Gear legs, Wheels, Tires and Brakes

The engine mount is also the landing gear leg mount. Two nicely machined titanium tapered rod gear legs fit VERY precisely into two very long steel cylinders that are part of the moly steel tubing engine mount. The two legs are held into the mount by two 1 5/8 inch titanium nuts which are torqued to 50 pounds and safety tied.

Note: the picture below shows how the gear legs go in the engine mount, but this method of landing gear/wheel alignment is ***no longer recommended****!!!!*

The Gear Leg "Foot"

At the south end of the gear leg, there is a steel "foot" or socket. The gear leg is machined down and the "foot" fits over the machined leg about 5 inches. At the end of the foot is a pad that will accept the axle for the wheels, brakes and wheel pant.

To get the toe in just right (supposedly), the plans tell you to level the mount on some surface and get plumb bobs and attach boards or angles and blah blah blah. Hooey.

I put my mount on my table and trued it up to level using my digital level. I had to shim the mounts with several large fender washers that I was using with the hardware bolts for attaching the EM to the FW. I used the top of the pads that actually set against the firewall for leveling. Nothing else on the "Indy" mount comes remotely close to being uniform as far as leveling. In other words you can't use any of the tubing or the dynofocal pads because they are all angled and offset.

Once the mount was level (more voodoo than rocket science), I clamped that baby down to keep it from moving. It is going to hold two gear legs extending out and down from the mount, so it has to be tight and secure.

Now assuming (and you know what that means) that the mount is level, I inserted the gear legs into the mount.

BTW, my gear legs are side specific. In a better world, the legs would be machined identically, but they are not. And the steel "feet" are side specific, too. So I marked the mount, legs and feet so I can easier mate them back up later.

A rubber mallet is handy not only to remove the gear legs from the mount, but also in seating the legs into the tapered cylinder before nutting them down. I put the locking shim on the head of the leg and spun the titanium nut on it and tightened it down. I whacked it a couple times and tightened the nut again. I did this several times to assure the legs were completely to seat. Well, as completely as they could be without torquing them to the final 50 pounds. The plans say torque to 10 pounds for this procedure. I made the nuts as tight as I could, using the mallet taps and my hands. I still don't have the crowfoot wrench required to torque the nut. I didn't worry about it. The legs have a machined thread area at the head that VERY precisely fits through the top of the EM gear tube. That lines up the legs VERY precisely. Once seated, the gear legs do not rotate. Well, I don't think they do, and I will assume they cannot.

The legs are now securely in the mount, and hanging over the side of my table in mid air. The steel feet are placed on the ends of the legs with the round pad facing out.

Note: Don't use this technique to align your landing gear socket. This is where the "Hooey" really comes into play. I did NOT use a plumb line, boards, water, nails, laser etc.. What I did was use my trusty digital level and just set it up against the pad. Then I rotated the foot until the pad showed that it was 0.5 degree toe in. The plans say you are supposed to set the pad 1/32 inch toe in at some 13+inches away from the pad. The likelihood for me to get that kind of accuracy with a plumb line is slim to none. With a digital level, it took me about 5 minutes to get the feet marked and ready to drill!

I used a ruler and marked several lines across the gear leg and foot. This gave me a way of making sure I kept the leg and foot in alignment. One foot was extremely tight and did not want to wander, but the other foot could move fairly freely. This was a potential problem during drilling.

The idea here is to mark the feet and then drill them to accept a 5/16 bolt to hold it on the leg at a very slight toe in. And with my gear foot set a 1/2 degree, let me tell you, just the slightest bit rotated off the mark would make a huge difference in the amount of toe in. Back when there were email archives, I read it was very common for guys to get this wrong and they would have to do some serious shimming to align the wheels. Well, we shall see how it goes. I'll know more later how successful I was when I get the plane on the gear and check it sitting on the floor.

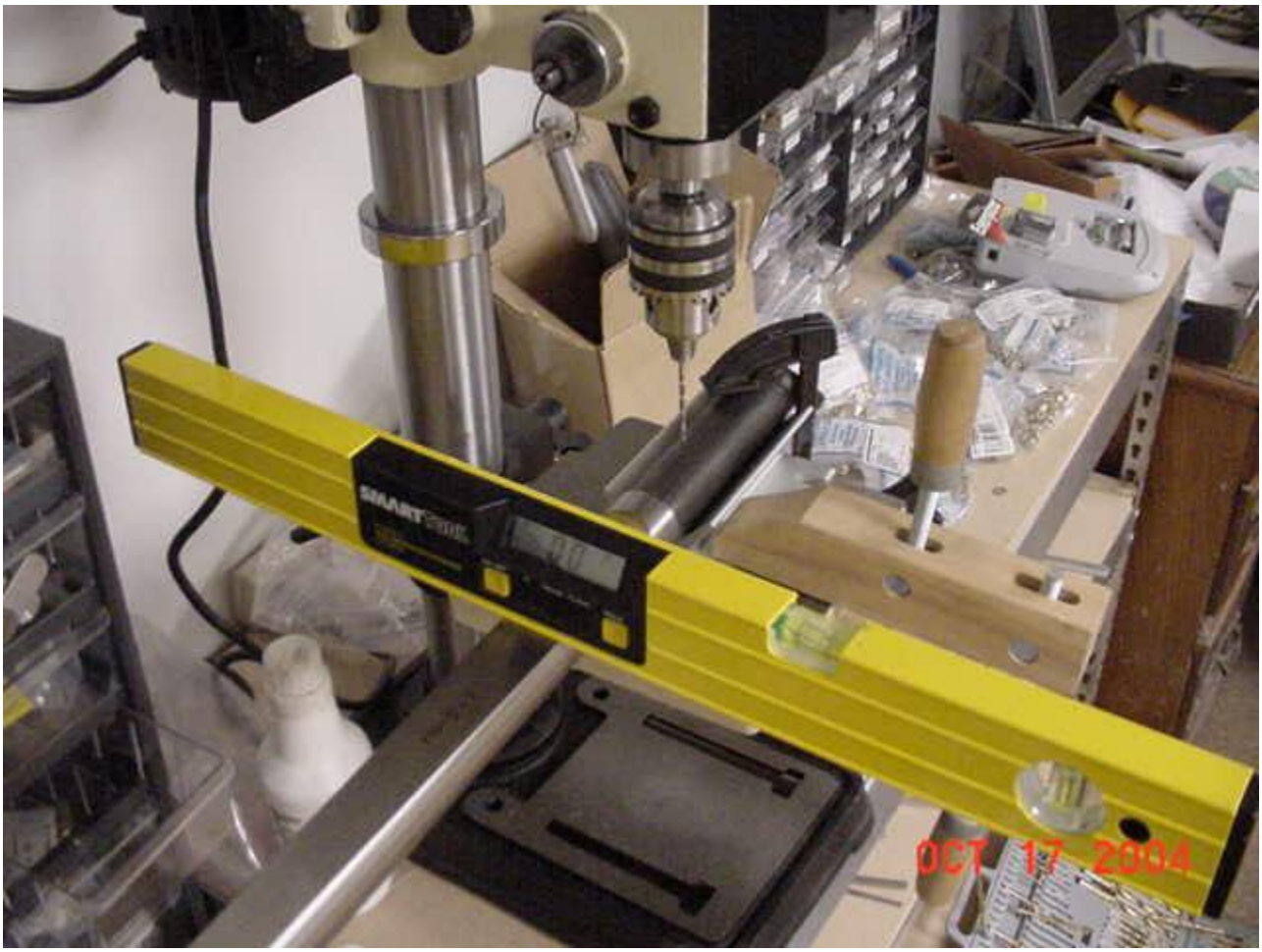
I made about 6 marks on the gear leg and foot, and the carefully tapped (malleted) the gear leg out of the mount. I set up my "CENTER-IT" drilling jig on my little bench top drill press. This little V shaped aluminum jig made drilling the center of the round tubing and leg very much simpler. I bought it at Wicks during OSH. $15 well spent.

I used some cardboard boxes to support the leg, and clamped the foot very carefully into the Center-It.

The plans describe a step drilling technique to drill the bolt hole through the steel foot and titanium leg. I only used 3 of the 4 described sizes. I started with #30, then 1/4, then 5/16.

****BIG NOTE**: In the pic below, I drilled the hole ***WRONG***! please note that I am drilling the gear leg hole PERPENDICULAR to the flats milled into the gear leg. The plans say align the bolt hole with the

flats. I read this as using the flat for alignment and making a vertical hole, when actually Mark wants you to drill PARALLEL to the flats and put the bolt in the slip stream. That will make fitting the bolt under the fairings much easier. Duh... what a brain fart.



I heard horror stories about drilling titanium. Let me tell you, I was nervous. As it turned out, titanium is easier to drill than stainless steel. It was actually quite fun. The titanium peeled out of the hole in large spiral strands. I had to keep removing the wads of steel, er, titanium "wool" from the work area. I went slow (whatever the factory setting was on my press), and used lots of cutting oil (same as I used when reaming the EM for the gear leg). I chewed up one cheap bit. Those titanium bits (just coated) suck. I threw one out and got out my cobalt bits. I just sailed through it, cleaning and oiling frequently. As with most projects the learning curve is steep uphill at first, then steep downhill after that. The first leg took me about 30 minutes to drill. Then second leg took about 10 minutes.

One gear leg and foot was kind of a loose fit. It wanted to rotate and wander a bit when I was drilling it. What I found was that my drill bit was a cheap POS, and it was getting chewed up by the titanium. The leg was wanting to wobble apart as the trashed tip of the bit wallered around work hardening the hole, not cutting it. I stopped, removed the bit, threw it in the trash, got a fresh Dewalt cobalt bit, said a prayer, and went back to work. Soon as the new bit started cutting cleanly, the parts stopped wanting to move, and I did not have any more problems.

Oh, a note here. I could clamp the foot in the jig on the press, but the gear leg was just resting on top

of a couple cardboard boxes. It wasn't sophisticated, but "adjustable". I dented the cardboard to cradle the leg. That allowed me to get the foot flat and flush into the Center-It jig, too. The only draw back? The leg could move, no way to secure it. But for the most part, this was not a big issue. Only when I had a drill bit go belly up.

Now I have a beautiful 5/16 hole through the foot and leg. The hole corresponds to the flat side machined in the gear leg. The plans state this makes the fit of the bolt and nut under the fairings easier.

I needed a hand file to clean up the edges of the foot after drilling. I cleaned up the steel hole, removed the oil with Prep-All (degreaser cleaner) and scotchbrited the whole thing prior to spraying with self etching primer. I also did this to the wheel pant bracket. After priming, I sprayed these parts with grey enamel and set them aside to cure.

Now that the paint is drying, I decided to start assembling the wheels and brakes.

Wheel and Axle Assembly

I have Grove wheels and brakes with my kit. I dumped the Grove box out and looked for instructions. They ain't for shit. Don't bother.

I got out the wheel halves and removed the retaining clips that hold in the bearings. I tool out the bearings and greased them but good. I cleaned up the excess grease and put the bearing back in and secured the retaining clip.

I couldn't figure how to put the tube in the wheel. Mind you, I have always done my own tires, wheels, brakes and bearings on my other planes, but I hadn't seen a tube and stem like this before. I emailed Mark and told him I must have the wrong tubes. DOOOH!

After taking a break, I came back and looked at the tubes. They have a threaded stem with a ring and two nuts. No instructions. I finally decided to tighten the two nuts to lock the ring against the root of the stem (against the rubber). This little assembly fits nicely in the round cut out in the wheel halves. I placed the tube inside the 5x500 tire. I then lubed the stem a bit and forced it through the grommet in one wheel half. It sticks out perfectly straight. A very nice assembly!

I then let some air into the tube. It helps to mate the second wheel half if the tube is somewhat inflated. I pressed on the second half and bolted the halves and disc rotor, using 7/16 wrench and sockets to secure them GOOTUNTITE!

Don't forget, you have to align the stem with the red mark (yellow with some MFRs) on the rubber.

I was still waiting for the paint to dry on the gear foot and pant bracket, so I started looking for something "landing gear" to do. I checked to make sure I had the wood dampers that you ProSeal to the gear legs. Sure enough, I still had them. So I unpackaged them and checked them out. There are two halves for each of two legs. I wondered why they came in halves, but oh well, no matter.

I figured I was supposed to glue them together. Nothing in the instructions about this. I had some carpenter's glue I bought about 10 years ago laying around. Sure enough, Elmer was still in the bottle and fluid, not the big rock I expected. So I smeared some to each mating side of each pair. I used different glue patterns on each one, trying to get thorough coverage. Had the Elmer's not worked, Liquid Nails would have been my next choice.

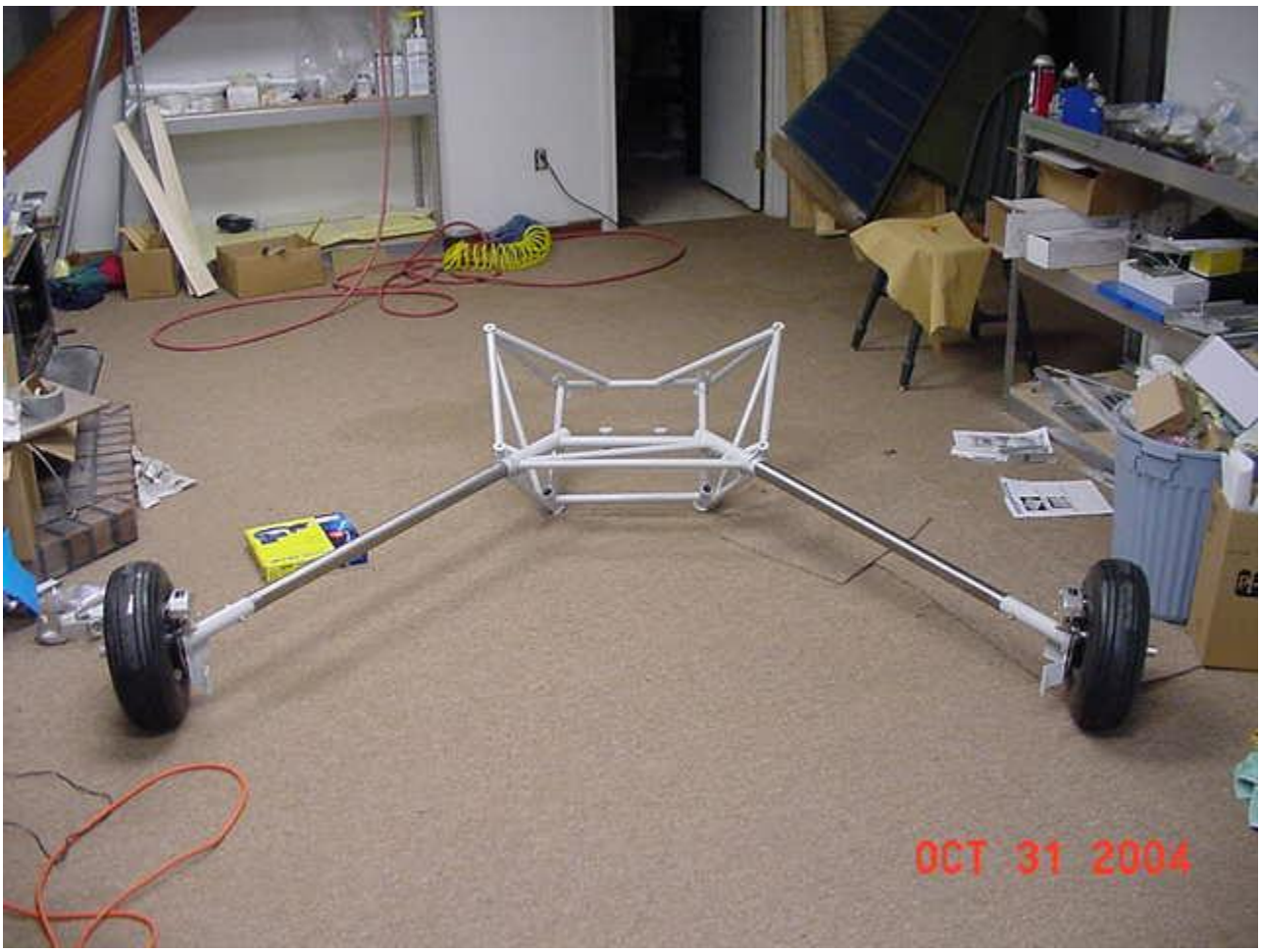
I got out every clamp I own and used 1x2's and clamped all four pieces carefully together. I checked them the next morning and those babies are set! Soon as I get some more parts ready to assemble gear-wise, I'll ProSeal those to the legs, then wrap over them with Fiberglass tape and epoxy.

Rustoleum is not a good paint for my airplane. I figured that out after I painted several different parts with spray cans. Compared to automotive coatings, like PPG Concept, well, the retail rattle-bombs just don't cut the mustard. Everything I've painted is going to get refinished with Concept. Man, I wasted a bunch of time. Now I have lots of stripping, sanding, cleaning and painting to do! DOH!

I sanded and stripped the gear leg "feet" and the wheel pant brackets, then used my touch up HVLP gun to shoot PPG wash primer and primer/sealer on the parts. Next I'll shoot them with PPG Concept. After that, I'll get back on track. I don't want to assemble the brake calipers, axle, and other parts until the bare metal TR parts have been properly painted.

Top coating the parts with the PPG Concept was pretty fun. Once I figured out the right settings on my little HVLP gun, it actually turned out pretty nice. The "warm grey" 1999 Toyota color I picked looks nice and glossy. Except where I shot it too "dry", i.e. not enough paint or too much air pressure. But I got it figured out. Don't think I even had any runs this time. That's a first!

Now that the gear leg "feet" and the wheel pant bracket are painted, as well as the engine mount, I can stick the legs in the mount and assemble the landing gear. That should be a fun little bolt up project. Later on, I'll get the fiberglass parts going. I may not do that until the engine cowl is in place.



Boy, the picture above sure makes my basement "shop" look messy. And it was. I need a lot more room so I can spread out the clutter more! :-)

I clamped the engine mount to my bench, then stuck the gear legs in the mount and finger tightened them down. I went ahead and bolted down the gear leg feet using the hardware supplied by TR.

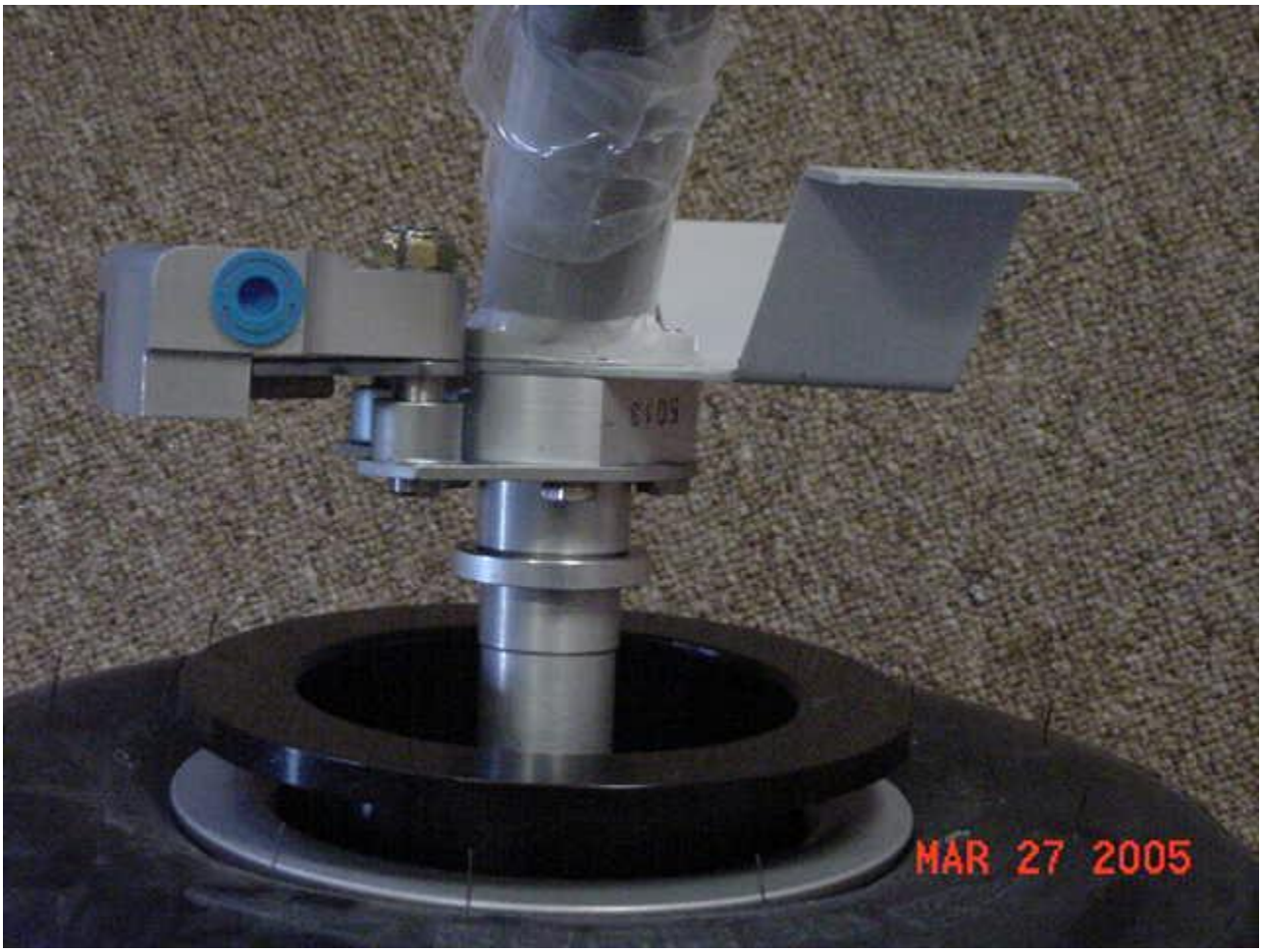
While the legs were dangling in the air, I decided to go ahead and assemble all the main parts at the south end of the legs. The wheel pant bracket goes on first, then the Grove brake retainer, then the axle. It took me three times to get the orientation and combination right. Man, the plans suck in this area! But fortunately, and as usual, the parts only go together one way to make it all work.

After bolting up all the axle stuff, I went ahead and put the wheels, rotors and tires on. I left these assemblies on the gear legs, and removed the legs from the engine mount.These parts go back into storage for a while. They are sitting against the wall in my basement bathroom. I need a bigger shop.

The order of the wheel and axle assembly is not directed in the plans, nor was there any information with the Grove brake assemblies. You have to guess at the puzzle. Again, the parts really only go together one way the best. Let me make it simple. Below is a pic from the top of the assembly showing the correct arrangement of the parts.

The order of parts from the foot outward is: foot, pant bracket (long side up), axle, brake thrust bearing. Originally I had the thrust bearing behind the axle not on it. Thank goodness Mark straightened me out on that one. Not shown: there are two bushings that sit nicely inside the bearings on the wheel. One of them acts as a stop on the axle to hold the wheel/bearings away from the break assembly. In other words the wheel is retained in position on the axle by the bushing in the wheel bearing, not by the shape of the axle. The bushings have a chamfer on the ID. On the inner

bushing, I put the chamfer inboard against the chamfered step in the axle. I put the chamfer on the outer bushing inboard as well, to give the wheel nut the maximum amount of surface to mate against, plus I thought it might actually stay a little cleaner that way.



Contrary to what the TR plans recommend, I am probably making all of my hydraulic lines out of 1/4 inch Nylaflow tubing. I've had aluminum lines break 3 different times on other planes, so I'm making the switch to nylon. With brass fittings. The burst pressure is at least 1000 pounds, and I've been told that you can't put that much pressure on a brake line with your feet and legs. So I'm going plastic.

Some thoughts on gear legs and fairings. I had the pleasure of flying alongside with Vince Frazier the other day. First of all, I watched him taxi his Rocket on the ramp. His gear legs looked like jelly, even with the dampers. I couldn't believe how much they wobbled, even on asphalt. I asked him about this and he commented that it was fine and just took some getting used to. Dampers have been optional I guess in the past, but seeing how much the gear move WITH dampers, no question I'm putting them on from the get go. Also, Vince flew his first 5 or so hours without his gear fairings or wheel pants on. He said his plane flew straight and true, and didn't need any tweaking. Then he put on his fairings and ended up with a significant turning tendency. I think this comment is very helpful and is going to dictate how I proceed with my wheel pants. I think I will initially fly before I put my fairings on, too. And I'll try not to permanently mount them, or make it so I can more easily adjust their position if the airframe develops a turning tendency after the fairings are mounted. Also, Vince commented that he mounted his wheel pants too low to the ground. Operating off of an unimproved or grass strip requires a little more clearance. Not only will the bottom of the fiberglass show considerable wear, but catching plants and debris will put quite a load on the bracketing and could cause failure of the pants. I'm going to try to mount mine high enough to get off the ground, but low enough to still be aerodynamic. I

actually don't know if I can get both. Having decided to proceed in flying first and then adding fairings later, I'm only going to prime the parts, not final paint them. I'm sure I'll bugger them up trying to get them aligned.

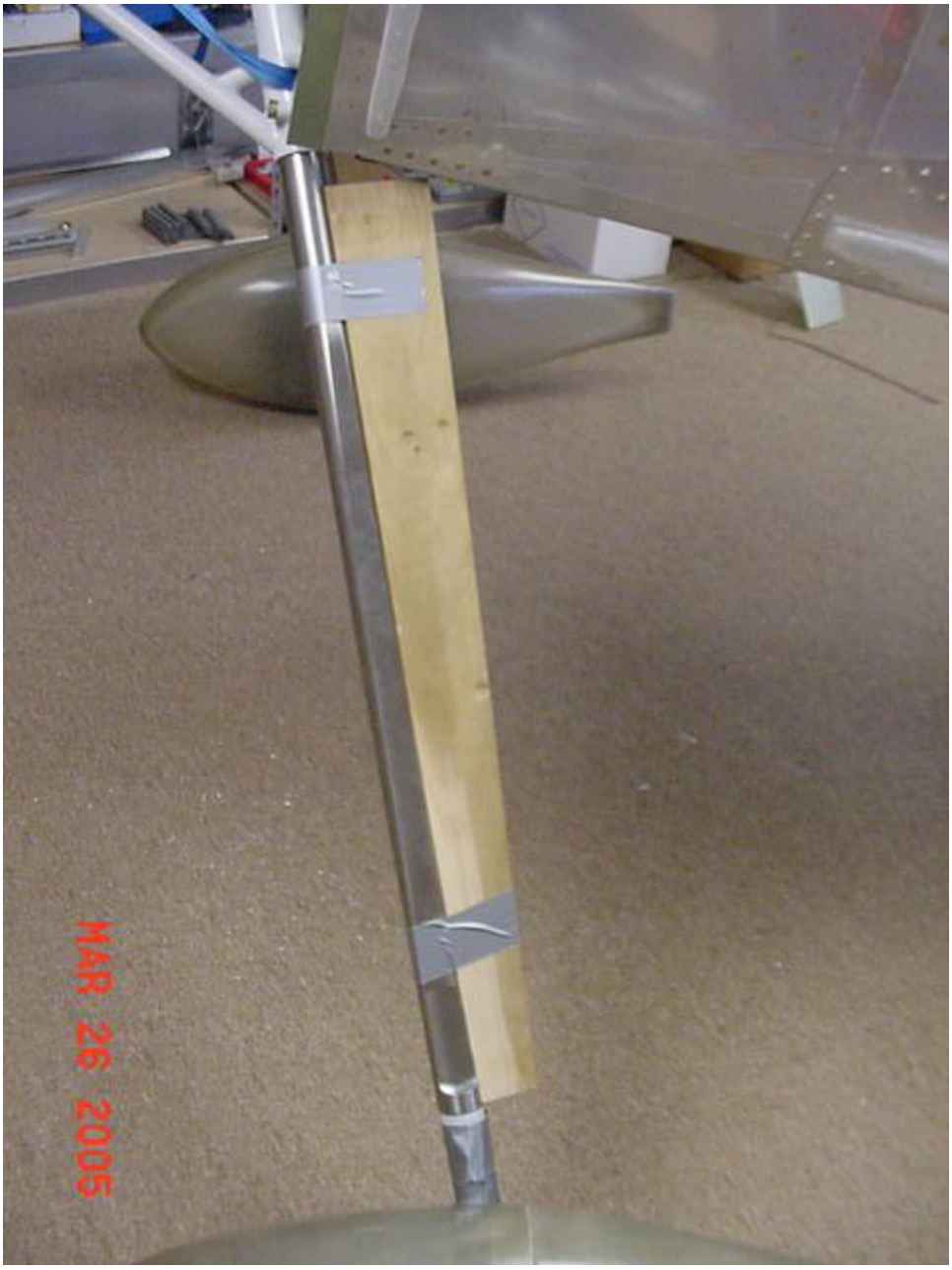
I'll be adding the dampers pretty soon. My engine "core" should be here soon (March '05). I will need to reinstall the engine mount and of course the gear legs in order to hang the engine and begin installation of the engine cowl and other components firewall forward (FWF). The plan is to mount the mount and hang the engine in my basement so I can work on the cowl in heated, well lighted comfort. Then I will remove everything back to the firewall, and send the engine back to the builder for completion. At that point, I will move back into the garage and permanently start mounting parts FWF.

Gear Leg Dampers

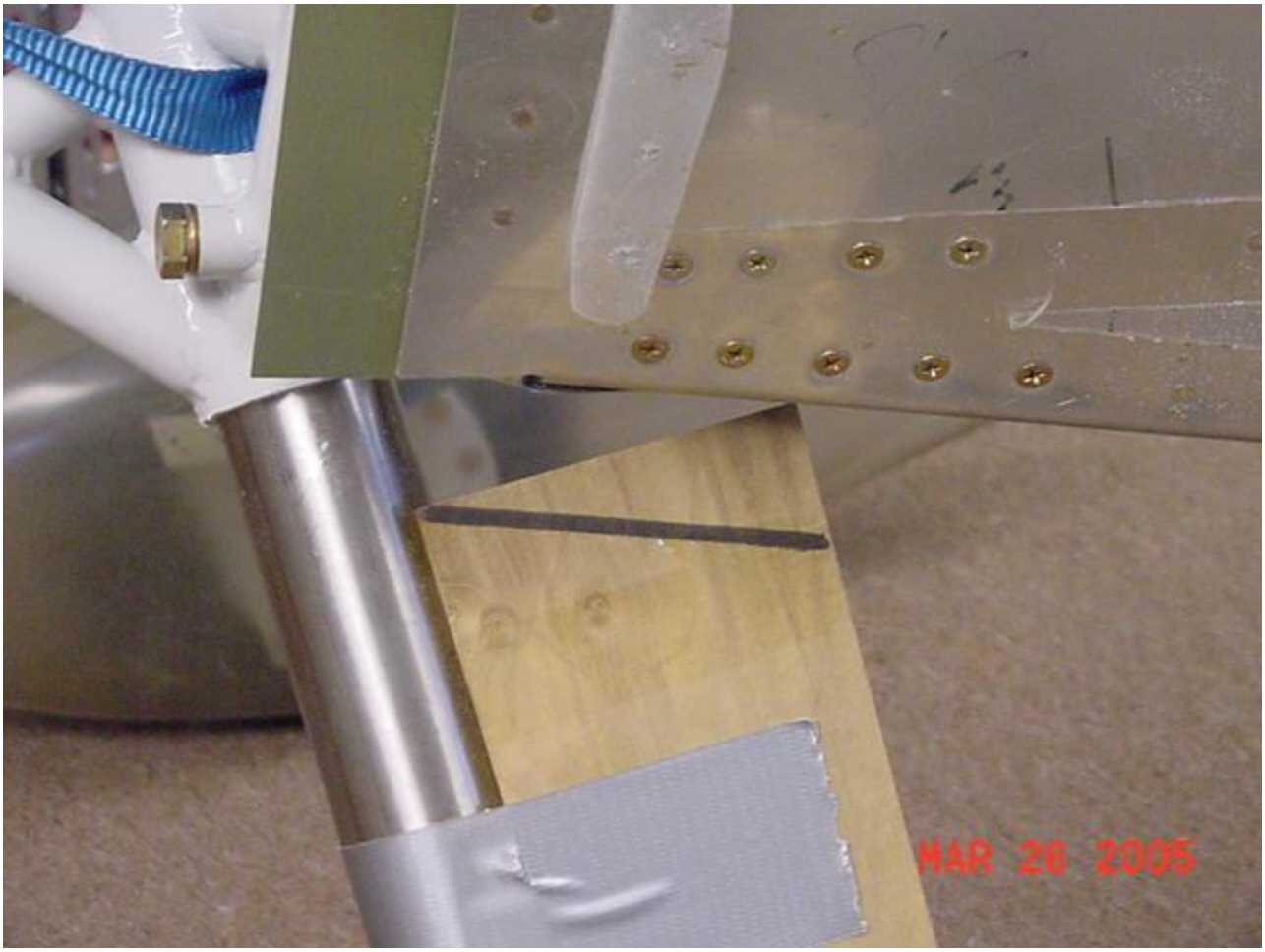
Now that the business end of the gear legs are together, it's time to consider the wood dampers again. Evidently some of these machines have a nasty shimmy due to the nature of the gear leg structure. Whether it's the titanium "spring" type gear leg, the way it comes out of the engine mount, or what, I don't know. But gluing fir (not fur) to the titanium legs reportedly cuts the shimmy out nearly completely, and is now a standard part of the kit.

After due consideration, I will not be grooving out the wood gear leg dampers for an aluminum sleeve to run inside along the gear leg. There are reports of brake line failures due to running them inside tubing under the dampers. So I am just going to keep it simple and run the nylon brake line along the dampers, probably fastened (more like "guided") with cushion clamps on the top side of the dampers.

The gear leg dampers (as provided in halves) have already been Elmer's glued together (about 6 months ago). I sanded the recessed part that mates to the gear leg in the center with a coarse grit sanding sponge. I cleaned up the glue and the edges. The dampers are 31 inches long and over 3 inches wide at the broadest part which goes near the fuselage. The plans need updated. There is only 32 inches of titanium visible below the fuselage. I would think the more wood you can glue to the titanium, the less wobble you're going to get, so I am reluctant to trim the wood until it measures the 2 3/4 wide measurement in the plans.



What I plan to do is just to slice a bevel on the wood near the fuselage and ProSeal (or GOOP) the wood dampers to the titanium legs.



I think if you leave the corner on there, it's going to interfere in service, plus the damper will extend over the steel foot. The cut might make fiberglassing the tape over the leg a bit easier,too. I think it will work. I checked the fairings over the dampers already and it should all fit together.

I simply duct taped the dampers into place to see where they sit. The plans don't specify where along the leg to put them. Some would think this a no brainer, but I would rather be sure before the ProSeal goes on. Of course you're supposed to use angles and center the damper trailing edges. I'll certainly follow the plans in that respect as soon as I get the dampers cut and confirmation from Mark on the cut.

Mark confirms that I have the right idea, so I'll Carry On! as his emails are signed.

The fuse was already hoisted so I could change the Charley Fox on the wheel assembly order, so decided to go ahead and glue up one of the dampers. Not a big deal. I grabbed some extruded angle scraps I had laying around and quick clamped them to the gear leg flats. I also used a coping saw to cut the angle off at the top. The angle ended up not matching the lower edge of the fuse, but at an even more open angle away from the ship. I have no idea how much flex there is going to be up there, but I don't want the wood contacting the fuse if I have a hard landing. I suppose if it's THAT hard, I'll have other things to worry about besides a couple pieces of fir.

The dampers won't fit between the clamped extruded angles because the dampers are actually wider than the gear leg. Not much, though. I just guesstimated the location of the angles and took the damper to my bench grinder and knocked off a bit of the edges. When you put the dampers between the angles now, chances are that they are going to want to sit at just the right angle. I'd recommend that when you trim the wood in order to fit on the leg in between the clamped angles, you should trim the the edge of the wood where it mates to the leg entire length of the wood so that when you glass it down, you get a nice smooth profile and transition. In other words the wood dampers are slightly

wider than the diameter of the gear leg and the dampers need to be sanded or trimmed to match the leg. Remember, you may want to fly the plane without the gear leg fairings on and the dampers exposed to the wind. It's a good idea to have them smooth and uniform.

I used GOOP instead of ProSeal. I have both materials. The GOOP is easier to work with, sets faster, cheaper and readily available.. My basement is cold-ish and my ProSeal is old. When I used it on my windshield, it took about a week to set up. I don't wanna wait that long. I smeared a good coating of GOOP on the gear leg where I thought the damper would contact it. Then I loaded the channel in the leg with lots of GOOP. When I seated the left damper, the thing just went right to place and stayed there. I was thinking I could just leave it that way, but then decided that it might slip over time. So I got out my wooden screw clamps and carefully squeezed them onto the leg and damper trailing edge. The whole thing shifted ever so much with the pressure from twisting the handle of the clamp, so I very carefully scooted the damper back to position by pushing the trailing edge. This is not an exacting process, but you can get it right eyeballing it. The wood just has to be close to centered so it sits under the gear leg fairing (GLF) OK. I went back about an hour after I clamped it and made sure nothing had shifted. I think I'll leave it clamped for a few hours at least.

Two days later, the GOOP is set. I kinda forgot about the gear leg dampers while I was playing with other stuff. I came back to the left leg and removed the clamps. That puppy is one there! I was feeling frisky, so rather than GOOP the other leg, I decided to glass the left leg.

Before I started painting epoxy on the BID cloth, I cut some regular cloth off the bolt. I don't know the weight, it's about the same as my tapes, and FAA certified BID stuff. I had it on hand, so I used it. The plans say wrap a tape this way, then wrap a tape that way. Well, I had some 3 inch tape left and I did a test wrap. Man, it would take a full roll of fiberglass tape to do two wraps on each of both legs. That's a LOT of tape and a bunch of money. I decided to be cheap and use cloth (since I had a bolt laying around), so I cut a tapered piece that would wrap from the trailing edge on the top, then all the way back around, passed the trailing edge again, and ended at the trailing edge on the bottom. That hides the ugly edge, and makes sure the "tail" of the cloth is going aft. Not that it mattered, because I was going to wrap it once with 3 inch tape.

Note: Having completed this process, I probably should have started the cloth in the middle of the bottom side of the damper instead of at the trailing edge, then double wrapped it. That way you would go over the trailing edge twice. The way I wrapped the cloth, the weakest point is the trailing edge because there is only a single layer over it. I'll tell you that it was somewhat difficult to get the cloth to lay over the trailing edge without bulging into big bubbles. A double layer would have been even tougher. The good news is that since you still want to wrap it at an angle, the tape would undoubtedly pull the trailing edge cloth down taught, even with 2 or more layers. But I would imagine that the trailing edge of the damper gets the most force from the shuffle and bowing of the legs. Therefor the trailing edge of the cloth should probably be thicker. As it is I have two layers over the edge, with 3 layers overlapped in some places. Time will tell how it holds up. I think it'll be fine. If not, you'll certainly hear about it.

I slathered the epoxy resin on the damper and over the gear leg. Then I set the bare cloth onto the leg and started wetting it with a 2 inch disposable brush. I did the top, then the bottom, then the top, then the bottom. As I went along, I brushed in the direction of the trailing edge to keep the cloth taught. There was still some air bubbles at the trailing edge. The fiberglass cloth just doesn't want to make that tight of a turn.

I kept brushing and working the cloth until it looked saturated and most all the air bubbles were out from underneath. Then I got the 3 inch tape that I test wrapped on the leg and started wrapping it

from the bottom up. I overlapped the edges anywhere from 1/4 to 1/2 inch or so.

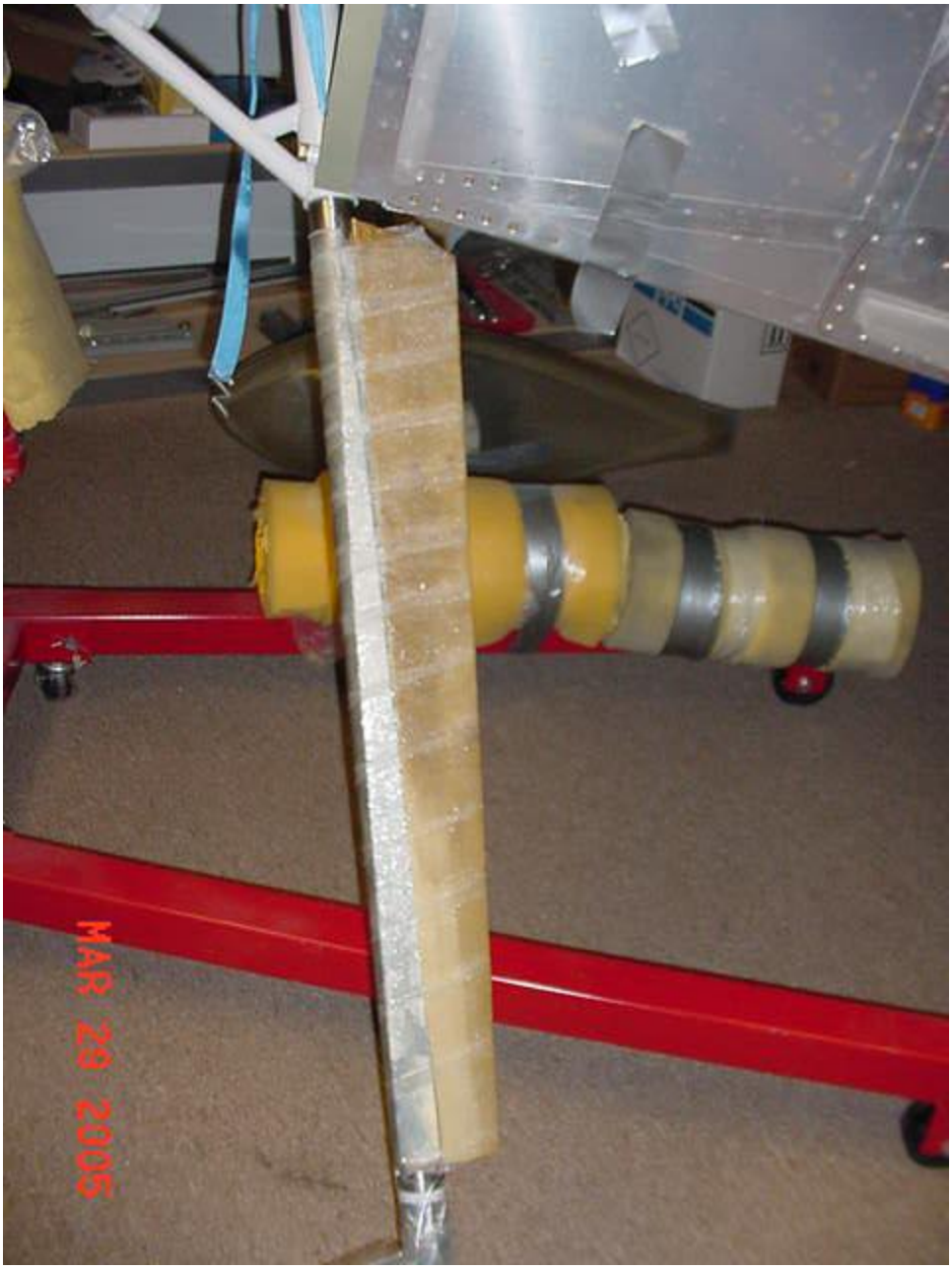
Don't forget that all this COULD come loose. I made sure the cloth and the tape were positioned in the machined area of the flat of the leg at the bottom, to help keep the whole thing from slipping down if the damper breaks free from the GOOP bond on the leg. I also lapped the tape over the beveled top of the damper, so the fiberglass would help to retain the damper at the upper end.

I used the brush again to work the tape taught. Be careful not to pull the edges of the wraps apart or you'll have to peel it apart and start over. Don't ask how I know...

Once this was done, I of course snapped a picture then walked away. If the second batch of slow I had to used to put down the tape layer sets in relative comparison to other 4 squirt batches, that tape should be mostly set by late tonight. Sure enough, just before bedtime, the resin was almost cured.

There is nothing holding the tape on except epoxy resin. I did not have to fasten the cloth or tapes to keep them in place when I started. I suppose that if I had a staple gun handy, I might have shot a few staples in it just to keep the tail end in place, but once I wet and overlapped it, the cloth stayed put quite nicely.

Once it completely sets up, I'll check it, perhaps trim it some, then move on to the other leg.



After glassing the left leg, I went back and did the same process on the right leg. GOOPed, left the damper clamped 2 days, painted the surfaces with West System, wrapped 2 plies of BID cloth as one continuous piece, terminating at the trailing edge, then wrapped 3 inch tape from bottom to top with about 1/2 to 3/4 inch overlap. After completing that side, I went back with a course sanding sponge and hit the surface of the other glassed damper to knock down and smooth out the glass. Once both are set up, I'll need to go back with my dremel and clean up the ends. That might have to wait until the legs are off the ship again to do that, which should happen soon. Unless I take down a wall and knock down my fence to get my plane out of my basement.

Wheel Pants

When I was goofing around waiting to hear from Mark on the Dampers, I started playing with the wheel pants. You have to cut them before you can get them located and install them. They come without any opening for the gear leg. I simply held the front half of the pant on the tire and bracket and marked where the top and bottom of the gear leg would intersect. I cut the "hole" at the mating edge of the pant and tried it on. I had to cut it three times to get it where I wanted it (so far). I shoved the halves of the pants together and marked the "hole" on the rear pant. Then I cut that one too. I did the same thing to the other side and then duct taped the parts together over the tire and rear leg. When you start this process, cut the front half to fit the gear leg and the width of the tire first.

Starting to look pretty cool, eh? Those wheel pants came very clean from the factory as far as the quality of how they mate. The finish in some places kind of sucks, but over all they are VERY nice. Some guys don't like the front/back style pant. Unless I can find a faster set of pants, these are the ones that I'm sticking with.

Contrary to the plans, the first thing you should do when you try to it these pants is BEND THE SHIT out of the wheel pant bracket. I bent the top and the bottom bracket down a lot. Not because they didn't fit the contour of the pant, but because they made the pant too tight. IOW, the brackets pull the pant very hard and bind it against the outside of the tire and the mounting spool. So I bent them and reshaped them a little to take some tension off the fiberglass pant.

One thing I did that was sorta wrong was to cut a bunch out of the rear half of the pants to fit them over the gear leg. You could actually just shave the edge off and get it to fit on the wheel over the axle. I cut completely back thought the "doubled" area that fits under the front pant. It wasn't necessary, but other than cosmetically it shouldn't hurt anything. I don't think it will compromise the strength. Anyway, when you start to fit these pants, most of the cutting is done out of the front pant. You certainly can cut too much off, so you need to be careful. But the wheel pant gear leg intersection fairing is pretty large and can cover quite a bit of mistake there.

I set the two halves together and duct taped them. The plans say to put in 5 or 6 #8 screws, and don't get too close to the bottom. That just means drill your hole where you can get a good straight shot at the screw with a screwdriver. For fitment purposes, I actually only put in 4 #40 clekos. It's possible that I may not want to use the holes I drilled in the end. I can fill them easy enough if I need to.

I did not use a 1 inch spacer on top of my tire. I used a 5/8 inch thick piece of scrap wood I had laying around. It was fairly long, so it probably held the pant up more like around 3/4 inch. I duct taped it to the rubber.

During this fitting process, I had the fuse hooked to a hoist. I was moving the whole thing up and down off the gear so I could see what what going on under the pants and mark them. What I found was that most of the marking and therefore cutting that I did was at either end and on the outboard side of the tire cutout at the bottom of the wheel pant. Even after bending, the bracket holds the wheel pant quite a ways out away from the tire, so there's quite a gap at the bottom on the brake caliper side of the pant. I had to cut more than 1/2 inch at the ends, and every bit of 3/8 from the outside at the tire opening of the pant. I used my air saw to cut the tire and axle openings in the pants.

I stopped cutting everything when I could put on both pants clekoed together with the block on top of the tire, and the pants would move around somewhat easily. I have to adjust them to go with the slip stream. First, I had to make them easy to get on and off and get some clearance at the opening for the rubber. In the beginning, the pants were wedged against the bracket and the rubber, and felt bound up. Now they sort of rotate a bit, and I can put them in a range of positions. Now they are probably ready to line up with the slipstream. I'll come back to these later on, maybe months from now, and line these beauties up!

I visited Jim Winings in Indianapolis and he has a cool set of pants that may essentially be "one offs". They are two piece pants as well, but the separation is around the tire inboard over the brake calipers. So looking from the outside, you don't see any seams. Those babies are supposed to be the

slipperiest pants you can find. Jim described the features, which include a much smaller trailing edge "tail fin". When you look at the position of the pant above, you notice it looks pretty nice. Keep in mind that my tail is up on a sawhorse and if it was on the tailwheel and I hit a bump, I would easily scape the bottom of the fin. I may just fill in the back of my wheel pants from the inside with flox and grind them down to the size of J.W.'s, which would make them 2/3 to 1/2 the height. Less drag? Don't know. Dragging less? Absolutely!

Wheel Alignment

I took my legs over to Plainfield, Indiana and had them cut down. I also bought the Airkit LLC shortened gear socket (foot) that has a repositioned mounting plate. This plate significantly inproves wheel alignment (toe in and camber) over the stock sockets (feet). The kit also shortens the titanium gear legs and takes a lot of the jelly wobble out of them.

The alignment process starts when the Rocket is on the gear legs. The wings and everything that will be on and in the plane when flying should be added. In my case, I've been waiting over a year to get to this point. The wings are finally on the airframe out in my hangar. I'll put all the parts on that I can, then salt bag extra weight onto the plane to simulate my 200 pounds and full fuel (typical "flying weight"). I actually used 40 pound salt bags.... 5 to simulate me, 4 on each wing for fuel and stuff, 1 in the back seat for stuff, and one over the engine mount to simulate the cowls, spinner and oil in the engine.

I have some 1/4 inch aluminum plate left over from my tail feather jig. The plan is to grease the bottom of a couple wheel sized plates, and the floor, and slip a plate under each tire. With the added weight and some coaxing, the plane will come to rest in it's aprroximate taxiing stance. Then it's just a matter of marking the orientation, hoisting up the airframe and removing the legs, then center drilling for an attach bolt after assuring that the gear feet (sockets) have the pads aligned at ZERO toe in and ZERO camber (based on extended airframe and wheel centerline marks).

My foldable hoist (Harbor Freight) wasn't tall enough to get over the propeller and lift the airframe high enough to get the wheel assemblies onto the landing gear legs. I called my old buddy Keith Welsh and borrowed his "industrial size" hoist (which we used to get the airframe off of his trailer when I brought the fuse to the hangar). That hoist had more than enough ooomff to get the gear legs up. I pulled off the OEM gear feel and tossed them aside. The right wheel assy went on just fine, but I have to "coax" the left side a lot to even get it part way on. Out comes the files and sandpaper.. and a dollup of grease. After that, no problem!

Originally, I was going to use lasers along the wheels (tires actually) to check the alignment. That's just not practical. However using a laser to get the centerline of the ship IS VERY practical. I centered the ship up in my hangar over the center seam in the concrete floor. Then, I centered my Dad's laser (thanks Dad!) on the seam and shot it along the floor and belly of the ship, all the way to the back of the hangar. With the plane's tires sitting on greased plates, it was easy to center the beam on the belly seam of the fusleage as well as the tailspring and tire. Now that I know the ship is centered, I can work on the wheels. Of course you don't really need to use the center seam on a floor, you can put the laser anywhere you want arbitrarily, and center it up on the ship, and check you measurements agains the beam. I used the BEAM, not the floor seam to make measurements.

Instead of a laser, I used two peices of aluminum angle I had in back stock. Each was over 4 foot long. To prop them off the floor, I used 4 oil filters (still in the box) at the outer ends of the angle and a

brick laying against the angle to make sure it stayed agains the tire. After that, it's a one man job using a large tape measure and double/triple checking measurements just to get everything equal and centered. You want a rectangle, not a parallelogram! Equal AND centered to make it all "square".

It wasn't hard to rotate the wheel assemblies. I used a dead blow and tapped (OK, BANGED) the rubber a couple times to coax the wheel around on the gear leg. Very small taps on the tire with my palm was all that was necessary when I got it down to about 1/8 inch. Once I thought I was finished, I took a break, then came back and double/triple checked my measurements. Good to go! So I made some marks along the leg and foot to index the alignment between them for drilling on the bench.

As an afterthought, I removed all the ballast and checked the aligmentment again. The index marks had not changed, but without the nearly 600 pounds off of the airframe, the tires scooted the greased plates about 4 inches! A quick measurement between the angles showed that there was now about 1/8 inch of TOE OUT! Let that be a lesson to you boys and girls, if you shoot for "zero/zero" on your wheel assemblies, it never actually stays that way. All you can do is guess at your flying weight and hope for some "fudge" when you are flying light. Toe out is not particularly good on a high speed taxi (landing). And flying a little heavy in MY Rocket will probably make landings a lot easier.

Time to hoist up the airframe again, remove the gear legs and wheel assemblies, then drill them together on the bench. That wasn't too tough. Had some help from my flying buddies. Ruined two bits going too fast through the titaium. Man, does that stuff get hot, even with copious cutting oil. Since the gear legs have the dampers on them already, and since the leg diameter is larger than the foot diameter, getting the leg to sit perpendicular in a drilling jig was tough. So the bolt holes didn't end up perfectly centered, but they are really close. I filed off the lip around the drilled holes, lubbed up the parts to keep corrosion down (that steel foot wants to rust pretty badly!), and reinserted the leg/wheel assemblies into the engine mount. NOW it looks like an AIRPLANE!!!!!

Brake Lines & Bleeding

Summit Racing has some nice AN fittings and braided stainless hose. The Grove brakes as supplied need a 1/8 NPT to -4 AN fitting. I was going to use a steel fitting, but opted to use a supplied 90 degree aluminum fitting down at the caliper. In fact the only steel fitting is the bulkhead fitting through the firewall.

Locating the bulkhead fittings was a little tricky. I was trying to figure out how to install a parkling brake valve in the brake system. Icouldn't figure out where I wanted to put the push pull cable because the arm on the valve seemed to work the opposite of what direction was convenient. Finally I stuck the valve assembly on the top of the footwell in the firewall, directy in the center between the brake cylinders. Then, I needed to determine access to that valve and run high pressure lines to the

other side of the firewall. I was going to run the hoses outboard near the sidewalls on the firewall, but decided instead not to have long tubing runs over or around the pedals, and just went through the center of the footwell. The next decision was where to run the lines and where to locate the bulkhead fittings in the footwell. Essentially you have to decide top or bottom. I decided to run the bulkhead fittings just above the level of the engine mount bolts in that area. The bulkhead fittings are then over the mount cross tube and away from the fuel pump and the exhaust pipes and hangars. That makes the braided lines that run along the legs longer, but overall a simpler and more convenient.

The wheel pants are pretty tight around the wheel/tire assembly. It was going to be tough to use a straight fitting in the caliper. A 45 fitting probably would have worked, but I didn't have any on hand. So, 90 degrees it is. Then a 45 degree fitting on the -4 hose end at the caliper. The braided line will run along the leading edge of the gear leg, up over the engine mount leg tube and attach, then up over the middle horizontal mount member and attach to the bulkhead fitting with a 90 degree hose end. Summit makes hose ends in red/blue and anodized black. I decided to use the black for the brake lines. A, because they look cool, B, because the caliper gets so dirty anyway, and C, to differentiate between the red/blue braided stainless fuel lines.

The 5606 FAA/PMA brake fluid has worked very well for most light planes for decades. It does have a low flashpoint, and if you have a hydraulic leak, like onto a red hot brake caliper, it can catch fire. Actually it looks like all brake fluids can catch fire, it's just a matter of temperature. The consensus amoung experimental builders is to use synthetic ATF (automatic transmission fluid), which can tolerate nearly double the heat before reaching flash point. Also, it is compatible with the O rings in the Grove brake calipers. Auto Zone supplied me with 2 quarts of Valvoline synthetic ATF. Turns out that it's red and looks just like 5606. Sure doesn't smell like it, though. They both are nasty.

Once the stainless lines were along the gear legs and attached to the fittings, and the nylon brake system inside the cabin was ready, it was time to fill the sytem and pressurize the brakes. Sadly, it's not as easy as just filling the reservoir and pumping the fluid down. Nope. You gotta get a bleeder adapter and push the air out of the high pressure side of the system from the bottom up. It's an easy job, albeit often messy. (and it did not work for me...)

Bleeding the brakes turned out to be tricky, but easy once you know the secret. Well, once you stumble onto a method that works. Slow, traditional bleeding from the top down? Nope. Pressure bleeding from the bottom? Nope, didn't work. What my friend Jeff Tucker finally suggested was to fill the reservoir, hold pressure on the pedals and then quickly open and shut the bleeder valve at the bottom of the calipers. Once we got the rythmn down, it only took about 20 minutes to do the whole job. Took 3+ hours total to figure out what didn't work! DOH! Once you get that solid feeling brake pedal, the satisfaction is tremendous!

Gear Leg Fairings

Now that the wheels and brakes are installed, it's time to close everything in. The wheel pants will need a little extra trimming around the gear foot bolt and the brakes lines/fittings. After that, it's a matter of positioning the spats and leg fairings. This will be a little interesting because my gear legs are 3 inches shorter than stock. That means I'll have to trim the leg fairings about 3 inches at the top. I hope that doesn't create TOO big a gap at the gear leg/fuselage fairing.

Let me continue by saying that right off the bat, you need to cut like 6 - 8 inches off the top of the GLFs. And contour the top cut to parallel the lower fuselage. After that, I split the "spats" which fair

the junction between the wheel pant and GLF and the GLF and the fuselage. My idea is to work from the top down.

Once the engine cowl is in place, it's pretty easy to take the upper spat and coax it to a stable and good looking position. I drilled each once of these in 3 convenient places into the cowling, but NOT into the metal fuselage. I'm going to try to combine some fasteners into the fuselage with the wing root later. Anyway, once the upper fairing is clekoed in place, then I took the cut GLF and trimmed it some more. So far, the GLF sits inside the upper spat about 3 inches. When I put the wheel pant fairing (lower spat) in place, it looked pretty good all together! I did NOT trim the bottom end of the GLF AT ALL! I kept trimming the top of the GLF until the lower GLF actually sat in that notch in the titanium gear leg. That ends up putting the GLF substantially inside the necks of the spats, but still short enough not to interfere with the wheels/brakes or fuse during service.

The TE of the GLFs have to be cut. Even the molded cut line is not enough, but it is close. Once I trimmed the GLF at each end's TE, just enough to fit in the spats, I observed how everything sits together. My theory here is that if the upper fairing is right, and the GLF is lined up using the upper fairing, then the lower fairing should be easier to locate, and maybe that will help locate the wheel pant. Again, trying to get it all to "work together" (orientation) from the top down.