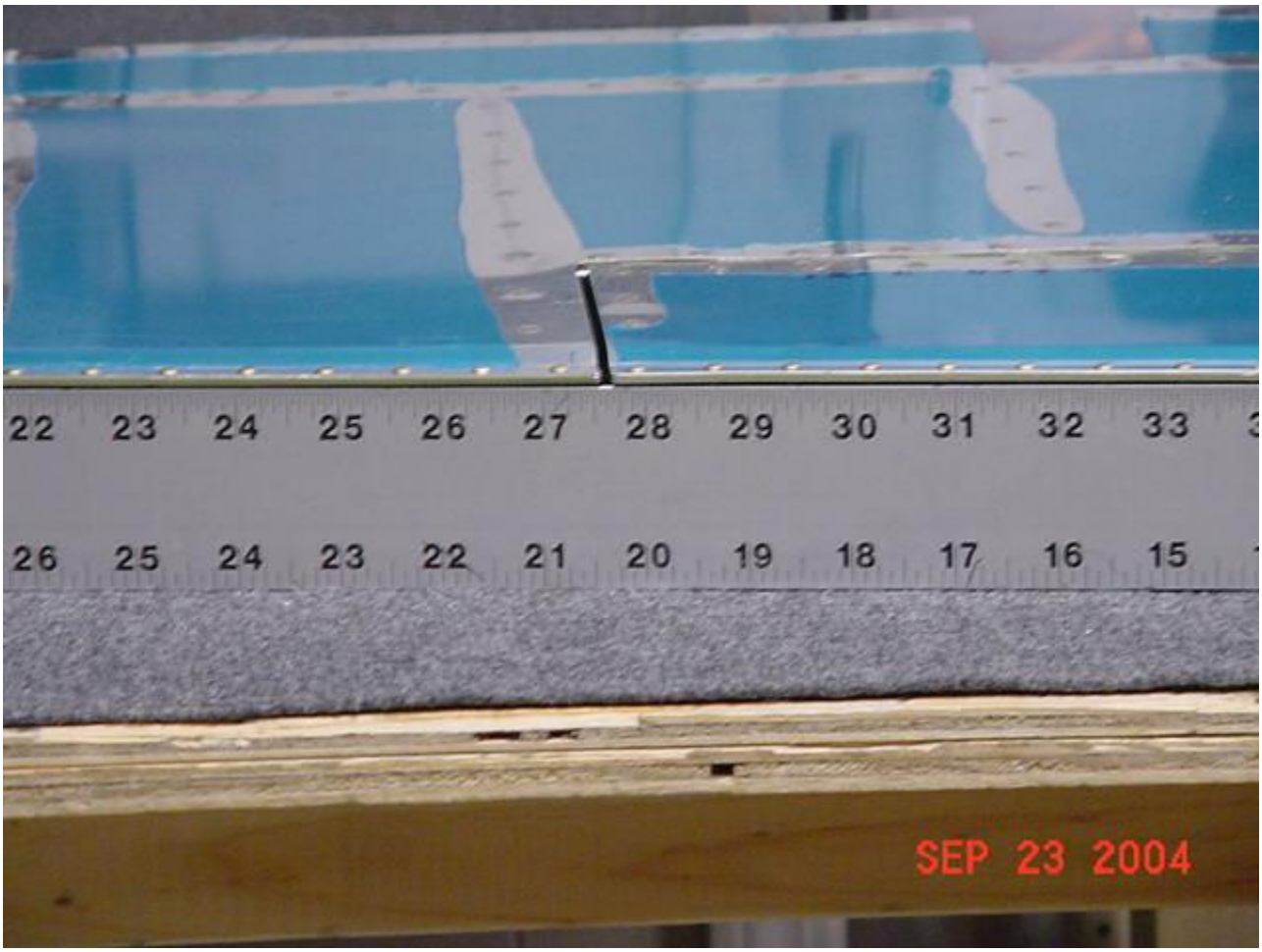
Well, I must have gotten in a hurry and riveted from end to end instead of from the middle out (but I don't remember doing that), and that must have caused the darn piece to end up catywompus. Even though during the trial fit it was straight.

Solution: drill out the trailing edge rivets on the tab and start over per Mark F.'s recommendation. I think what I will do is drill it apart as little as necessary and pin it, clamp it and make sure it's straight. Then, per Tom Martin's recommendation use adhesive and GLUE the edges together with some angle holding everything square. THEN I'll go back and rivet it. I'll post the process here and we'll see how it goes. Well, I didn't glue it before I re-riveted it together and got it OK. My recommendation: GLUE THE SUM BITCH. then rivet it.

OK, OK, it was REALLY bugging me... so I went home on my lunch hour and drilled out the trailing edge rivets and pinned the trim tab back on the elevator. Still bent. Palm and thumb this way on one end, that way on the other, and VIOLA! Flat as a pancake. Now the clekos and IT'S BENT AGAIN!

DRAT! Coax again...FLAT! Oh, so it's going to be THAT way, it it?! Sure enough, I had to "coax" the trailing edge (by manhandling the entire piece) in between every rivet to keep the trailing edge flat. But IT WORKED... so far. (I didn't glue it together before riveting, and it would have been much easier if I had!)

It was near then end of lunchtime and I only had every other rivet squeezed. I should hope that the piece would be stable enough to stay flat at this point. But I may be manipulating it in between every rivet. If that doesn't work, I'll drill them all out again and GLUE straight, then rivet it.

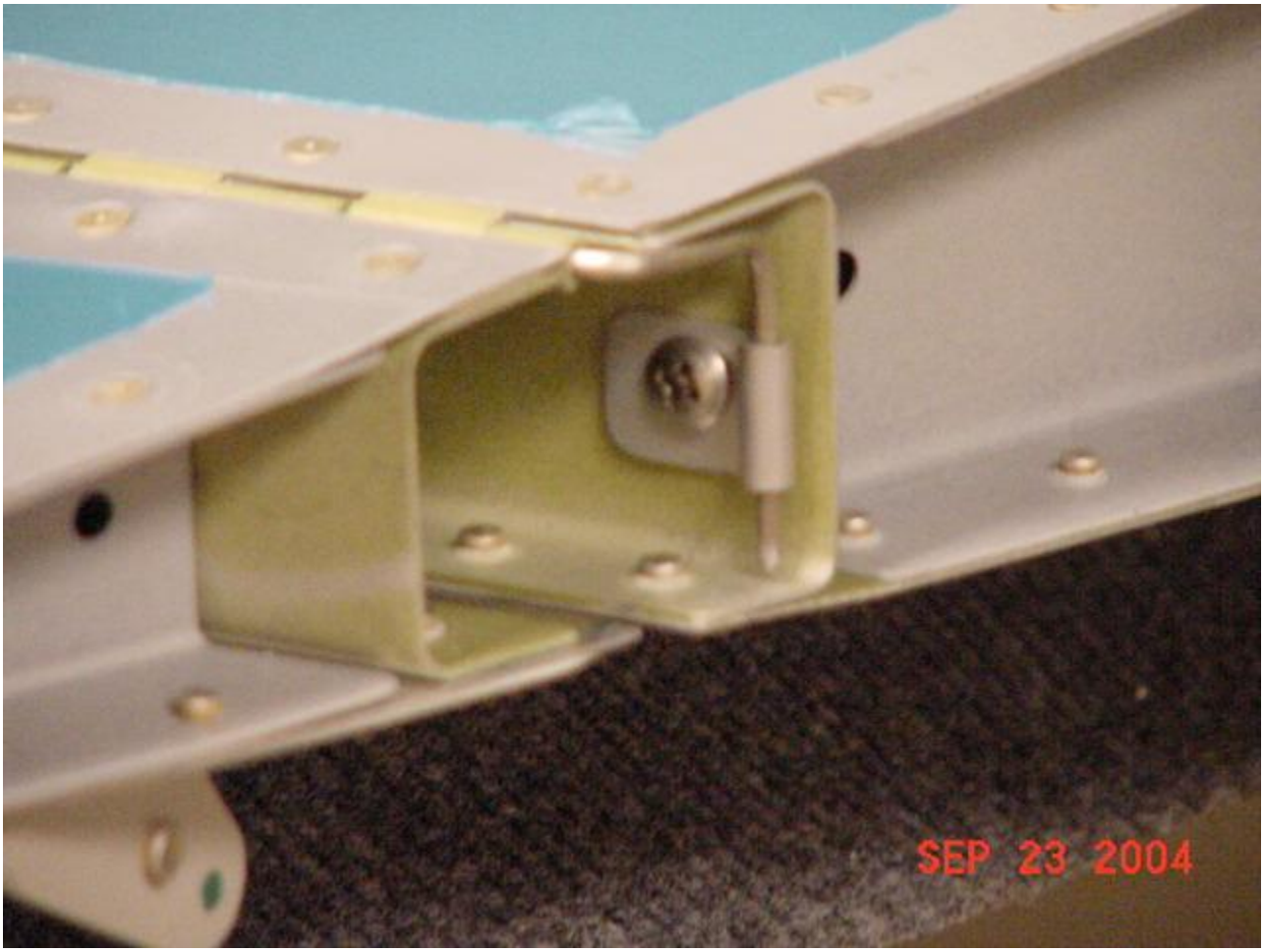


As I suspected, even riveting the "in betweens" wanted to cause the bow to return. I did a few things to fight this. I ran a drill bit through the holes biasing the direction I wanted to put pressure. I also tried to hold the trim tab with the twist I wanted (untwist, if you will...). And when I squeezed the rivets, I tried to press them the direction I need to bend or correct the trailing edge. It worked. With a little more coaxing, of course. Matt Happy!

After the trim tab dilemma was under control, I grabbed the hinge pin and rounded off the outboard end. I slid it through until it stopped against the far end, then marked where the inboard hinge stopped. I took the pin to my vice and put a 90 degree bend in it. I inserted it in the hinge again and marked where the web of the spar was, pulled the pin and made another 90 degree bend so that the pin was flat against the spar. Now I had a pin that would fully insert and lay against the spar web to facilitate retention (and keep it out of the way).

Per Randy Pflanzer's website, I grabbed a scrap piece of the hinge and made a little retainer for the

hinge pin. I was too lazy to put a nutplate in. You ain't gonna pull that pin without taking the entire elevator off, are you? Well, in that case, I'm just putting on a nylon stop nut.



Rolling the forward side of the left elevator was pretty simple. The pre-punched rivet holes are exactly the same right and left, so I was able to use the same, now pre-drilled, piece of copper pipe. I clekoed it in, then rolled one of the three segments at a time. I started on the straight side, not the bent side. That made the job easier.

The right elevator took me two hours to roll. The left elevator took me 20 minutes. Now THAT is jump along the learning curve! Of course having the pre-drilled pipe helped a bit.

Time to mount the electric elevator trim servo under the left elevator. The access cover and bracket are already D&D'd and primed. I had to hand bend them a bit to get it all to sit flat. Unfortunately, I can't find the proper nutplates to put on the bracket to screw down the servo. I'll have to find four more K-1100 nutplates so I can get this part finished.

Since I didn't have the correct nutplates to anchor the trim servo, I decided to complete rolling the leading edges of the Right Elevator and the Rudder. This is pretty straight forward. I used my copper pipe, clekoed every hole and rolled one segment at a time.

I thought rolling all three control surfaces at the same time would save me some time. Well, I did roll two of them as a batch and riveted all three at the same time, as well. Don't know if it saved me any time, but at least I have the primary metal work done on all three control surfaces.

Today I used AVEX blind rivets and closed the rolls in all three empennage control surfaces. That's pretty easy. You have to drill up to #30 and then pop the 1/8 aviation type blind rivets to close over the two skins. These blind rivets are pretty nice. They have anti-rotation splines on them to help keep them from spinning in service. Pretty neat idea!

The fiberglass tips were just gathering dust, so I decided to do some preliminary trimming. I'm not sure how the trailing edges are supposed to line up, so I'll have to look at some RV's and maybe a rocket or two (if I can find any) and see how they "terminated" the trailing edges.

Those brown dremel cut off wheels sure don't like fiberglass. I was making the mistake of cutting at the edge of the glass instead of scoring the surface to cut. You'd think I'd know better by now!

I seem to be getting itchy for some reason?!! Talk about fiberglass parts gathering dust!

The elevator caps aren't too bad to fit. I took a dremel drum and finished out the edge that mates against the metal, as well as trimmed the mold flash from the center. Then I used 220 (although 180 or 150 would probably go a little faster) sand paper (I know, that's not PC anymore) to rough sand to shape. Gonna need a bunch of filler to smooth these babies out.

I took the scrap strips I cut off of the HS skins and used them as doublers under the caps. One set was about 1 1/8 wide. I cut 4 18 inch strips, rounded the ends and held them in place under the fiberglass.

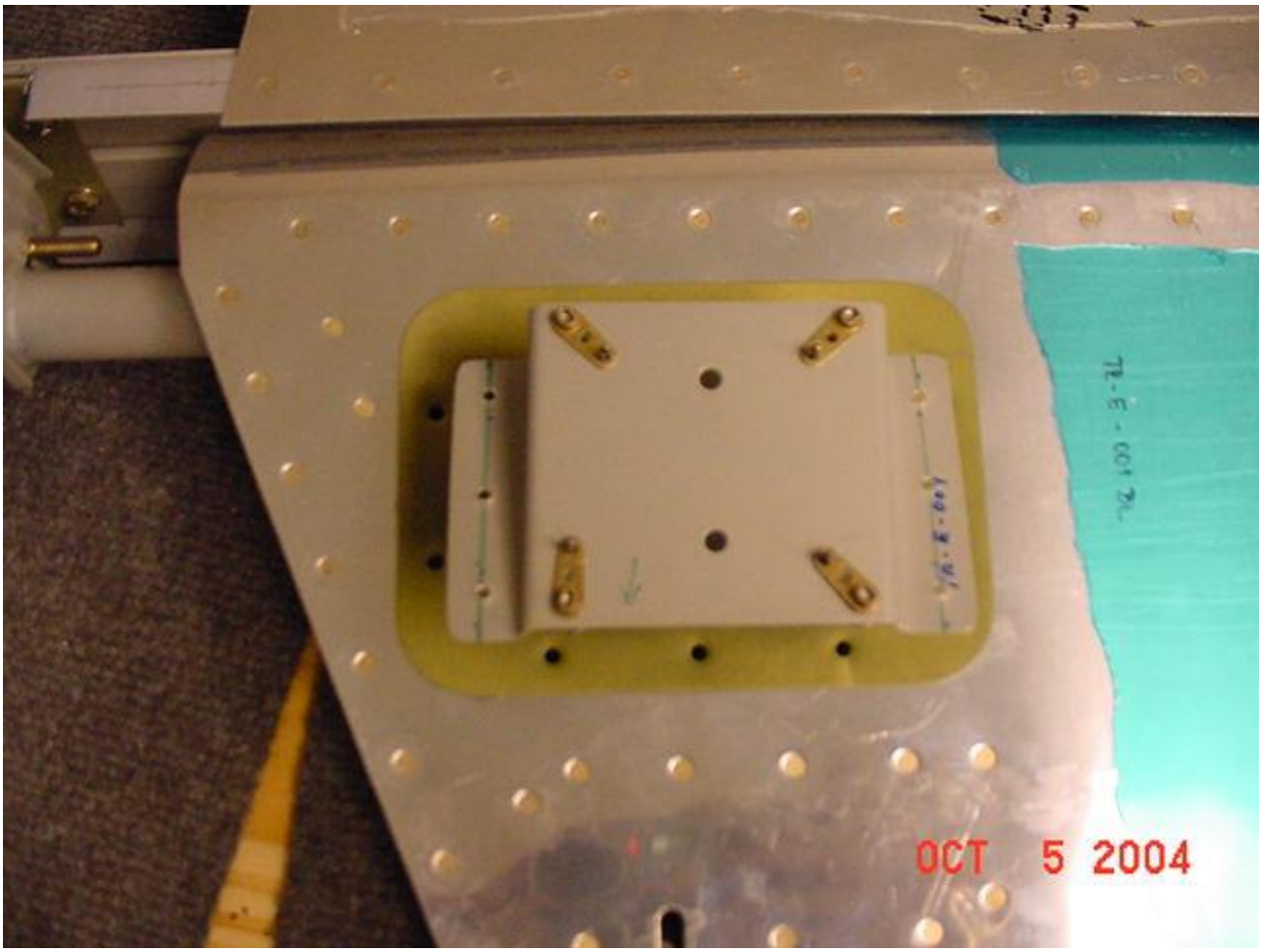
I used 3 inch spacing. I drilled all the doubler holes beginning about 1/4 inch from the leading edge end of the metal. With the edges lined up, I drilled #30 through the fiberglass just aft of the L E curve. It's pretty cool, you can see the holes in the doubler through the fiberglass, no marking required. I drilled and clekoed both ends, then proceeded to drill the rest of the holes.

I used the NAS tack rivets to hold the doublers to the fiberglass. I could have used #3 soft rivets, as well. Either way, my intention is to screw on all of my tips. In the case of the elevator tips, the screws and nutplates will hold the fiberglass to the metal, so the strength of the rivets isn't that important.

To make sure I got the rivets good and flush, I very lightly countersunk the fiberglass. One hole I over sunk, so I just stuck a #3 soft rivet in there. No big deal.

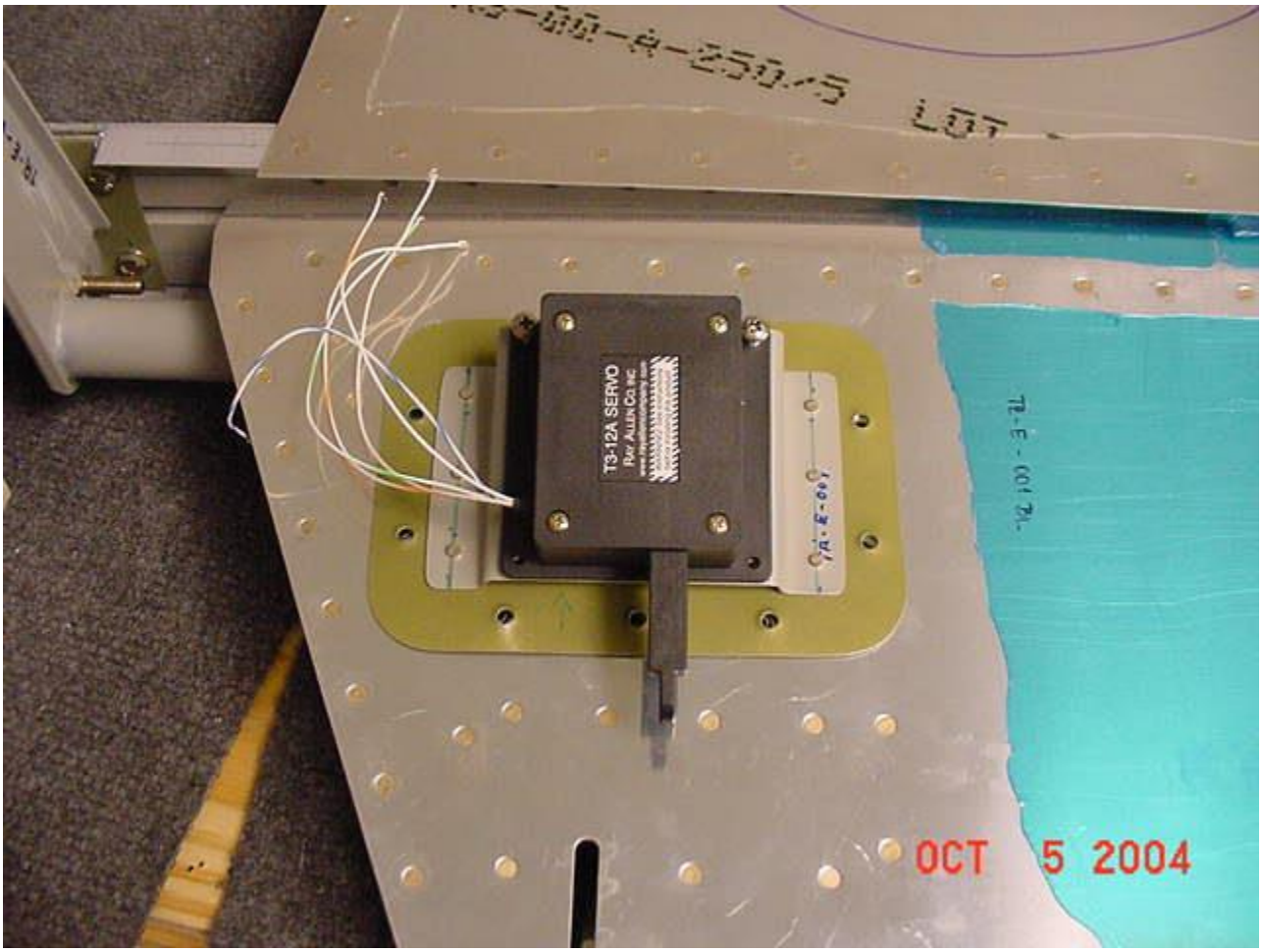
<>I have yet to re-mate the elevators to the HS to fit everything up. That will come up soon. I'll go back to work on the rudder first, then come back to the HS and E's afterwards.

Trim Tab Servo



I finally got back to working on the trim tab. I didn't have the correct nutplates, so I made an order for #6 screw "end" nutplates. Once they were in hand, I grabbed the trim tab bracket and riveted the nutplates with #3-3.5 flush rivets. I screwed down the servo and riveted the bracket to the cover plate with #3-3.5 flush rivets. This was kinda fun!

BTW, I machine countersunk for the nutplates. These are merely anti rotation devices and I wasn't too worried about making the metal too thin here. It worked VERY well.

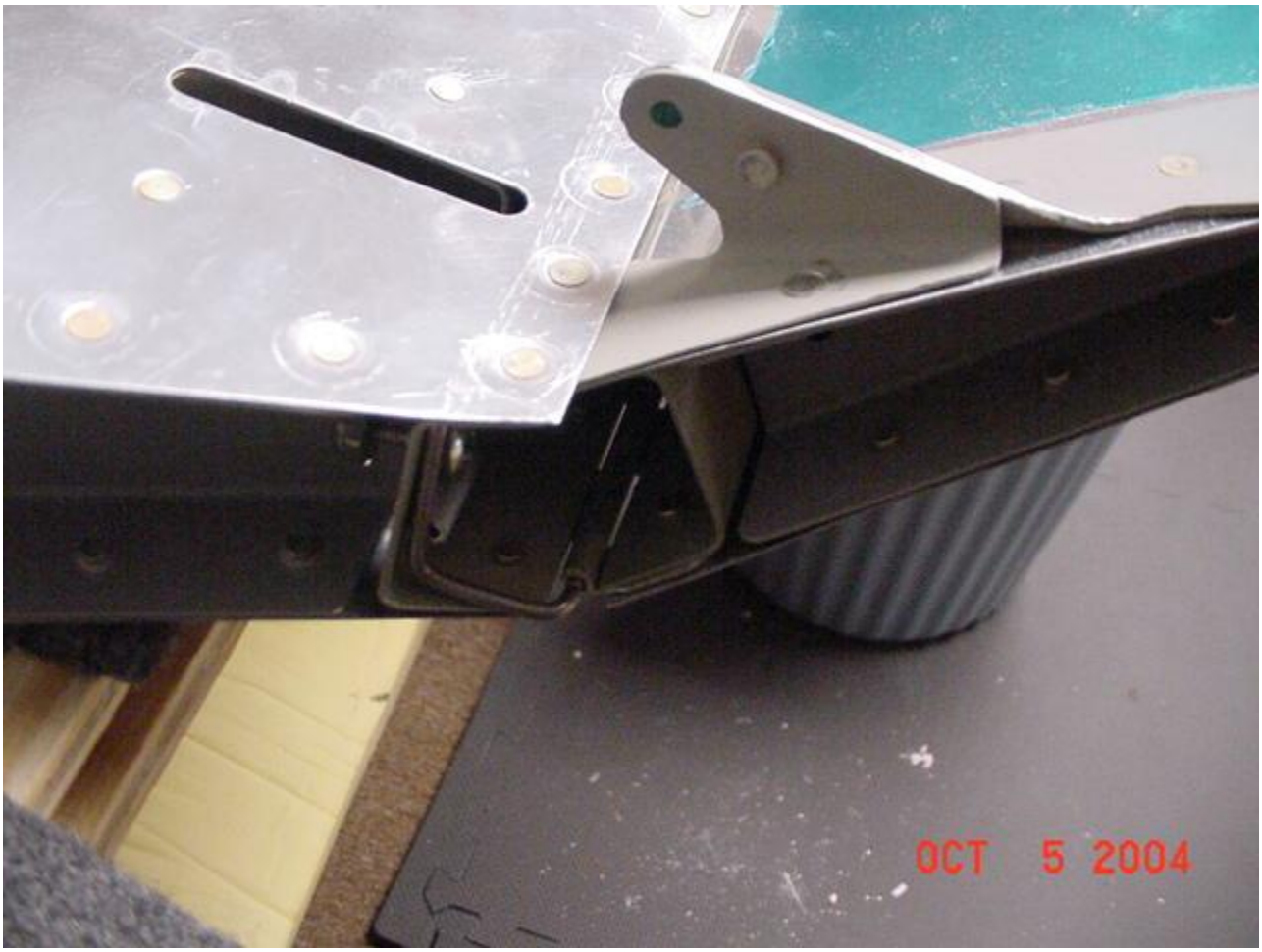


Once the servo bracket and cover were in place, I played with the activation rod a bit, just to make sure it cleared through the hole.

What I found out during this playing was that I had bent one of the hinge loops on the trim tab and the pin would not go through. I bent the loop back to position, only to find that I had closed the hole! DOOOH!

I couldn't figure out how to open the hole in a loop that was not on the end. Finally, I took a #40 drill bit that was 12 inches long and drilled through it. It worked. And the loop must have been pretty close, because next to no metal came out while drilling. WHEW!

The other thing that I found out was that I did not have full travel of the trim tab. The actuator bracket on the tab was bumping the elevator skin and rivets. So I took a dremel and cut the edge of the bracket down at an angle to allow for more clearance. Then I finished the bevel with a hand file. Now I have more clearance for the trim tab to swing through it's full spectrum of motion. I'm sure it will never need this much travel, but at least it won't bind at the bracket, either.



Counterbalance Weights

My counterbalance weights finally came from Van's. 6 of them. I ordered the E-614-020 weight for .020 skins. Kinda pricey to get lead bars shipped from Oregon to Indiana. The FED EX guy was not happy. He stated that it felt like a box of lead. He just shook his head when I told him that was exactly what it was. I got a chuckle out of it.

The weights fit in the c/b nicely. When you line the prepositioned bolt hole in the weight with the machine hole in the c/b rib, the weight is about 1/2 inch from the tip of the c/b. Physics kicks in here. If I used the hole that's already in the rib (all ready for an AN# bolt!), I may need more weight to balance the elevator.

Two of the weights set in the left c/b (the heavier one with the trim tab and servo) did not even budge the elevator on it's hinges. I had the HS off the edge of my work table so I could test the elevator weights, of course. Three weights at the location of the existing hole would move the elevator, so it was enough weight. But it didn't seem overly heavy.

The poop on the weights is to use 2 full weights and a half weight in each elevator c/b arm. I'm not sure how far from 3 full sized weights I'll need to be. I think I'll be OK.

My thought is to perhaps put 3 full sized weights in the right end and 2 full sized weights in the left end. Since the elevators work as a single unit, the theory is that the plane will be better balanced. I.E.,

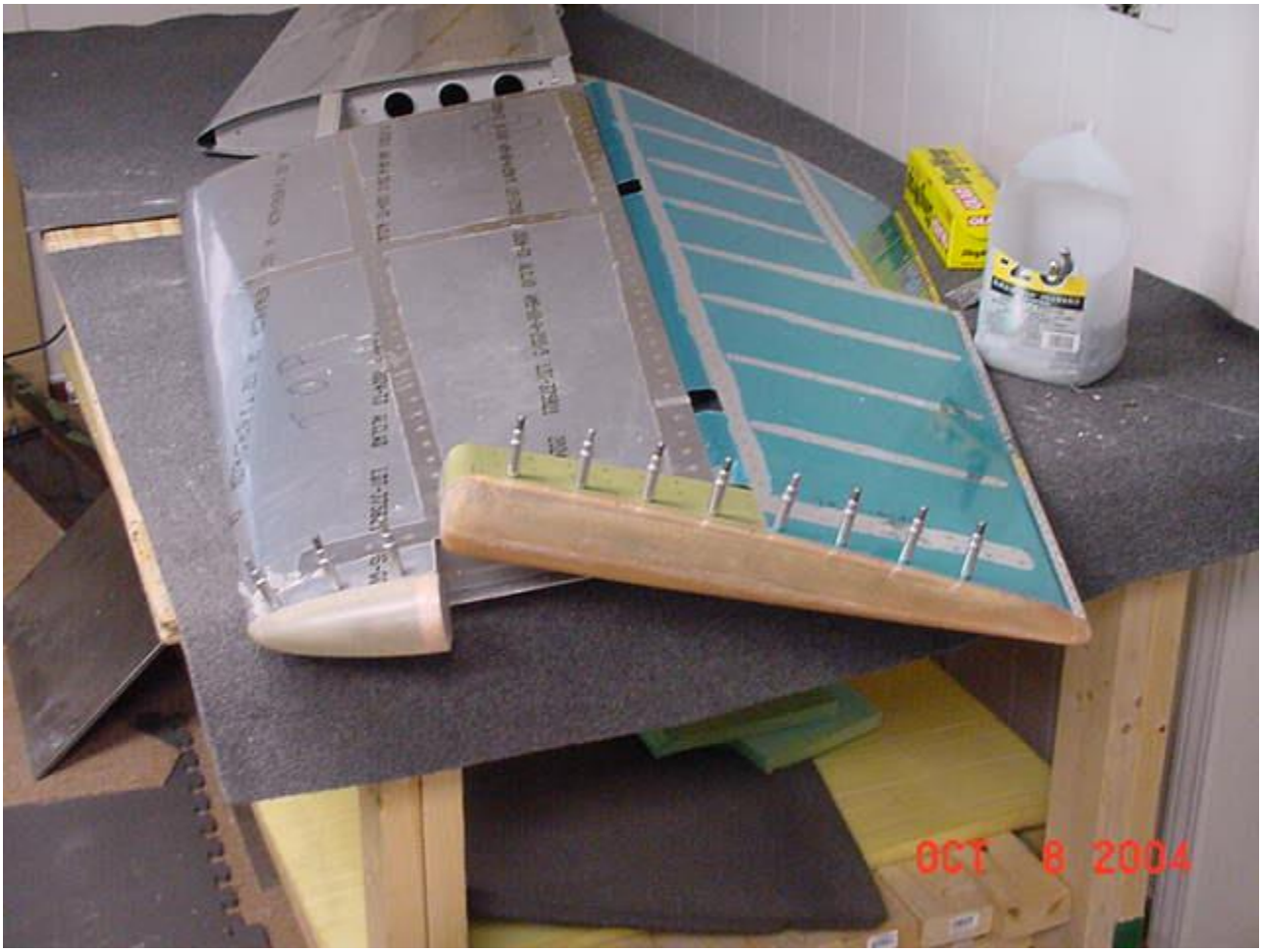
the weight in the right c/b would offset the extra weight of the trim tab in the left elevator. I'll ask someone smarter than me before I attempt this measure.

Keep in mind that when I actually complete the balancing, the left and right elevators will be mated. So perhaps I'll need less weight on the left elevator, because I can compensate on the weight in the right elevator.

At any rate, 2.5 weights are supposed to go in each elevator, then 1 weight is supposed to be enough for the rudder. We'll see how that works out when I get the fiberglass parts completed and the empennage primed.

I'll set the doorstops, er..., counterweights aside and go back to fiberglassing.

Fiberglass End Caps



After I got home from work today, I was going to go to the electronics depot and start collecting some switches and things. But I made the mistake of looking at that sad HS and left elevator on my bench. I thought "what the heck" and grabbed my end caps and went back to work. I had already put on the doubler strips in both the HS caps and the Elevator caps, so set about getting more toward finishing them. These parts seem to be taking forever.

I set the pieces in place, after I measured the amount of inset I would have for drilling holes in the skins. I ended up with 3/8 inch as a good figure. I marked where all the rivets were and ended up

working around them. As it turned out, my #4 screw holes will end up being 2 inches apart. I hadn't planned on putting in that many screws, but to make it look right, that's what I ended up with.

I centered up the caps, used a file to dress the edge where they mate to the skins and got the best fit I thought possible without making major shape changes. I marked the drill holes and started drilling #40 from the center outwards. I clekoed as I went. After drilling and clekoing one side, I flipped the whole thing over and did the same thing on the other side.

Now I have the fiberglass pieces clekoed in place. I assessed how they sat, and figured I had some filing to do. That made them sit better.

There were several places where I either had little gaps, or the skin was "taller" than the fiberglass. So I decided to start adding material to even out the levels and fill in the gaps.

I got out my cling wrap and selected a piece longer than the caps I was working with. One piece for each cap. I removed the caps pulled the wrap loosely over each cap, then inserted the cap back into the skin. I pulled the wrap smooth and even, then clekoed the caps back down.

I went to my epoxy room (well, the shelf that stuff is sitting on) and selected the correct blend of material (I only have West System). That means, one pump 105 and one pump 206. After mixing it thoroughly with a tongue blade, I added about an equal volume of micro balloons.

Micro balloons are new to me. Epoxy and fiberglass I've worked with before, but I always used cloth or epoxy, then auto body type stuff (polyester) as filler. Then Randy Pflanzer started talking about "micro". Since his results are without question some of the nicest work I've seen, I'm going to try it his way!

So I made my concoction up and buttered it all around the fiberglass edges, and anywhere else I figured I might need some filler (the "spine" where the fiberglass pieces were mated in the molds).

Now that I've "buttered her up" we'll she if she takes a shine to me. Hopefully, once she's all set, I can get my hands on her and really smooth out her curves. Ooooh la la!

My friend Bruce brought over his welding equipment and a digital set of lab scales. My Van's E-614-020 lead weights are now confirmed at a NOMINAL 830 grams. I think that is precisely what Mark calls for with the rudder in the plans. So now I have confidence that I can use all 5 of the other weights in the elevators when I get a little further along. Still trying to find out if I have to cut one of the weights in two.

In retrospect, glassing over the fiberglass parts with micro balloons, at this point, was a waste of time. It was necessary to used the micro to reshape some areas anyway, but for filling pin holes and finishing it's pretty worthless. After sanding I found SO many pin holes to fill, it's depressing. I wish I would have gone straight to the auto body putty and pin hole filler. It would have saved me time and materials just to do most of this shaping and filling with "bondo".

Hang the Elevators

.It's a year and a half since I started this project. The Elevators were constructed months ago, and put away in storage. I brought them out and dropped them into place on the HS. 2 AN3's in each one and an AN4 between them at the horns and WOW, it looks like a real tail (no fiberglass caps, though...) .

Kinda Hard to get the entire tail in the pic because I have so little room in my basement. I'm just surprised I can get the tail on at all down there!

Now that the elevators are pinned in, time to hook them up. To start with, I got out the big diameter push tube, marked and cut it at 64 and 3/4 per the manual. Then I drilled it for the 8 pop rivets. I drilled it #30, cleaned it up, slathered JB Weld on both mating parts and inserted the end cap into the tube. 8 pop rivets and a bit of clean up and this part was set aside to harden.

Time to drill the elevator horns. The manual sez to mark 3/8 in from the lower forward "corner" on each horn and drill them for an AN3 bolt. I can't wait to see how much gap there is between the elevator horns for the rod end bearing.

First off, per plans, you neutralize the elevators. I used wooden screw clamps over the counterweights and clamped down to the forward spar. I also used a spring clamp to keep the trim tab from flopping around.

When I marked the left horn for drilling, I used the very forward leading edge, not the back of the stiffening bend, to measure the 3/8 in. I hadn't realized it, and I was going to drill these horns off the ship, but you actually drill them together in place. And I'm the guy who can't drill a straight line. So I started with a #40 bit and tried to stay straight and level. All the way through the right horn. Then I incrementally stepped up each size drill bit through #12 for the AN3 bolt. I think it turned out OK.

Randy Pflanzer riveted 1/8 inch aluminum spacers on the horns to take up the slack. I'm going to do the same thing. After that, you really only have room for a washer type shim. I could even eliminate that by sandwiching in an extra thinner layer. Symmetrically of course. OK, so now the elevators come back off the ship. Turns out that there is a very nice piece of 1/8 that comes with the ship. It's meant to use to bolt down the battery contactor, but I decided to cut it up for spacers. The way I riveted it is overkill, but I like symmetry and I can buck AD4's much better than 3's any day. This little gem is just to keep you from having to fumble with too many fasteners back in the emp when you're bolting in the elevator push tube. I probably didn't even have to use flush rivets, but they are clean looking and cool.

While the elevators are off the ship, I'm also going to go ahead and trim the elevator skins back to the rib in the lower area near the rudder horn. There is some potential interference with the emp deck, so I'm going to max the clearance there.

Elevator Control Tubes

I took the big assed aft elevator control push tube with it's end cap and rod end bearing and slipped it into the fuselage and back to the elevators. The rod end has a little slop in it when between the elevator horns. Note to self: JB Weld a thin AN3 washer to the inside of each e horn spacer next time the e's are off the plane. That will keep the fumbling down to a minimum. Probably going to do the same thing with the big fender washer at the bell crank (JB the standard washer to the fender washer). Too may parts to work with in a tiny uncomfortable position.

I climbed back in the fuselage and bolted up the re-re-remade bell crank (back to stock) and hooked up the rod end for the aft tube. Oh, forgot. Have to clamp the elevators to neutral, and neutralize the

control sticks. Hmmmmm.... When you start this, with the sticks neutralized, the bell crank is supposed to be vertical. It's not. The intermediate tube is set up too long. Drat. So I disconnected one end and tuned the rod ends all the way in. Drat. The tube is STILL too long. The center tube is holding the bottom of the bell crank too far aft. Not much, perhaps an inch, but it's at the bottom of the bc, and that's the place where you have the most likelihood of contacting the bulkhead of the plane. Not good, could restrict full stick movement and full (adequate, anyway) elevator deflection.

I was able to get it all hooked up, but you have to remember, if the intermediate tube is too long, the ALREADY CUT aft push tube is going to be too short. So I adjusted the rod ends on the aft control push tube and basically had to max out the threads. I still have a couple turns to play with, but they are certainly not centered like you would like at the beginning. Not much margin for adjustment.

So the elevator control system was in place, but with errors. The center tube was too long by about 1 inch, I would say. That's how far back the bell crank appears to be displaced, and that's how much I seemed to have to crank out the rod ends on the big aft tube.

I climbed back in there and took a speed square with me. Well, at least the bell crank isn't as far off as I thought. It is an optical illusion back there. The top of the bell crank was only off about 1/2 inch or so. Really pretty minor, and I probably could go ahead as is. But the sticks aren't vertical, and neither is the bc. It was REALLY bugging me.

The problem with the control system never surfaced. It's close enough that I could go with it as is, but I finally decided to finish the aft elevator push tube, and order a new rod end for the intermediate tube. When the new rod end gets here, I will cut one end off the middle tube and put a new end on it. By the time I cut the old end off and clean out the JBWeld, the length should be just about right to solve my problems. So a shorter intermediate tube will allow me to get the bell crank back to vertical and neutralize the sticks as well. Were talking less that 3/4 inch to solve this problem.

For the time being, I went ahead and marked drilled, prepped, epoxied and blind riveted the other rod end cap on the aft elevator push tube.

That was a fun little project. I put the aft tube in the emp, released the clamps on the elevators and checked the travel. I get about 28 degrees down, so I'm good to go there. I only get 17 up, though. Regrettably, that's because I forgot to cut the emp deck panel right after I put the angle bracket back there to hold the VF. But the bell crank does NOT hit the bulkhead so that tells me I'm really in pretty good shape with the control system. Waiting for the part, and on to other things....

The stock length of the rear elevator push tube works great. Assuming all my control parts are in the correct location, the only thing that needed changed was the intermediate tube. I shortened it to 42 7/8, down precisely one inch from the plans. I don't think I could be off and entire inch, so I think there's a typo in the plans.

Since I was setting up the elevator controls with the push tubes ("rods"), I decided to make my lifer a little easier and bolt on the counterweights I bought from Van's a year or more ago. The kit has 6 lead blocks, pre-drilled for AN3 bolts and shaped to fit the pre punched RV 8 controls (I think). You use 5 of them on the elevator and 1 of them on the top of the rudder. Instead of cutting one of the elevator counterweights (CW) in to two pieces, for now anyway, I just bolted three weights on one elevator and 2 on the other. One weight goes INSIDE and the orientation is to put the thickest end from the bolt holes forward. This orientation gets the most weight to the end of the elevator CW and allows a lot of adjustability down the road. Of course when you bolt three weights onto one side, you will have some hardware sticking out beyond the edge of the skins. And of course you have to do this outboard, and it will be covered by the end cap anyway.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In final assembly, I will get at least one thread showing on the nuts per aviation practices. At this point I am considering leaving all 5 blocks in the elevators in tact. If one side ends up light, I will switch the weights side to side. If the elevator CW isn't heavy enough, then I will cut one of the weights and bolt each half to the forward bolt hole in the elevator CW. I'm not going to worry about that until after I have the parts painted and ready for final install.