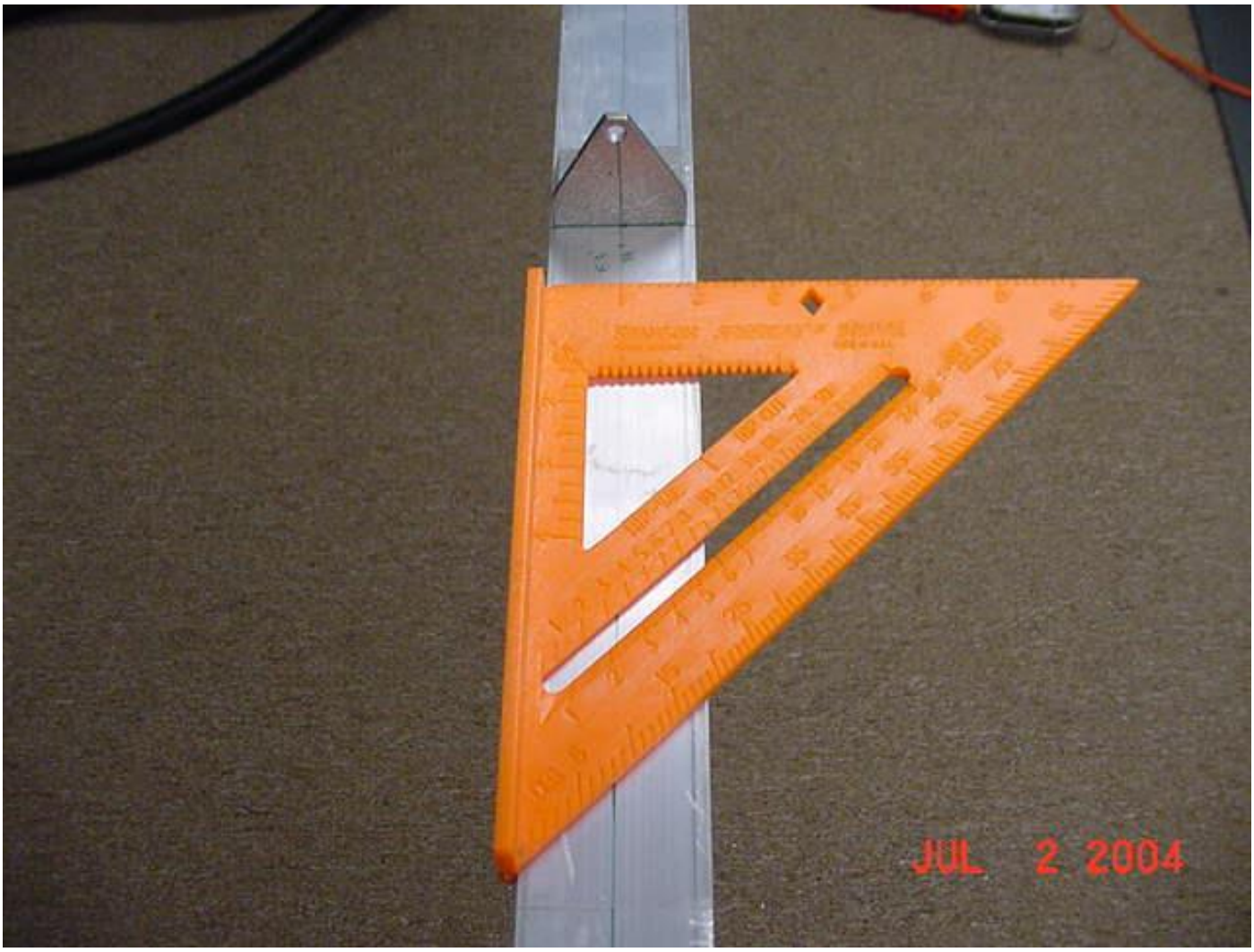
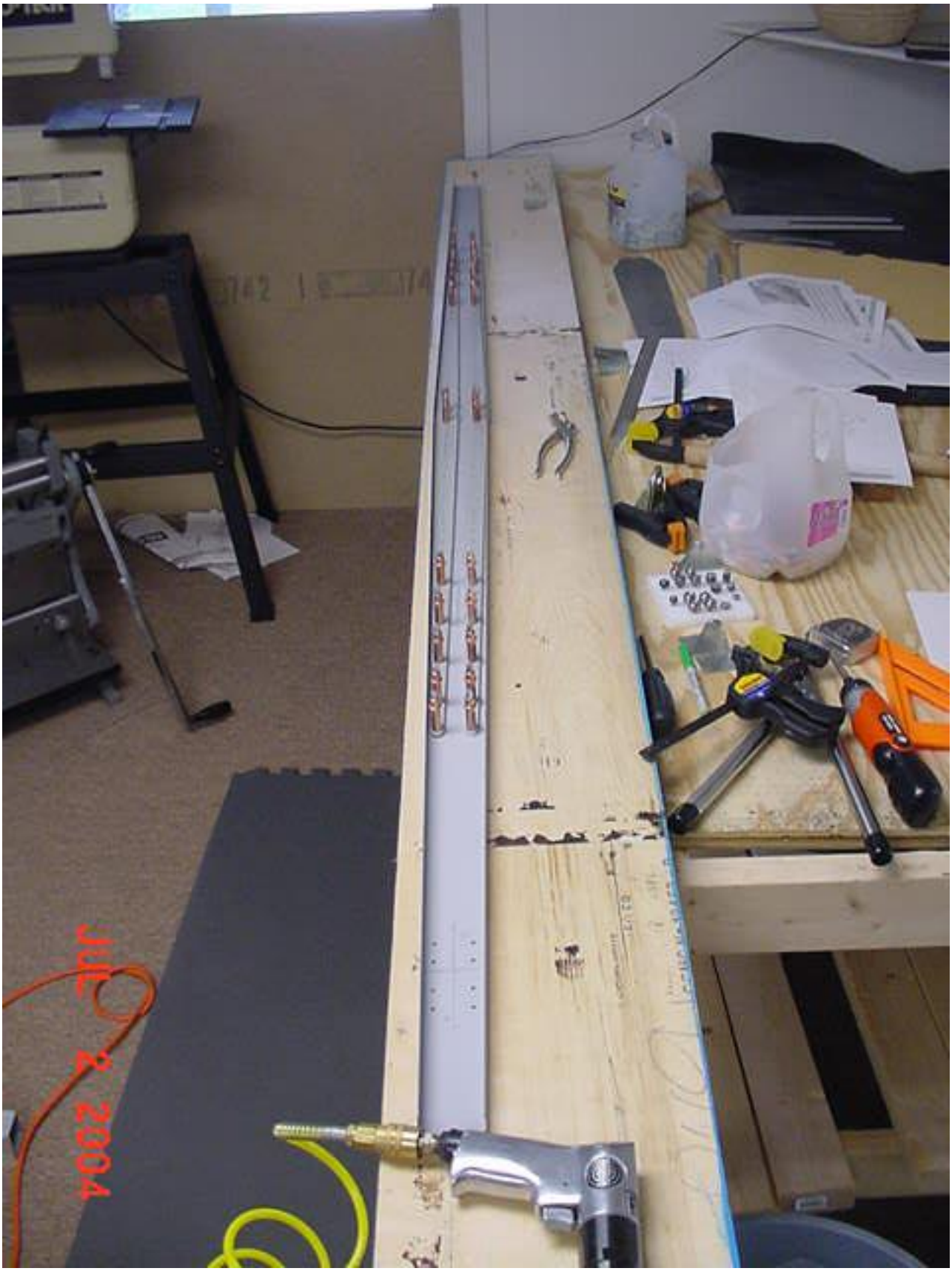
The HS Rear Spar

The F1 EVO plans are becoming available, so work begins simultaneously with the canopy and fuselage that has already been started.

I've started the Horizontal Stabilizer (HS) and I've had my "tail jig" set up for about 9 months. Time to put it to use. I bought pre made hinge brackets from Avery. I mounted them on the horizontal member of the jig. The 2x2 aluminum tube has of course been stable dimensionally since I erected it last fall. Bracket alignment on this square tubing surface is easy. I marked the center of the brackets and marked the perpendicular lines on the jig with a speed square. The centerlines on the jig was done with a 1 foot and 4 foot ruler. The brackets are positioned and squared with a speed square and clamped, then drilled and screwed into position.



Now that the jig is up (HAH!) it's time to build the HS to sit on it. The plans are very complete for drilling the channels and doublers that become the backbone of the HS. Measuring, and measuring again, drilling #40, and drilling to #30 and deburring took over 4 hours. The new EVO mods include extra doublers to reinforce the tail, so the HS channel has doublers on the front and the back. That makes for a pretty thick assembly. I'm glad I had a high speed air drill for this, because a battery drill would never keep up.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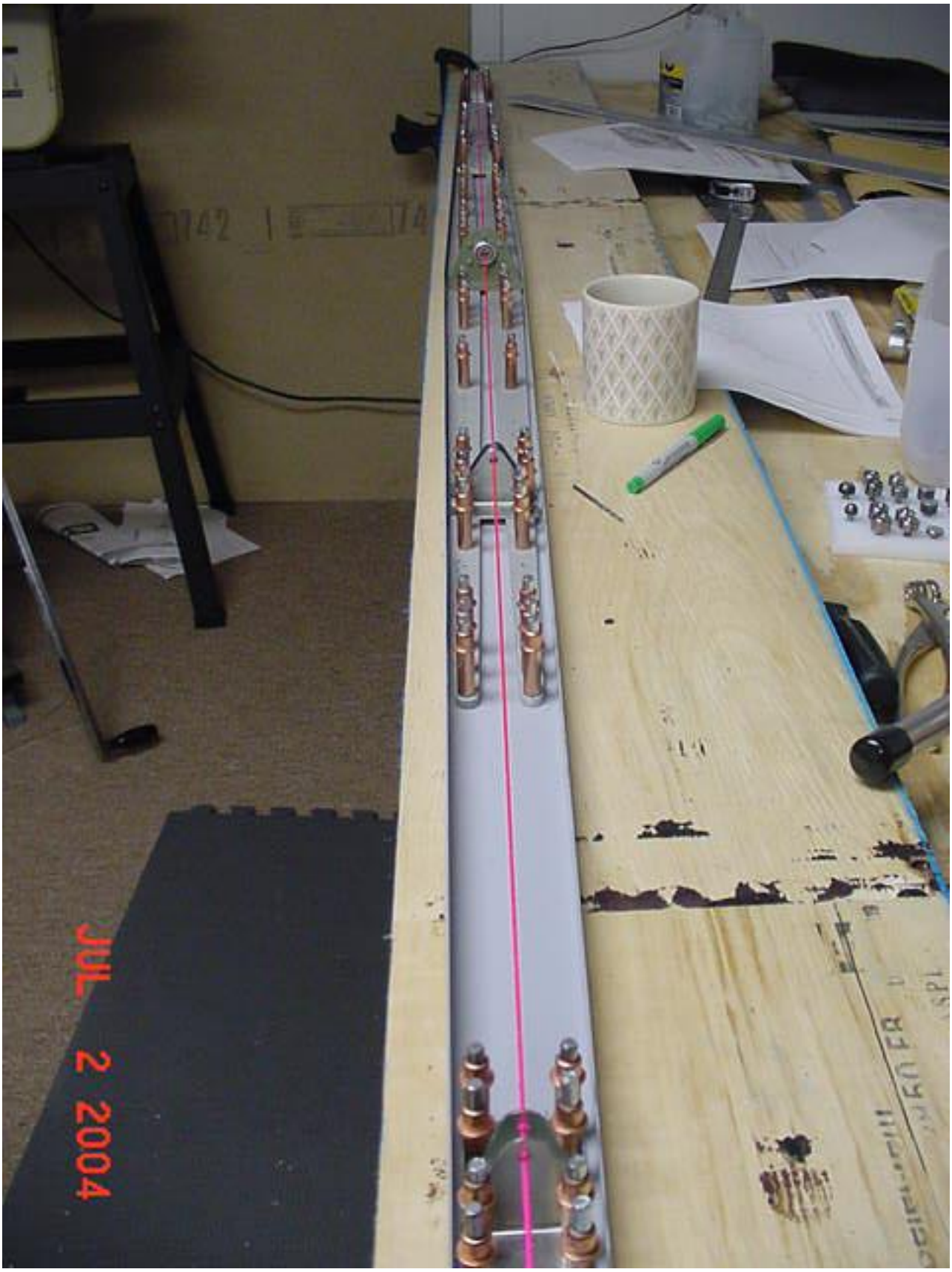
For a building surface, I bought a laminated 10 foot beam. My 2x4 work table is pretty square, but comes up short. You need 9 feet, and I would have had to build an extension. It's easier to buy a nice rigid flat beam that will ensure your work surface is very flat. You want to have a flat surface so you do not induce any twist in the HS (horizontal stabilizer) during construction. I checked the beam with a digital level to ensure it was consistent from end to end.

The HS rear spar is a combination of two tapered aluminum channels and a thick pair of tapered aluminum doublers on the aft side, and a funky shaped aluminum doubler on the front side. The idea is to align everything and drill it all together very flat and very sturdy. The plans has detailed measurements for every rivet and bolt hole in this process.

In the picture above you can see the two pieces of aluminum channel and the two aft doublers aligned, drill and clekoed into place.
In the picture below, you can see all the brackets aligned with a center string. I drew a line down the center of the HS channels and measured for the position of the pivot brackets. Per plans, you work from the outside brackets inward, making damn sure you get everything centered and aligned so that the elevator swings properly. (doesn't bind). Before any of the HS construction started, I struck a line from one end of my beam to the other. The channels were aligned and centered on this. After positioning and drilling the two outer brackets, I ran some twine through all of the brackets and clamped the string down centered and taught at both ends. This helps insure that all the pivot bracket holes are aligned.

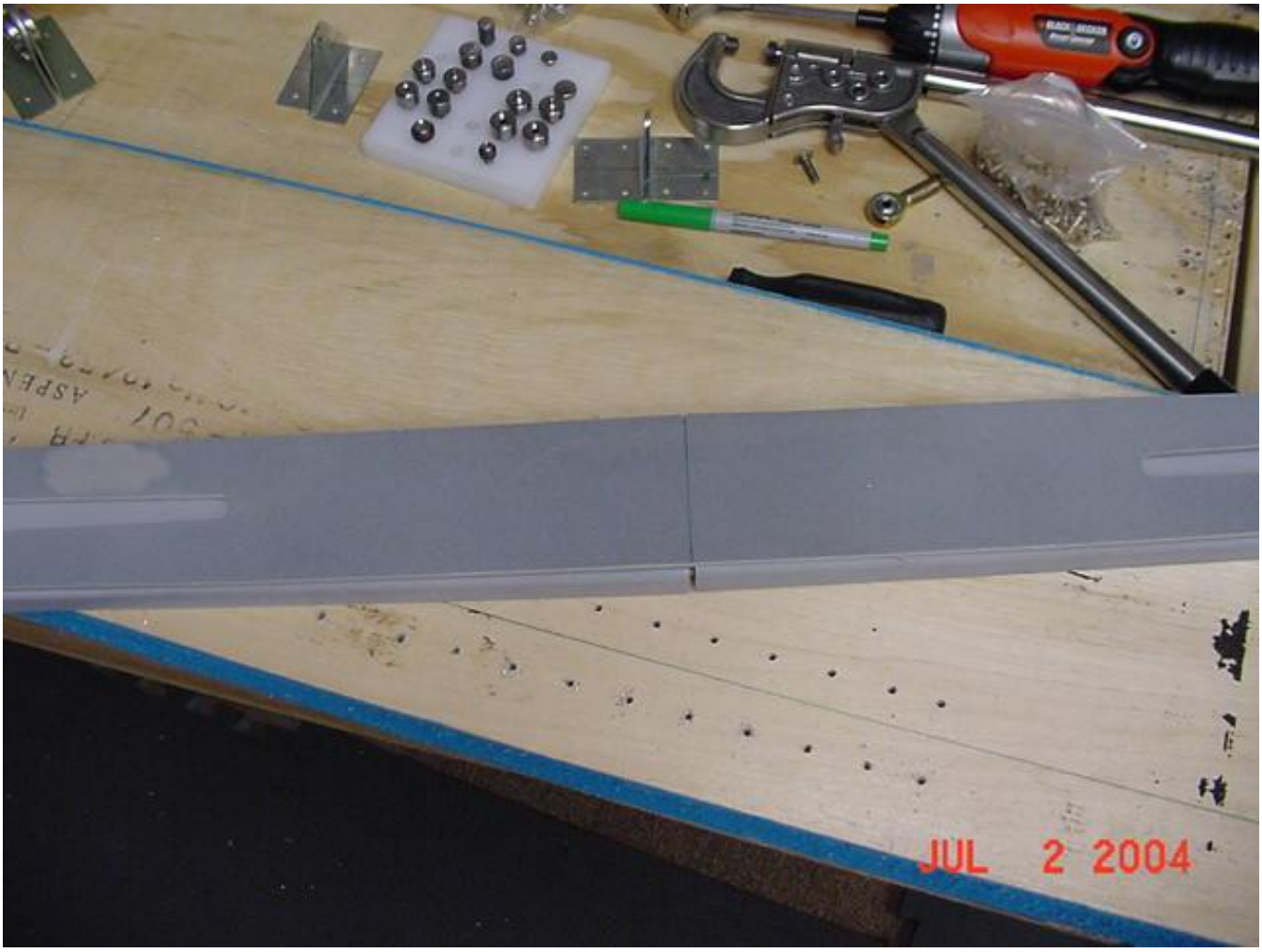


This is where I deviated from the plans a bit. The plans call for you to attach the pivot brackets and set the HS assy up on the jig to back drill the forward doubler into position. Rather than go to all that trouble, I merely removed the HS assy from the table, re clekoed it and flipped in catywompus over

the sides of my laminated beam. Then I precisely aligned the fwd doubler and back drilled 4 holes. Just enough to cleko it in position. Then I flipped it back over and clekoed everything back to the beam. The clekos barely go through the second doubler, let alone grip the assy to the table/beam. But the tips of the clekos do sit in the drilled holes in the wood enough to hold everything stable.

The pic above shows the HS assy clekoed before I flipped it over. Note the aft doublers are clekoed at the ends, but not where the fwd doubler will be drilled to the assy. The grey piece laying to the right side of the assembly is the new EVO edition double doubler! There's some serious reinforcing going on in the tail and with the new wings. I sure hope the plane flies fast enough to need them! The

company ship went 300 in a full power dive, so I think it'll be plenty sturdy! And that was with a STOCK tail!

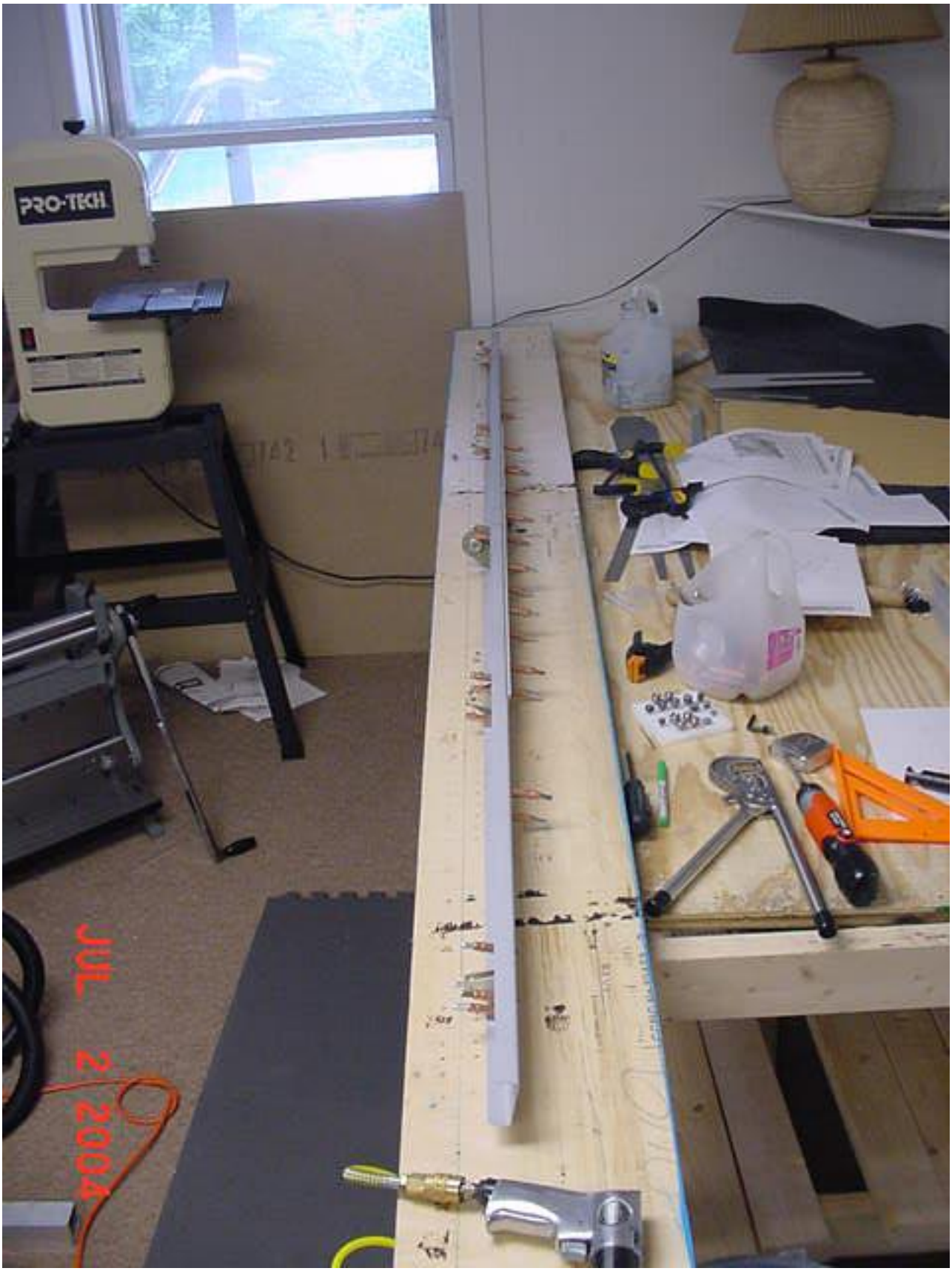


The fwd doubler measures 42 1/8". I found the center, and centered it on the "back" of the HS assy. You have to be careful that the edges of the doubler do not go over the edge of the HS channel, otherwise it would interfere with the skins, and the edge distance (ED) could be too small for strength (and "violate" 43.13). Actually this was pretty easy to position and clamp in place.

I flipped the assy over the edge of the beam and positioned it for drilling. This could easily be done over the corner of a table. I added some clamps and began drilling.

I flipped the clamped assy over on it's side, resting on the clamps, drilled 4 holes, flipped the assy back over again, clekoed everything down and finished drilling the holes.

Once everything is drilled, deburred, and primed, it's ready for riveting.



I clekoed the entire HS rear spar assy together just to admire it. When riveting it, I removed the brackets and flipped the HS assy on it's "face" and slid the ends off the end of the beam/table. I clamped the assy to the table and worked about 3 rows of rivets at a time.

I was able to get the aft doublers riveted with my pneumatic squeezer just fine. However the plans don't tell you what rivets to use (just "4" rivets, as in size 4). I used a AD4-6 in the ends of the channel/aft doubler. But when riveting the two doublers and the channel together, even an "8" rivet is too short. And the only size longer in a size 4 rivet that comes with the kit is an "11", and there are not enough of them. I'd have to cut them anyway. So this is where I stumble to an abrupt halt and wait for clarification and more correct parts from the Team Rocket home office. I have plenty of projects to work on with this kit plane, but it's very frustrating to have to stop and wait.

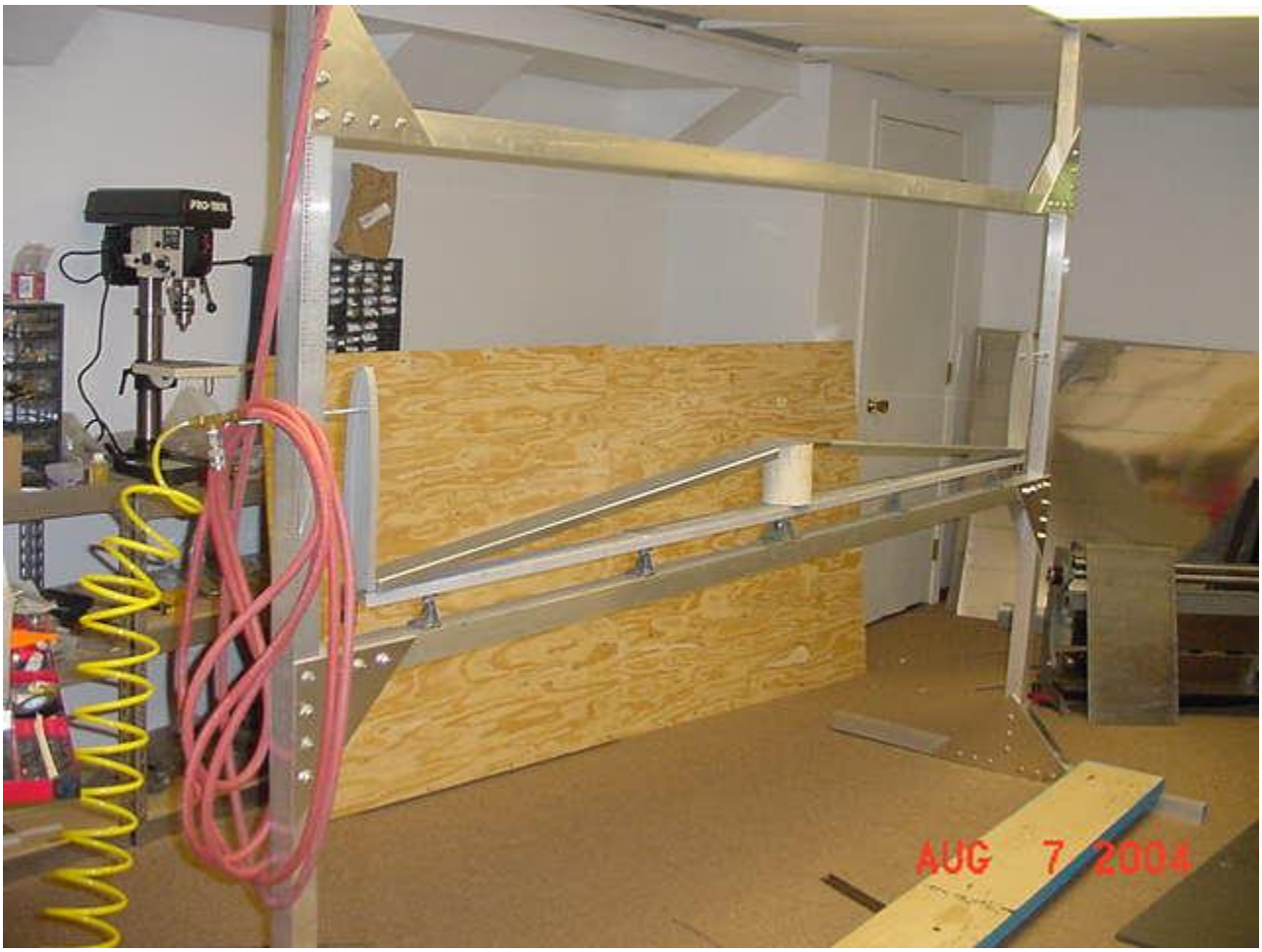
Since it's raining cats and dogs, my holiday weekend will be indoors. Darn. Have to build! Perhaps tomorrow will be nice (4th of July).

Airventure 2004 is over, and it was a great time. Flying and camping is always fun. Even a couple heavy showers could not dampen the experience.

Time to get back to building. The Vertical Fin (VF) is all but complete, so it's time to get back to the Horizontal Stabilizer (HS). On the previous "emp" page you can see that I started the project on the H-frame jig. I got the rear spar ready to rivet, then found out that I was not provided with the correct rivets. That was corrected very quickly by Team Rocket, but by the time the rivets came, I was already working on the VF.

Soon as I got back from OSH, I puttied my oops on the VF and also dragged the HS back out. I had to customize some #4 rivets. With the two doublers and steel brackets on the HS rear spar I had to use "10" length rivets. They weren't supplied, so I cut down some 11's. Most of the doubler areas take 4-8 and 4-6 rivets. My pneumatic squeezer works well on 6 lengths, but doesn't seem to like 8 length and longer. So I got out the 2x gun and the cup set and my trusty little bucking bars and went to town.

The HS rear spar is completed, except that the center bracket is not in place. That area takes AN3 hardware, and is supposed to be drilled up and bolted now. I thought it might interfere with mating up the forward spar and center parts, so I skipped it for now. I went ahead and repositioned the HS rear spar on the H-frame jig, and I'm ready to build the HS skeleton.

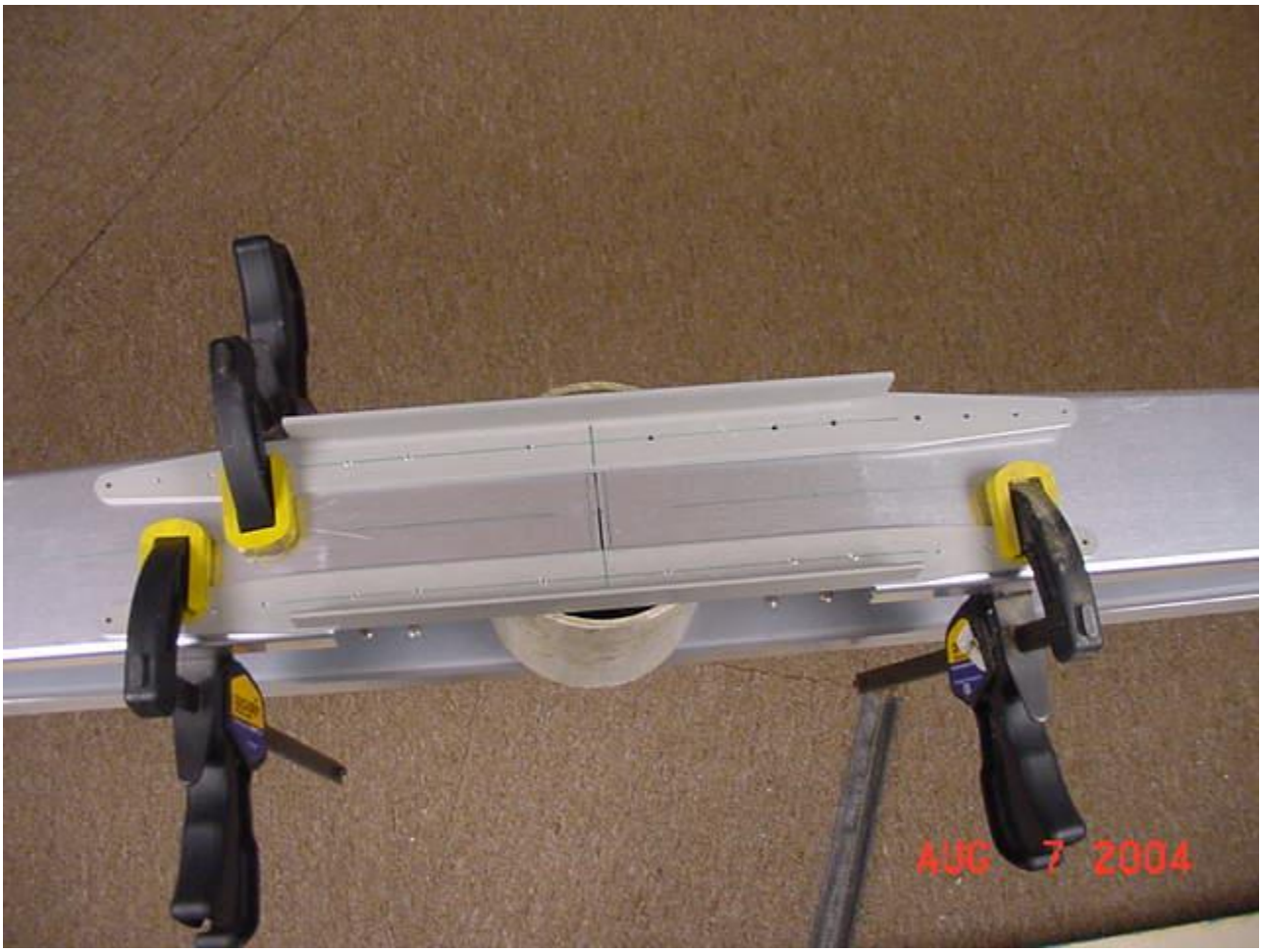


HS Front Spar

The HS front spar is the next sub assembly to be constructed. You essentially build it on top of the rear spar in the H-frame jig. I put the tip ribs in position on the rear spar, trued them up, checked the HS for level and no twist and went to town.

I just happened to have a scrap piece of 4 inch PVC pipe, so I used a hand saw and cut a 5 1/6 inch piece to sit on the center of the rear spar. This is a support for construction the forward spar. The front spar has a flat central part, and the ends bend back toward the tip ribs.

It's easiest to measure all theses parts for drilling on the bench. The two main aluminum channels also have to be trimmed to length. I marked the doubler and the angles for drilling. On the HS3201 you really only have to mark the outer areas of the fingers where they drill solely to the HS002 channels. All the other holes will be drilled based on the other parts. This is one thick sandwich of parts!



This gets a little tricky, but it makes sense once you see it. You put the HS014 angles on top of the HS002 channels and align the outer flanges to 3 5/32. Make sure they sit symmetrically about the bends on the HS002 flanges, and that they are centered in the entire assembly. Clamp them tightly. I then drilled the tip of each finger and clekoed them. Then I drilled the 4 innermost central holes and clekoed them. After that, I drilled and clekoed every other hole.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At this point, I didn't understand the plans and went down my own path. I removed all but about 6 clekos on the flat part of each HS002. Just enough to keep the parts straight. I took the front spar assembly and flipped it over on it's back. I had already drilled the tip holes. I aligned and centered the HS3201 doubler and clamped it down right over the HS002 with the cleko heads protruding. I drilled the tips of the HS3201 through the HS002's and clekoed them. I then drilled through the middle hole on the finger and then drilled the closest hole to where the tip of the fingers on the HS0014 was located and clekoed these holes. I then back drilled just enough holes through the HS014's and the entire assembly to keep it together, and removed the original HS014 clekoes.

You'd think that the original HS014 clekoes would keep the HS3201 from sitting properly, and make the holes a bit off center. I didn't find that to be a problem. All of this is done through this point using a #40 bit, and after all the holes are drilled, you drill up to #30. Any discrepancy in hole location is taken up by the larger bit. I didn't find this to be a problem what so ever. And I thought my technique to be much easier than aligning the HS014's on the HS3201, match drilling them, then trying to transfer the exact alignment on either side of the HS002's. I found it much easier to do most of this drilling in assembly on the support on top of the rear spar in the jig.

Assembling the HS Skeleton

The nose ribs are easy to locate. Just center them above the central ribs and clamp them to place. I drilled the main ribs to the spars first, then back drilled for the nose ribs. Then it was just a matter of a LOT of bucking of a LOT of different sized #4 rivets.

Big note here: it is recommended rather late in the plans NOT to rivet the tip into place at the very ends of the assembly. Drill them, cleko them, but leave them removable so you can get in there to buck rivets when the skins go on.

At this point I went back and re-checked all the dimensions. I have to say that having a digital level really speeds things up and gives you confidence that you are plumb and level.

The tip ribs are set, nutted to the all-thread, so they should always stay straight. But I checked the rear spar for level again and found that I had shifted it some. Just to be safe, I went ahead and repositioned everything as necessary. I had already pre drilled the ribs and deburred them, so it was just a matter of getting them positioned, then back drilling them though the spars and nose ribs.

The rib dimensions are well set out in the plans. The center ribs are easy to locate, and just use a speed square in the pic above to set in position, then use and angle drill to drill them in place. The root ribs are a little tricky due to the measurement you have to set from center.

At this point, my 4X gun came back from being repaired at the Taylor factory in Florida. It was defective when it came new. They repaired it at no charge and turn around time was a little more than a week.

I had been using a 2X gun on everything to this point. I have to tell you that I will probably retire that 2X gun, and just use the 4X as much as possible. It's much more controllable, at lower air pressure, hits harder and requires fewer bucks to get the rivets set. My hands don't hurt nearly so much as they did with the 2X. And I don't screw up as many rivets!

The skeleton is ready to finish. The rivets in the center section are flush set to the rear. I had machine countersunk these areas. The kit has 4-9 rivets for this entire area. I used the 4-9's in the flush area, but opted to use 8's in the universal rivet holes. 9's were too long, and if I cut them, I couldn't get them any different than an 8. So the shop heads are smallish, but adequate.

The HS Skin

**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 HS, I would glue the top surface completely down and use releasing agent on the bottom where it's harder to see the results.

The HS skeleton is complete. I marked the centerlines on the flanges of the ribs and transferred them to the H frame jig. Next, I have to position and clamp the skins, then design a drill pattern for the #3 flush rivets that hold the skin on.

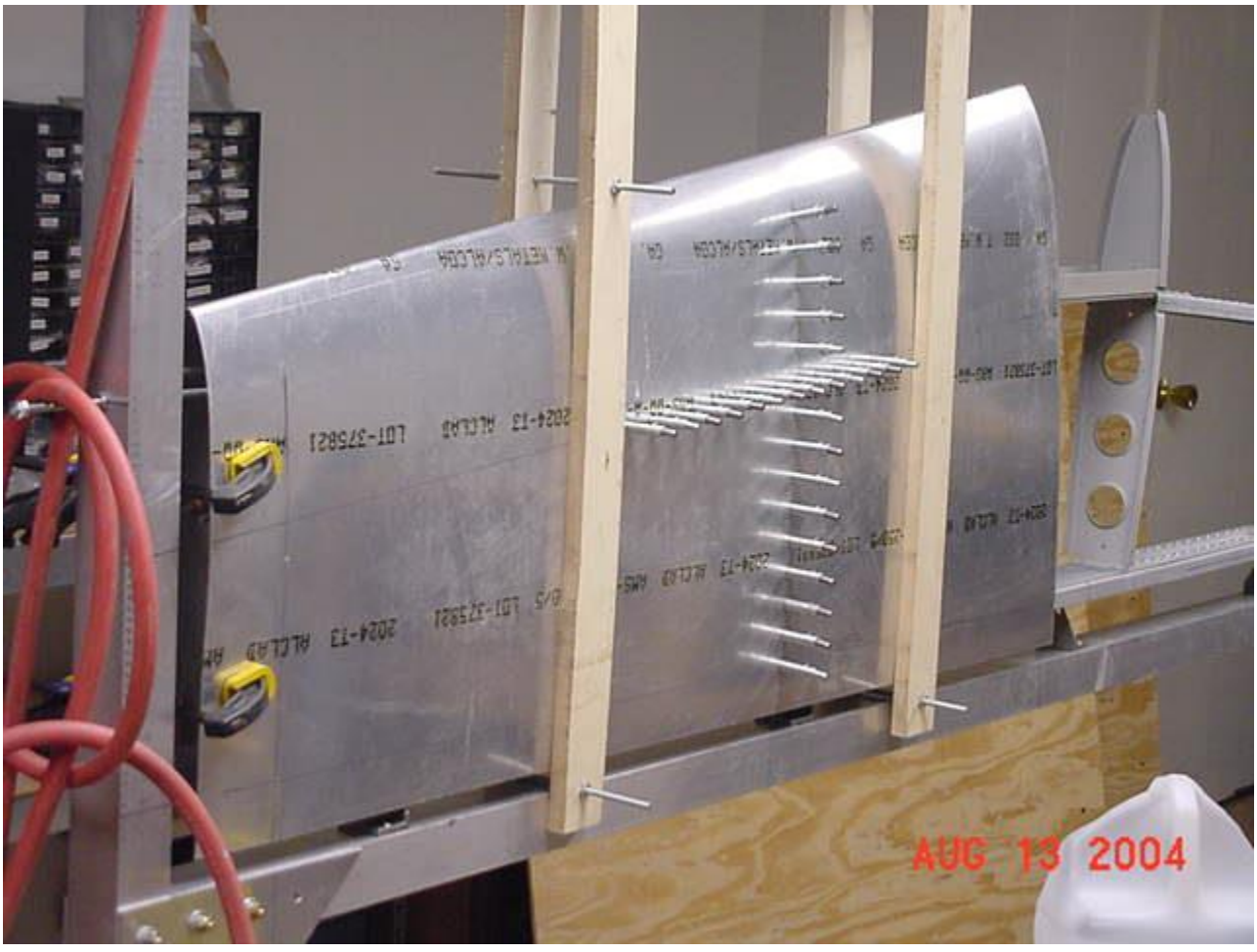
The plans do not say that you use #3 rivets, but this is kind of the "RV standard". Even though the F1 skins are thicker, you don't need to step up to #4 rivets.

The plans also do not give a spacing requirement for rivets on the skin. I will be using 1 1/4 spacing as I did on the VF. I still have my borrowed fan spacer. That makes the task much quicker to accomplish, in my rookie opinion.

It looks like a perfect weekend for flying, so I probably won't get much done with the skins. But at this point, I feel like I'm making very good progress. I'm having a lot of fun, learning every day, and getting a lot of satisfaction from the building process!

I went flying after work and fueled my Super Decathlon. Our EAA Chapter 83 has a great lunch fly in tomorrow and it is a must show. Considering there are hurricanes in Florida today, we really lucked out. It was a nice cool 72 on the ground. Not bad for mid August. What's this about global warming?

After flying, I got kinda restful. I had a nice nap. Then I got restless. So I went to the basement to look at the HS skins. Well, I put one in place. Well, I decided to clamp them down. Well, might as well draw the centerlines for the flanges. I wasn't even planning on working on the plane and ended up putting over 4 hours in, getting the first HS skin drilled and clekoed. On just one side.



Some builders use a horizontal board as well as vertical boards and clamps to hold the skins down. The tighter they are to the skeleton, the prettier and more precise they are. I chose to just use 2 vertical boards only, just like I did on the VF, and it turned out just fine. What I did do, however, was

make sure and press the skin down flat with my fingers on either side of the drill mark. And I started at the center of the skin and worked outward, pressing it tight all the way. It was already fairly tight with the all threaded vertical boards, but there was still some "slop". Perhaps it would have been a bit better using 3 vertical boards. You have to draw the line somewhere. It's a matter of diminishing returns on your investment... time and materials in this case versus potentially better cosmetics. You can be the judge when I'm done.

The other HS skin is set in place. I'm all but done drilling the skin on the first side of the first side on the HS. Next I'll go the the other side of the same skin and finish drilling and clekoing that one. I think I'll barely have enough clekos to get the job done. I think I have over 300 #40's. I may need to get more, but I think this will be the biggest assembly I produce on this entire project. So If I can work around it, I hope I don't have to invest in any more clekos. But boy it sure does take a blue million of those things!
On the first side, I did one small area at a time. Mark, drill, cleko, mark, drill, cleko... about 8 holes at a time.

On the second skin, I decided to do things a little differently. I went ahead and used the same 1x2's and clamped the skin in position. This time I cranked the boards tight and marked both sides for drilling at the same time. I started in the center of each side and marked all four "corners" from there. I loosened one end of the boards and slipped the fan underneath. Then I went to the other side and marked the same "corner". I had to drill the intersections and the ends of course to locate the fan spacer, but otherwise I drilled all the holes at once... more or less. This saved a bunch of time.

I found that my centerlines transferred very accurately and I had to make very little compensation when I actually drilled the holes. In a couple places I determined the ribs and skin did not meet in perfect edge alignment, so I had to fudge a couple places to either side of the line. And at the HS014 angles I had to drill quite a ways out of line. (quite a ways is like one rivet width).

The first skin took me over 4 hours to just get positioned and drilled. The second skin took about 2. There's a big learning curve here, and I hope to get on the more favorable side of it one of these days. Probably with the NEXT kit plane project (if ever...).

Now that the skins are drilled in position, I need to trim the aft edges. It's easier to do this on a bending break than with shears or dremmel. I'm going to mark the nominal edge distance (I think it's 1 1/2" from the face of the rear spar) and then take the skins to my friends at the local U. They have equipment large enough to take care of cutting these wider skins, and it leaves an extremely nice edge. After that, I'll Debur and Dimple (DB&D) the skeleton and skins, which will certainly include having to machine countersink some places that cannot be dimpled. Of course, after that, I'll start riveting the flush #3 rivets.

Another note on my riveting plans. When I constructed the VF, I did most of the work on the tabletop, not in the jig. Having drilled the skins in the H-frame jig, I think I like the idea of bucking in the jig, if I can manage it. I think the skins will look much better by the time I'm finished. Also, I wont remove all of the vellum coating on the skins. The plan is to round off my soldering iron and melt through enough of it along the rivet lines that I can dimple and buck them without interference of the plastic.

I went ahead and used a pencil type soldering iron to remove the "vellum", or plastic protective coating, from the drilled holes on the HS skins. It is necessary to remove this layer prior to deburring and dimpling. The film on the HS skins is quite thick, and in a few places, I had to drag the tip slowly, and even go over some places twice. On areas where you only have to melt one side of a strip to remove it, you can start lifting the material and then pull the strip off as you drag the iron along ahead of peeling the strip. It's not that easy when you have to do both sides around a central line of holes.
I deburred and dimpled the skins. On the first skin, I had the male die just below the surface of the skin and the carpet adjacent to the C-frame. That was a mistake! Also, I didn't keep my fingers tight on either side of the die when I wanged the plunger with my rubber mallet. Consequently, there are smileys around the dimples from the skin being bent down, and some of the simples went off center on the second blow. None of these are part scrapping problems, but the cosmetic result is not very pleasing.

After dimpling the skins, I had to close the bend to make the skin sit better on the HS skeleton. You might notice that there is considerable pull on the VF skin on the Emp2 page, and the rivet closest to the leading edge has a bunch of "pucker" around it. Hopefully I can avoid that with these parts.

I used 1 inch PVC clamped inside the bend and used my palms to press the angle closed. I should have stuck with the 1x2 I was using initially, because my palms made irregular waves in the skins. Those skins were pretty tough to get closed!

You can tell in the pic above the difference in the open angle of the factory skin and the manhandled skin. It took quite a bit of grunting to get it closed just this much.

In retrospect, I probably should have used a larger diameter pipe inside the bend before pressing closed the bend angle. I think the profile of the leading edges may have been more uniform and also cosmetically pleasing. We'll just have to see if it affects performance.

I had not drilled and bolted the center bearing/bracket on the HS spar. Before finishing the skins, I re-clekoed it onto the spar, got out a nice #12 drill bit and went at it. Once I got through the aluminum and into the steel bracket, the bit just wasn't quality enough (read: hard and sharp) to get the job done. So I got out the corresponding cobalt Dewalt bit and punched through the steel. I then used a large "titanium dipped" (what junk!) bit and deburred the bottom of the hole.

I "German torqued" (GOOTANTIGHT) AN3-6 bolts with nylon stop nuts and washers on both sides. I put the bolt head on the bearing side to be sure and have maximum clearance from the elevators.

Originally, the thickest washer left me nary a thread outside the nut, so I went back and replaced the thick washer with a thin one on the bolt head side and ended up with a couple good threads exposed.

After closing the bends, I clekoed one skin to the skeleton. I quickly determined that my arms are not long enough to reach the first rivet with a bucking bar and gun. So now I am going to solicit some help. I was hoping that I could complete this entire project without help riveting, but alas, that's not the case. If I were 6'5" and had about another foot of reach, I could probably do it. At 5'6" I can only get to one side or the other. Now some serious groveling is in order!

**Note: when you have the HS free swinging on the hinges like in the pic below, be VERY careful. When you start riveting you will feel the need to rotate the HS away from you a bit. Remember that there are hinges down there and they are stronger than that trailing edge of the skin. You CANNOT rotate the piece very far or you will mangle the trailing edge of the skin!

Having closed the bends in the HS skins, I was ready to get help and bang those babies! My friend Bruce delayed some honey-do's and came over to help.

We clekoed the skins on the skeleton in the frame, beginning at the middle ribs. We both looked at the situation and decided that the ROOT nose ribs needed removed more than the end ribs, so we removed and installed them respectively.

The first REAL order of business was to rivet the nose ribs. Then we clekoed along the forward spar, flexed the metal up from the opposite side and then bucked along the spar from the center out. I decided to cleko every other hole. The last task of this two man operation was to finish riveting along the middle rib to the aft spar. I have a pneumatic squeezer that can easily reach around the outer edges, and the ends are easy to buck, so I didn't need my buddy's help on that area.

Everything in the HS skin riveting process went like gangbusters. Once we got the rhythm down, we sailed right through bucking the 3-4 flush rivets in the skin. A couple places required longer #3 rivets.

Regrettably, as I was finishing along the trailing end of the skins on one of the four "sides", I found that the skin had slipped. It was off so much that I couldn't even get the clekos in. So I got out the 40 bit and started drilling out rivets until I could "coax" the skins into place. I was tired from about 9 hours of building and finally quit as soon as I got some of the holes to cleko and line up pretty well. I thought it best to finish fixing this little snafu after cogitating, ruminating and resting. In the mean time, the next morning I went back to working on the control surfaces.
After much deliberation, I decided to just re drill the holes on the HS. I only had to re drill the aft/spar (along the bottom), and it didn't seem to affect the rivets. As in I didn't have to move up to oops rivets... yet. (I have elsewhere!)

I went ahead and riveted everywhere except the ends where the counterbalance swings through. Then I got a ratchet strap and tied off the HS to the top jig member and pulled out the hinge bolts. I carefully laid the HS on my table and admired my lousy riveting job. The area I just fixed was fine, but I removed and re-riveted about 40 or so other rivets. Not good to have to do it, but I'll sleep better. I hand squeezed all of these rivets today.

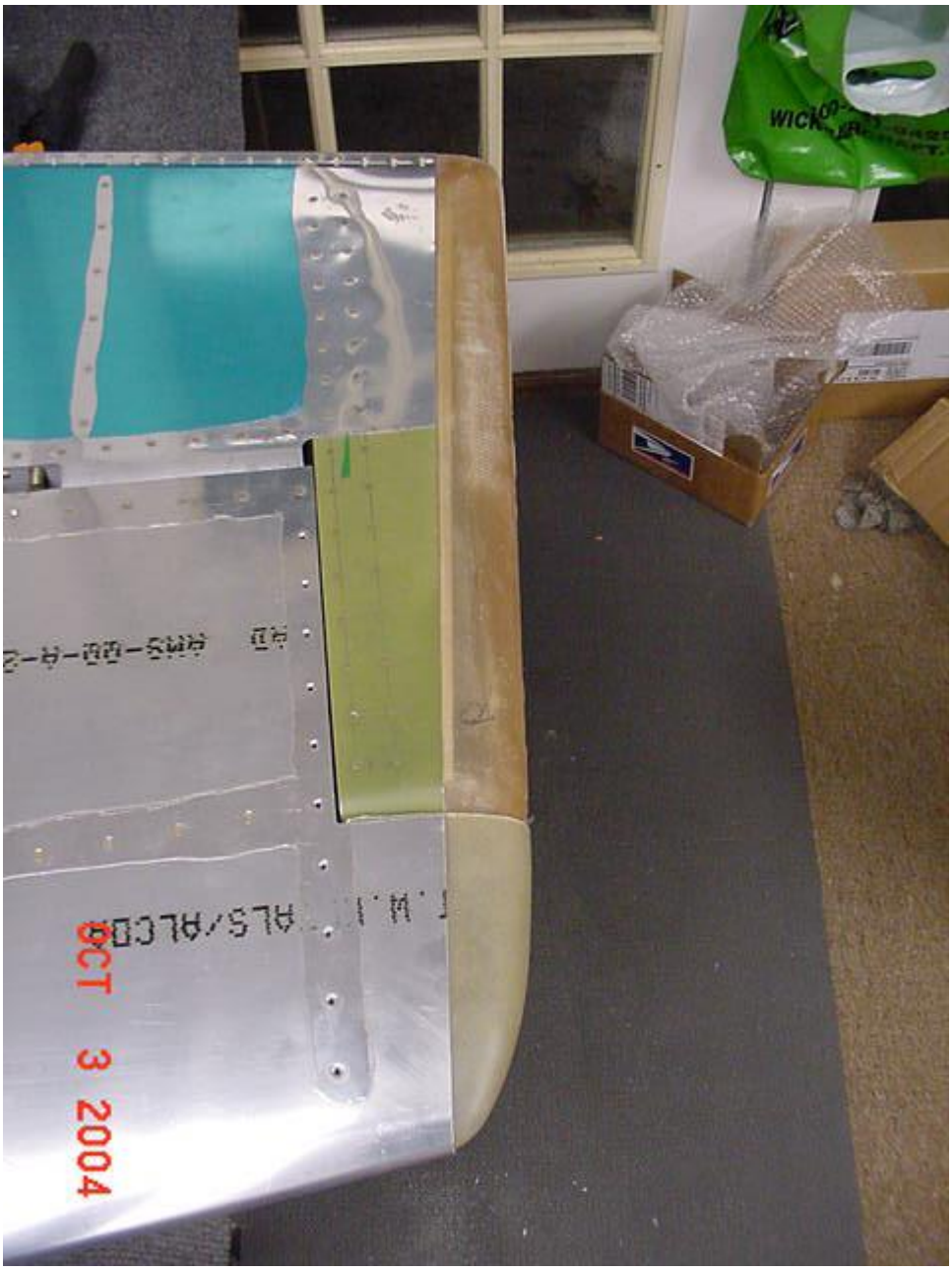
Another thing I did this Labor Day, 2004 was to cut the counterbalance notch in the HS skins. I used a regular cut off wheel (not a heavy duty wheel), and it ripped right through the skin where I measured and marked. I had to get this thing cut out, because I started putting the elevators together, and of course I need to be able to check the clearance and swing them on the HS.
Now it's October 2004 and I'm just back to work on the HS. I was working on the VF and rudder, and now that is down to finishing on the fiberglass. So I brought out the HS to work on it's caps and the elevator caps.

Trimming the HS Counterbalance

I still had not trimmed the counterbalance area of the HS skins. I had marked them some time ago, but wanted to make sure everything was correct. Well, today I checked them and my marks were correct (as far as I can tell... remember, I've never done anything like this before).

I put a disk in the dremmel and went at it. I cut the bottoms on both ends of the HS where the respective elevator c/b's swing through. I fine tuned them with a hand file. I flipped the HS over and cut the c/b's on the top side of the HS skins. Then I hand filed in a little extra clearance in one area. Seems I remembered reading in the plans that you have to trim the skins following the CB outboard contour. So I used my dremmel and cut one side. My whole goal here is to get a bunch of fiberglass parts ready to work on so I can make big gooey messes all at once.

I wasn't sure how to go about attaching the HS right cap. I could leave it as is, put a doubler on the back of both sides and shove the thing inside the HS skin. Then, like Randy Pflanzer likes to do, just build up to the skin edge with micro balloons and epoxy. I'm leaning toward cutting the fiberglass caps flush and then making flange/doublers and screwing the pieces on. As a matter of fact, I'm leaning toward screwing all of the fiberglass pieces on instead of pop riveting. I'm not sure making screws for everything is that much more work than glassing around those gauwdaweful pop rivets.



At any rate, I've worked about 10 hours today, and I'm beat. I cleaned up the basement more than usual (you can't tell!) and called it quits. I'll look at the HS caps again when I'm fresh and decide how to proceed.

I worked on one end at a time. I pinned each elevator in place and marked the HS skins for trimming parallel to the counterbalance outboard edge. I used a dremmel and a cutoff wheel to trim back the skins, then a hand file to straighten it out. I also had to trim the skin to allow the cb to swing through freely. I've allowed for about 3/16 clearance all around. I can adjust this later when I'm closer to finish trimming the edges.

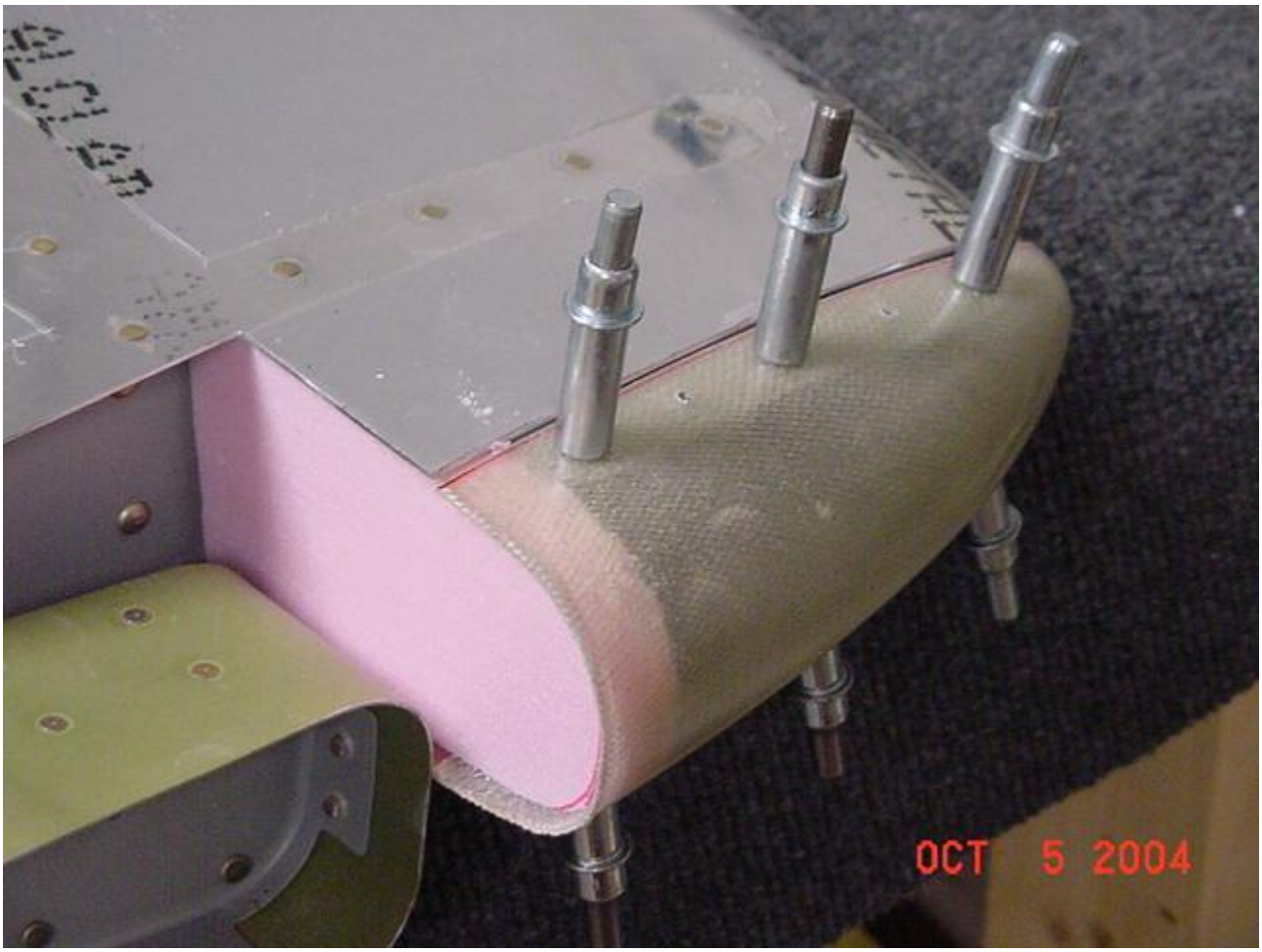
I still hadn't riveted the outboard rib on both ends of the HS. As I was trimming for the end fiberglass caps, I went ahead and finished the riveting. I also epoxied some rivets in holes that were unfortunately inaccessible to squeeze due to the brackets being in the way. This isn't according to Hoyle, but I'd rather have a nice solid rivet filing the hole than mess with a pop rivet. Those things are horrid looking, and so far I haven't gotten any of them to remotely resemble a squeezed rivet.

I'm going to use #4 screws on all the caps. I used scrap .025 for doublers on the left cap, just like the right. I pushed the cap in under the HS skin and eyeballed it next to the elevator cap (which is not

finished). I marked the skin line on the cap and cut it with a dremmel to size. Then I dressed it with a file.

I've drilled #40 holes and clekoed every other hole. I'll countersink the fiberglass and then use soft rivet to attach the doubler to the cap.

Once the doublers are on, I used some pink polystyrene board trimmed to shape to not only help contour the fiberglass cap, but I'm also using it to close the HS skin in front of the elevator c/b.



So far I'm only using one layer of BID cloth with a copious layer of quick set epoxy. I'll trim to fit, then sand and get this part close to being finished. Once all the caps (all 7 of them on the empennage) are close to being finished, I'll re-epoxy them, probably with micro balloons, then go through the normal fiberglass finishing steps with filler and sanding primer.

Install the HS

Months have passed and I'm finally getting back to work. Remnants of Hurricane Rita came through Indiana today, dumping rain for about 10 hours straight. I decided I might as well work on the Rocket. Since my engine is no where to be seen and months overdue, I decided to rearrange the basement a bit and begin to install the tail feathers. They will of course have to come right back off, but hey, I need something to work on.

The HS mounts on the flat area at the tail end (no surprise) of the empennage. It bolts to the two thick vertical bars sticking out of the back of the ship. It doesn't sit flat on the F-019 deck, but is in fact

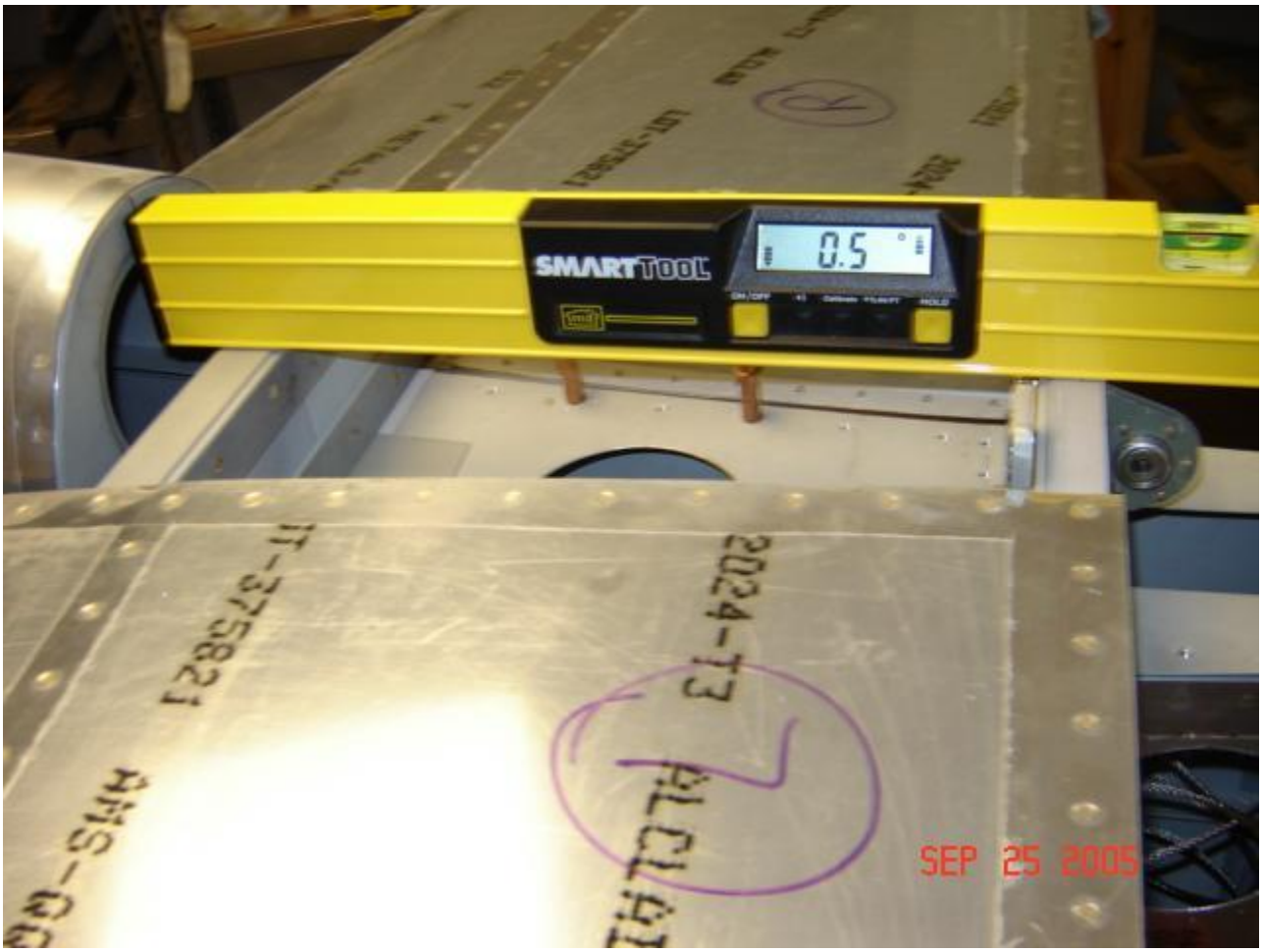
about 1/4 inch above it at the rear spar of the HS. This aids in setting the angle of incidence, which when finished is supposed to be +1/2 degree. I take that to mean that the leading edge of the HS will be .5 degrees UP at the front. That doesn't make sense to me, usually the HS is supposed to fly down in order to raise/hold the nose up. As is often the case, I am waiting for Mark to clarify that measurement.

When you set the HS in place, you have to shim it up. First, you level the fuselage in various locations, then you set a 5/16" shim and a 1/4" shim under the front and rear HS spars, respectively. In this case, I used the recommended drill bit. Yes, a drill bit. How handy is that? Already pre sized and just about the most convenient shape to get the job done. Once the bits were in place, I clamped the rear HS spar to the vertical bars (tail fork). Out comes the digital level. You are shooting for completely flat (as in LEVEL) side to side. This was not as easy as it sounds. I started by drilling the first hole located per plans with a #40 bit. Then the next hole is drilled and all the measurements re-checked to level. And then the next and the next hole the same process. Then up to a #30 bit. As I went along, I didn't have any fancy screw down type cleko thingies, so I left drill bits in the holes and the HS clamped to the tail forks. Finally, I stepped up in bit size and started inserting AN3 hardware. As I went along, I had to jockey the HS a bit to keep it level. After the first two holes were drilled, I also noticed the HS wasn't centered well enough, and had shifted. So I had to tweak those initial holes a bit, too. Fortunately using the method I chose mad correcting everything fairly easy, but it was quite tedious and took me a couple hours.

Once the AN3's were ready to insert through the HS into the tail forks, I made sure the holes were quite tight. You really don't want any slop at this point. Later on, it may be necessary if I find things are not as level as I thought, but for now, I want the HS to stay exactly where I put it. I did not nut up

the AN hardware, I just help both forks with a quick clamp. You have to take the HS on an off a few times, so it takes a lot less time if you just clamp it.

Now that the HS is level horizontally, it's time to set the incidence. I took out the drill bit shims from under the edges of the spars and made sure the midline of the spars was centered on the ship. My digital level showed that the HS was sitting at about +.1 degree incidence, so now I have to use aluminum sheet to shim up under the front spar until I get it to +.5 degrees. I used various pieces of scrap until I got the right combination of no more than two pieces. One piece would be preferred, but it's probably going to be over .040. So a combination of sizes will work best. I finally got the right combination of materials and I think I will err to the +.6 degree side because when I bolt the thing down I think it will compress somewhat.



*****NOTE:** In the pic above see that I have + .5 degree incidence. NOTE THAT FOR THE EVO, the recommendation is ZERO incidence! The +.5 degrees is for the stock F1. The difference between the HS just sitting on the emp deck and tightening down all the AN3 bolts is about -.2 to -.3 degrees.! Don't think you can just lay the HS on there and expect it to be the correct incidence after torquing down the bolts.

*****NOTE:** When you drill the holes for the AN3 bolts that go in the forward spar of the HS, the OUTER 2 BOLTS go through the emp/fuselage LONGERONS. The other two bolts can be one inch (or more) inboard those two holes. I chose to put 6 bolts through the HS into the emp instead of 4. Yes, I had already spaced 4 holes inboard of the longerons. Fortunately I had plenty of room for the two additional AND VERY IMPORTANT bolts. I used standard nutplates on the inboard bolts, but chose to use "corner" nutplates for the AN3 bolts in the longeron bolts.

Doesn't seem like I did much, but I worked on the F1 10 hours today. I did a few other things in addition to working on the HS, but it was slow going. After nearly four months of not building, I was really out of the groove. I hope it comes back to me quickly!

Here it is, after Christmas '05 and I still don't have an engine. It's hard to get motivated because of the repeated disappointment. Oh well, time marches on. Spilt milk and all that. If necessary I'll let the legal system try to straighten it out. Moore on that later.

Today, I finally bolted the HS in place. The tricky part is the bolts that hold the front spar down on the deck at the empennage. After leveling the fuse, I had two .040 shims in under the left side of the HS front spar to level it up. One shim was all the way across the deck and one was cut to cover just the left half of the deck. There is evidently some twist in the fuselage, because when it is balanced at the fuse and front spar, the aft end of the HS is not completely level. It may be twisted as much as .3 degrees. Guess I might have to contend with a turning tendency because of that. Of course there are so many variables it's hard to tell where a turning tending originates.

What I found out was that after you torque down the 10 each AN3 bolts holding HS on the airframe (I put 6 in the HS front spar and then 4 in the "forks"), the HS front spar shims were insufficient and had to add another .032 shim on the left side.

Time to go back to the Vertical Fin page to see how it is installed!