

# Francois's Hangar

## Gear inspection (AD 77-13-21 Part A)

Time flies, so does our airplanes. **AD 77-13-21** calls for repetitive actions for keeping the landing gear reasonably healthy. This AD has two parts, Part A requires a complete tear down to replace any component that are out of tolerances, and Part B requires to replace the assistance bungees the Comanches are famous for. The rest of the AD is a schedule of the repetition of the actions described above. One comment here, Part B calls for 500 hours and 3 years, IMHO 2 years is probably the most these bungee will sustain (most of their life is in the elongated state after all). These are very inexpensive and a zip to replace (with the right tool and after doing them a few times). They mean to lessen the effort onto the whole system, so in the spirit of preserving precious items such as our motors and transmissions, this is a smart investment.

This page relates to the 1000 hour inspection and a restoration exercise I performed on my ol Twinky. On the first year of ownership, I did replace the conduits with Piper brands and I may do a write-up on this exercise one of these days. Nothing really fancy though, just a major pain. My Comanche also came with recent switches already installed.

This is not a simple task. It takes a lot of time and method to do it well, and since this is something that has to last a long, long time, better do it good was my rationale. I am thinking corrosion and wear here. In short, the mandatory task consists of disassembly and measurement of a number of components. Anything that does not meet the serviceable limits by a certain margin is to be distracted. For the longevity aspect, all steel parts are to be cleaned, glass beaded and cadmium plated. Then, epoxy primed and acrylic enamel (catalyzed) painted. All aluminum parts to be stripped, phosphoric acid cleaned (Alumiprep), chromic conversion treated (Alodyne), and also epoxy primed and acrylic enamel painted. One note here about painting. Any two surfaces that will require torquing will be best to be devoid of any paint (or primer) as we want to avoid any fretting or material displacement that will later alter the torque values. It just take a little more preparation before the priming. Repair on other components is always to be expected and as described below, I found necessary to overhaul other components as well.

So let's do a "before" statement here:



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# Disassembly

The first item on the agenda is to take a zillion of pictures of the current assembly. Not that it will change the course much, but sometimes it helps to avoid some errors, specially on those “which way did this went” type of questioning. As I also discovered, some assembly was done wrong on my plane, not that it changed much the reality, it had to be corrected nonetheless. There was a particular curing solution I found that was made by a previous mechanic to correct what was in fact the recovery of an assembly error problem. There goes to say that one need to keep an eye (perhaps two) on all available drawings, SB, the SM and sometimes the parts catalog.



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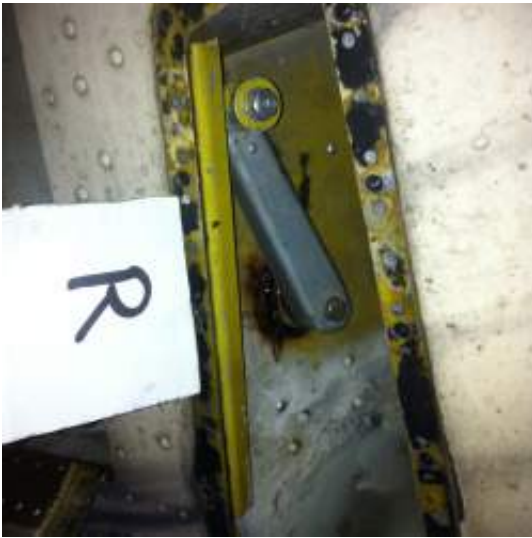
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There are a lot of parts involved. Lots of. So better getting organized. I used large shelves all labeled respectively and also a lot of plastic containers to make bins to hold parts on different stages of renewal. Once I disassembled a section, I cleaned and inspected each part, discarded the old hardware and taking note of what was required to replenish. There are a few close tolerance bolts in the assembly, and my aircraft had some regular bolts substituted, so from my own experience, a side-check with the parts catalog was imperative.



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On the procurement side, I mostly used Webco, Spruce and Avial. I then made hardware packages for each major components and put them in plastic bags for easy retrieval. Kind of making myself a kit built landing gear !



Oh well... this process was quite extensive. That and stripping the old paint on the aluminum parts. But let's move on.

## Other discoveries

Long ago, on the Comanche tips there were calls for cleaning out stress concentration corners around the holes of the web of the main gear struts. Cracks were originating from that hole area and propagated until... well... gear collapse. Although they were documented as done in my logs, I

realized that such was not the case. So “radiusing” and smoothing for the hole and the web edge were in order for both struts. Luckily no cracks were to be found. Braking while cornering seems to be a big stressor on these parts.



Landing gear doors tend to also take a beating. While I did the conduits, some time ago, I made the hinges tighter by drilling a #30 hole and inserting a 1/8 SS welding rod as the hinge pin. That made the door much stiffer and I did not pay much attention to them after that. However, stripping them led to discover other issues that needed attention. A few pictures are worth a proportional number of words on the quality of these repairs...







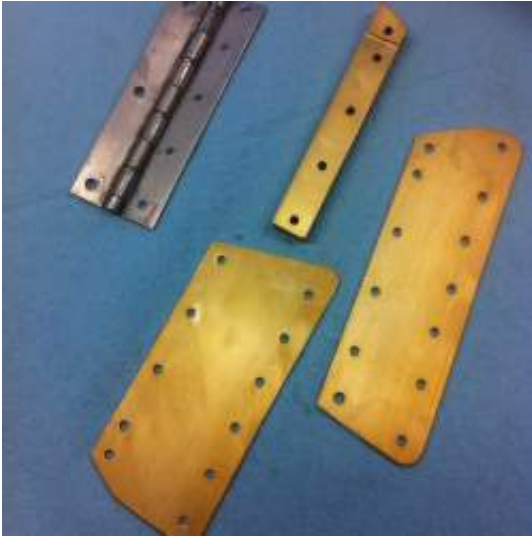


Yikes. Redoing the ugly patch plates (albeit re-using the same unaligned holes on the door portion) and with a mill I re-fabricated the spacer block, it yielded something like this:





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Another call for TLC here: the nose gear pushrod exit seal was showing its age. Time to replace. Using rubberized baffle material, I cut my own and using soft rivets. I re-installed it. It will contribute to less cold air into the cabin, I'm sure.



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# Cleanout

Painted aluminum deserves paint stripper. Old paint need to be removed, parts cleaned, old oxyde removed with phosphoric acid. Then, Alodine treatment is required as a corrosion barrier, but also to enhance primer adhesion to aluminum. Here are the steps one at the time:

Original painted part, paint stripped, Alumiprep treatment, Alodine conversion coating:



Then, steel parts are stripped with glass bead and then sent for cadmium plating.





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And finally, the parts are ready for painting. Here in this following picture, all parts are shown ordered at different stage of preparation being progressively readied for painting:







## Measurements

Unfortunately, I do not have photographs of that central stage, but suffice to say that Piper SL 782B was used as the method of compliance. One caveat here, although I had a complete set of go/no-go gauges, they are often useless whenever some items are worn in an oval fashion. Too many measurements I took were falsely showing good, as one dimension axis exceeded the service limit. So every measurements showing good on the gauges were also done with bore measuring gauges. Every bushings were also ball honed to improve lubrication. Here were my findings:





Bushing removal and re-insertion as usual, heat with a propane torch to extract and a press bench to re-insert. Any diameter reaming done on a drillpress. Measurements to the sidebrace threads were done at a machine shop equipped to do such. Luckily were found within service limits. Also, I replaced the nose gear springs (487-292) as they were no longer showing the service tension (which I cannot find anymore...sorry)

## AD 97-1-1



Also, while everything is disassembled, it is a good time to assess the sidebar stud health by performing AD 97-1-1. As convoluted as this AD can be to read, it is repetitive on a 1000 hours TIS basis.

## Oleo my dear !



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This is typical of a 10-20 year old oleo. Pitting and corrosion. So Off they must go. Wait. Identify and index the parts before parting them-out. These are match drilled. If the fit is so-so in the leg, one can always re-index them and precision re-drill, but chrome plated steel is a pretty tough material to get through. I elected to stamp a number underneath the leg where the holding bolt head is (yes there is a direction) and dremel-out a corresponding number of notches on the end of the sleeve. Putting the leg in a padded vise, a propane torch was sufficient to break the interference fit.

What I found-out also is that two of the legs (the nose and left gear) were not straight. I can't recall the out of straightness value, but that was in the order of 0.020". So.... that had to go for overhaul with a note. A bit of caution here: There are a few certified shops to doing such work, but also other outfits who are specialized in the hydraulic actuators and for the printing machinery who are used to work on much tighter tolerances. They all can rectify and re-grind cylinders, the real challenge is they must know and understand the mechanical relationships of where there is to be an interference



fit and so on. The nose oleo also has an inside piston/ring that must be properly fitted. Bottom line, my take is to pick someone knowledgeable on the parts and where they go. Anyhow the folks at Montreal Chrome were very knowledgeable and did a fabulous job. They successively ground re-plated a number of times to bring back the straightness, as they measured the interior and it was perfectly straight. Also, the interference fit dimensions were right on. They took care to plug the holes where the pins and the close tolerance bolts go as not to gift me of another fight later on. CDN\$ 375 (USD225) a piece was the damage. Not bad.





I elected to not redo the wheel shafts as they were still quite good, they have spent their entire life in grease after all. Re-assembly went easy with the chromed legs kept in the freezer overnight and inserted in the corresponding heated leg using a taper-pin (made-out of a discarded precision bolt). Speed is essential here !



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## Wheel wells... well

While all this funny stuff is happening, I elected to clean the old wells as they suffered from some 48 years of soiling, obviously something needed to be done. Aluminum is the kind, so same drill as the other parts, more corners, rivets and unfortunately much less comfortable positions to deal with (Thanks Rachel for your help there !).



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Once paint stripped, the Alumiprep and Alodine are much harder to apply. I used a spray bottle for the alumiprep (doubled concentration) and let it sit a little, scotchbried it as much as I could and then rinsed with a lot of water. Alodine was applied with a paint brush. It doesn't take much and for a short period of time to work (particularly if the stuff is fresh). Rinsing with ample water and protecting oneself, obviously.



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Here I am are getting ready for the painting. I am using a LPHV spraying system (Croix) and a lot of protection for my short period exposed to the nasty stuff.



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Time to do the well's rear closure plate and its edge protection. Note the main gear bump pad is being glued in place. Sure the exterior paint will need some attention... eventually.



While having fun at painting, lets' jump further into the party. Photos below shows my improvised paint booth and all the prepared parts suspended and ready for action !



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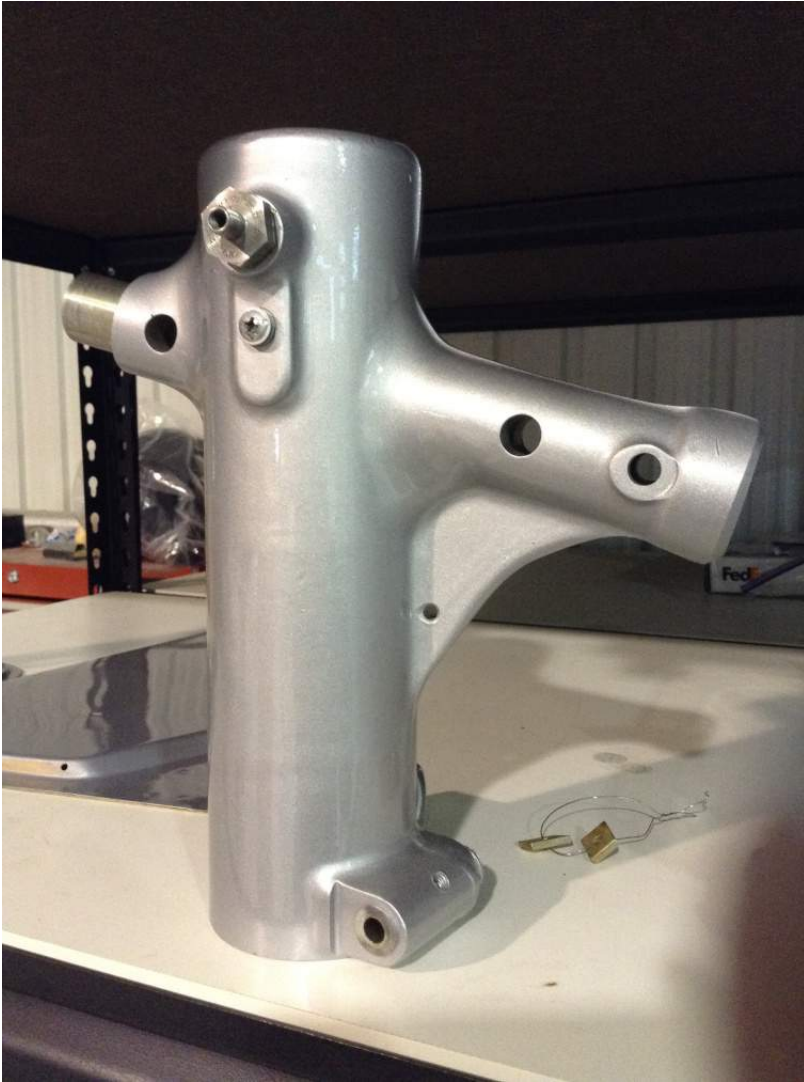


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## Re-assembly

What a treat ! After all this cleaning, sorting, treating, measuring, painting, sourcing... I can finally put it all together. As I said, Kit building is fun !



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Then it is time to put everything where it belongs. I found amazing how tight the assembly was, each component joint and mobility felt good. Wow.



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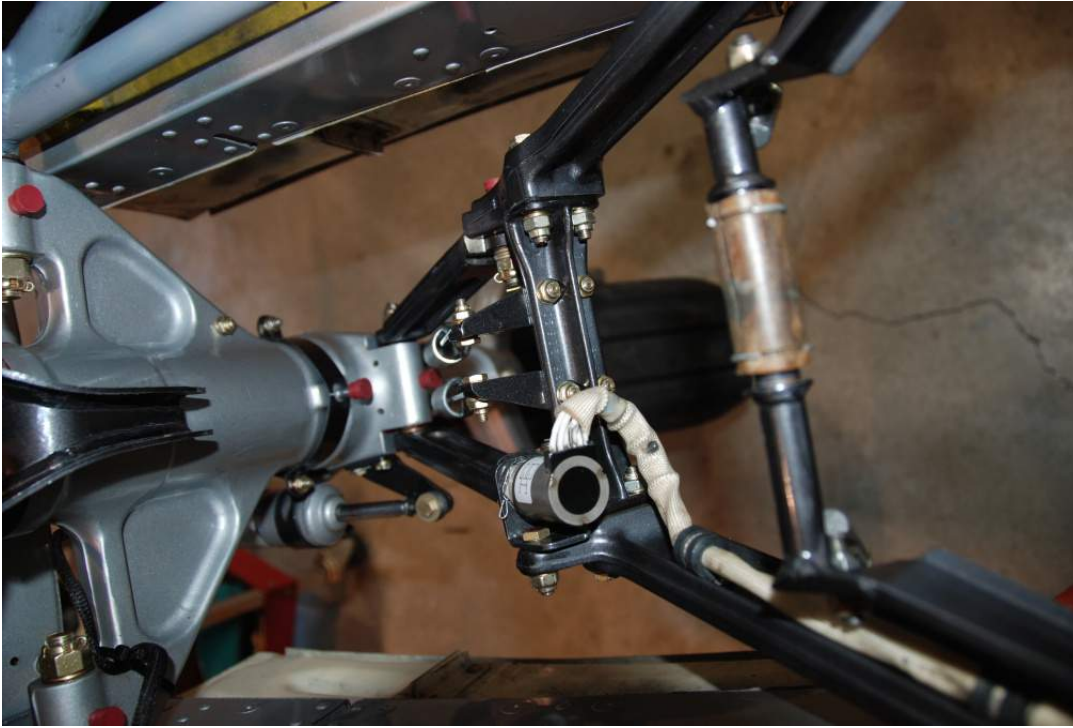


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The nose wheel switch cable has a unique routing to go through. I've seen so many variations of it... This is the way it should go:





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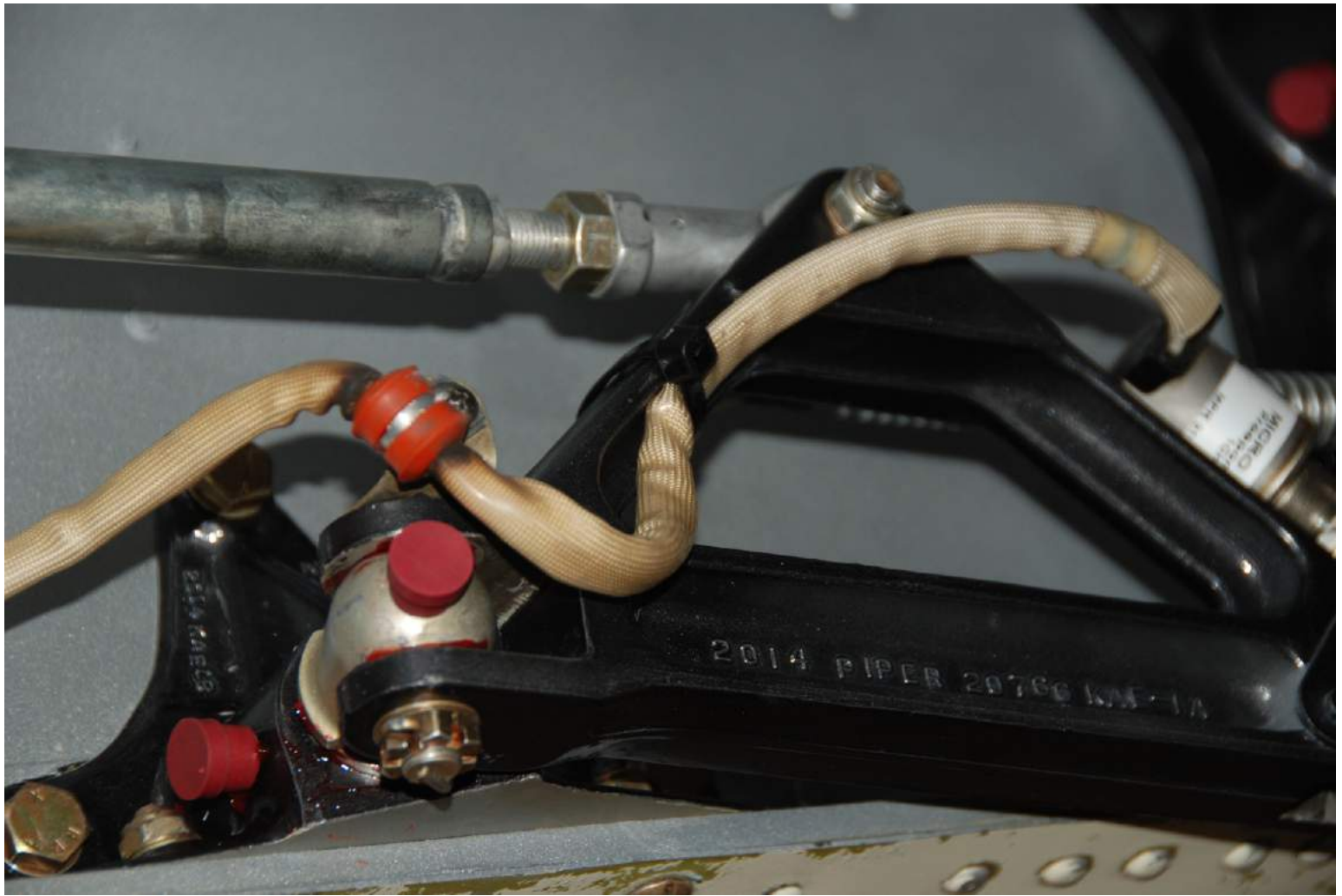
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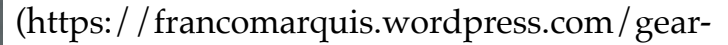


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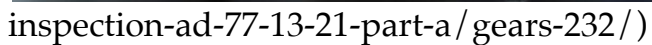
While on that subject, the same applies to the cable for the main gear switches. The proper way is like following. Out of the left of picture is he cable is also attached to the top of the trapezoidal member with an adel clamp.



Main gears are anchored in place. There are a number of shims on these where the longitudinal movement is stopped. The existing sequence on my plane was wrong and a few trials were necessary to get it perfect.



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One word about what is to follow, I do not install the cotter pins on the sidebrace studs as of yet. The clevis will need several install/removal throughout the rigging and switch adjustment phase, so I would keep this for the end.





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New brake lines, new tires&tubes, new brake linings completes the endeavour. Note the brake line routing. Again, this is the only way they should be routed. Note for the brake line leg strap, I used heat shrink tubing, but the variety that is UV resistant (and has glue inside). The wall are much thicker than the normal electronics variants and they should age well.



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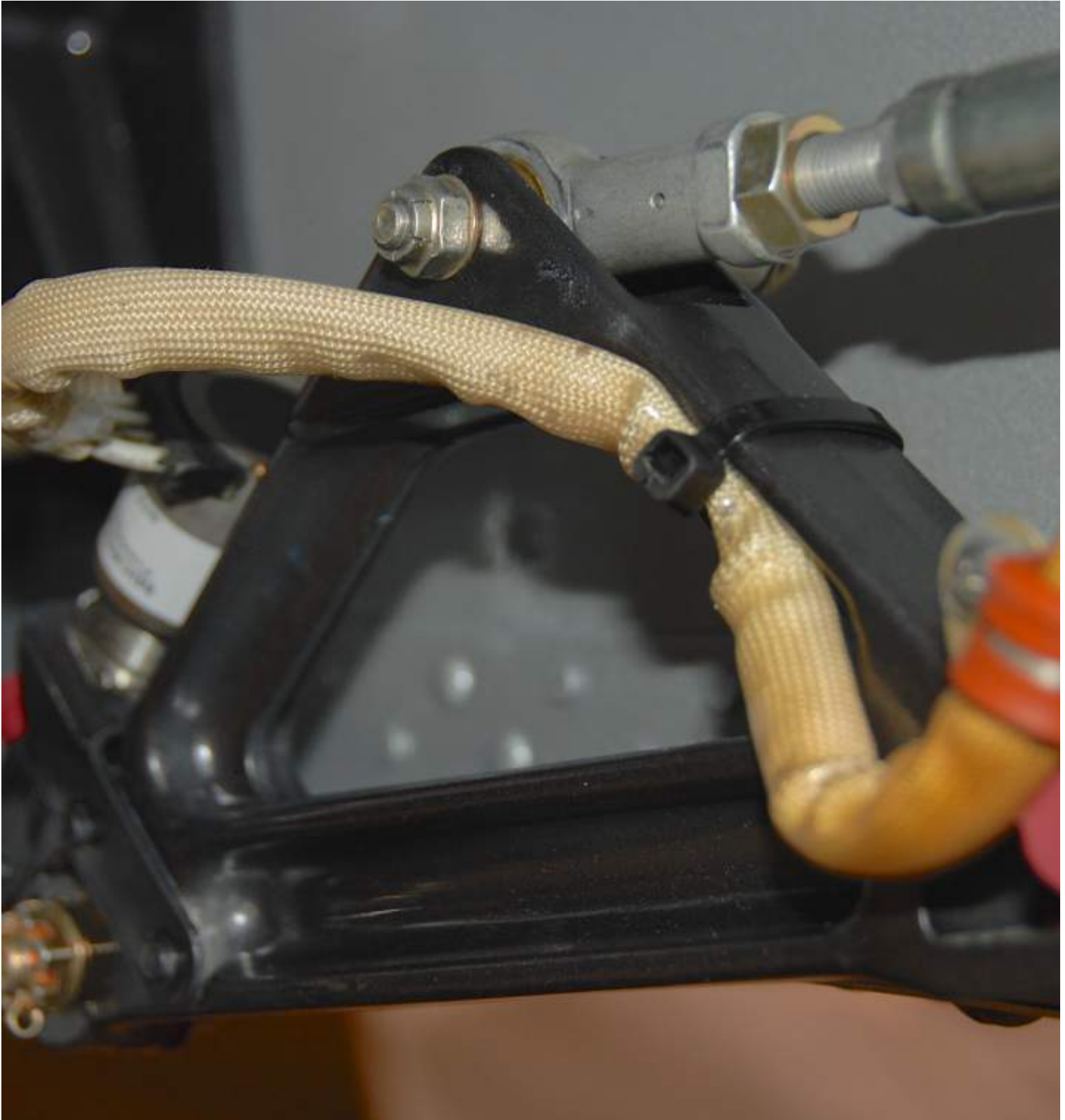
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## Rigging, here we come

Rigging is a very important and critical aspect to that task. By construction, since everything is anew and tight, it is a much better proposition than when I had to do it while installing new conduits. At that time, there was already a number of bushings on the nose drag link and on the side brace that were destabilizing the exercise. I had replaced the faulty bushings then, because I was chasing a moving preload target.

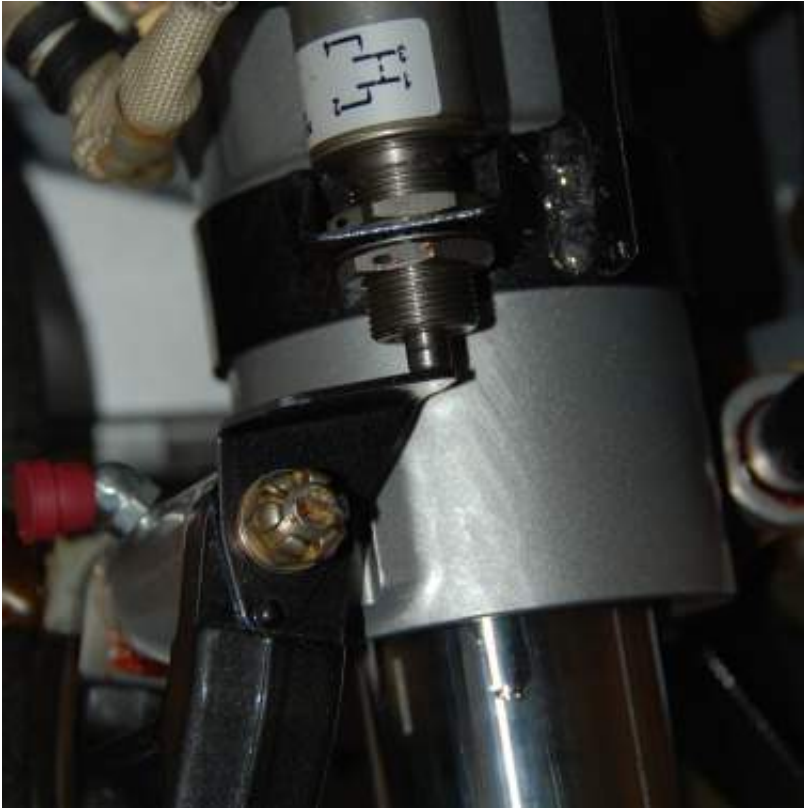
I will not go into the details of the rigging process (I may do a write-up on this someday) but suffice to say that the proper preload condition is the aim. Using the 10.875 reference bar in place of the transmission, I pre-loaded each main gear as per the SM and then I did the nose gear pushrod. Once everything is tight and the bearings are backed (and advanced) by the prescribed number of turns, bungees were re-installed, over-center springs (new ones as always) installed, a few manual ups and down to the down lock shall convince me the preload is fine. A check for each main gear over-centre pressure. They should be equal and definitely positive. With this established, I rigged the “squat” switch on the left strut and safetied it.

One side note here. There is an assembly error that is common with the main gear conduit bearing bolt and the washer schedule. The bolt attaches both the overcenter spring swivel and the conduit bearing to the sidebar arm. Firstly, the bolt head has to face forward. It is not the most comfortable position to install-remove that bolt and that is probably why it is often installed backward. Secondo, there should be one washer between the overcenter spring swivel bushing and the sidebar arm to prevent the bushing to drive itself into the sidebar aluminum.



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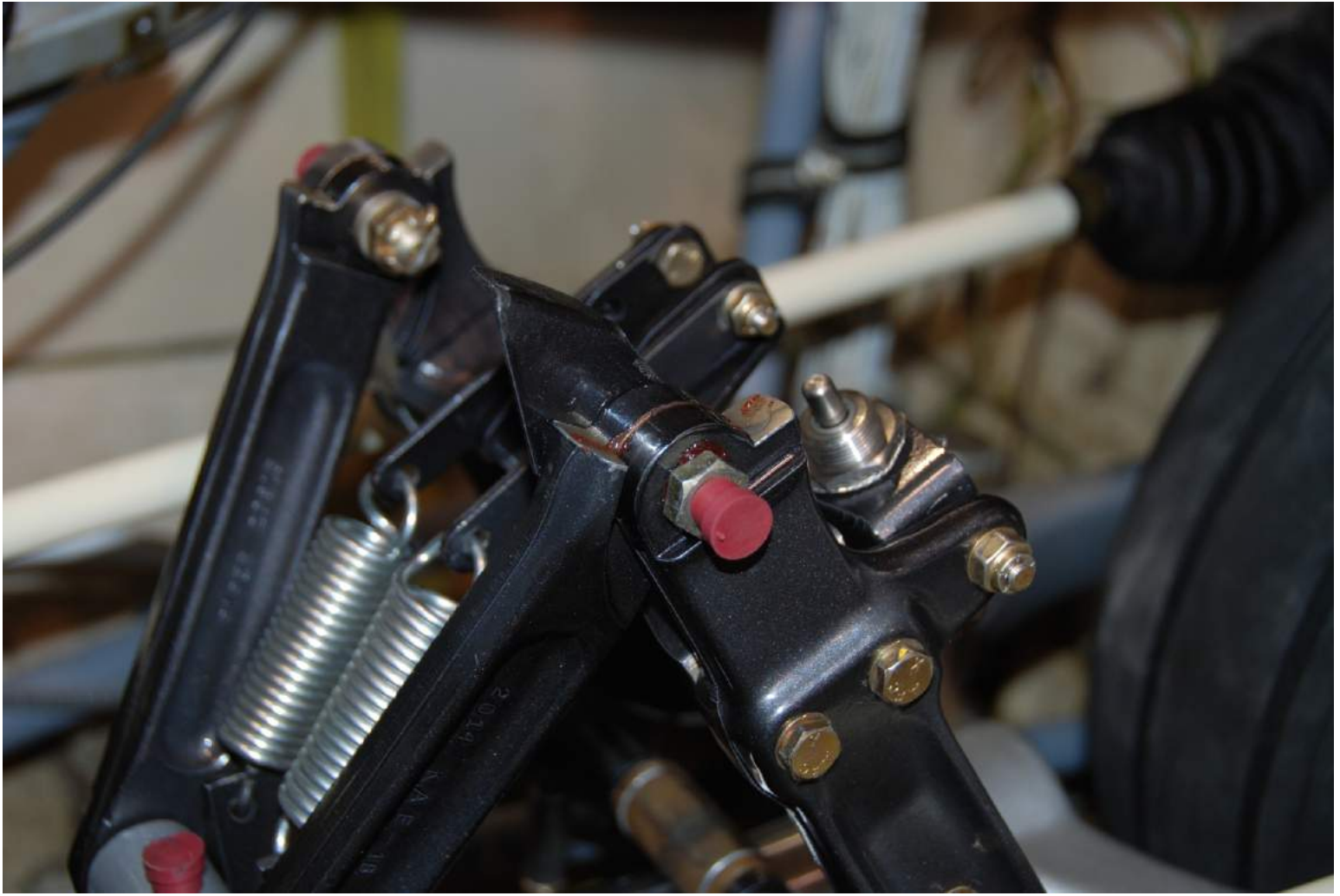


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# Down and locked switches

This is the dreaded part. The SM is so vague as how to do the adjustments that some common sense is required here. The goal is to have the switches to click in the over center position. Not on top, not before but after the overcenter position is reached. With the sidebar stud clevis removed and the rest of the assembly in position, it is easy to feel the overcenter position. It is also relatively easy to sense whenever we are past that point and also the end of the travel. The goal is to have the switch trigger about 1/8 inch past the neutral point. That would be very close if not on to the endpoint. This is where the switch must be set. A few trial and errors should suffice to reach the point. Any lock washer should be placed on the switch exterior jamnut. The inboard can be secured using lock wire against the outer one. For the nose gear, we are looking for 3/16 past the neutral point and is best done with both the springs and pushrod disconnected. This was in my case very much on the endpoint of the arms.



The up limit switch will also require adjustment and the SM describes the method to do that. The transmission can be re-connected and the gears swung. The gear doors that can now be re-rigged as per the SM.





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## Some finishing touches

I elected to do some closeout on the gear wells. Particularly where the conduits and a few cables goes out. The kidney shaped plates are glued with a dab of silicone. Here are some pictures of their construction and the actual finish.



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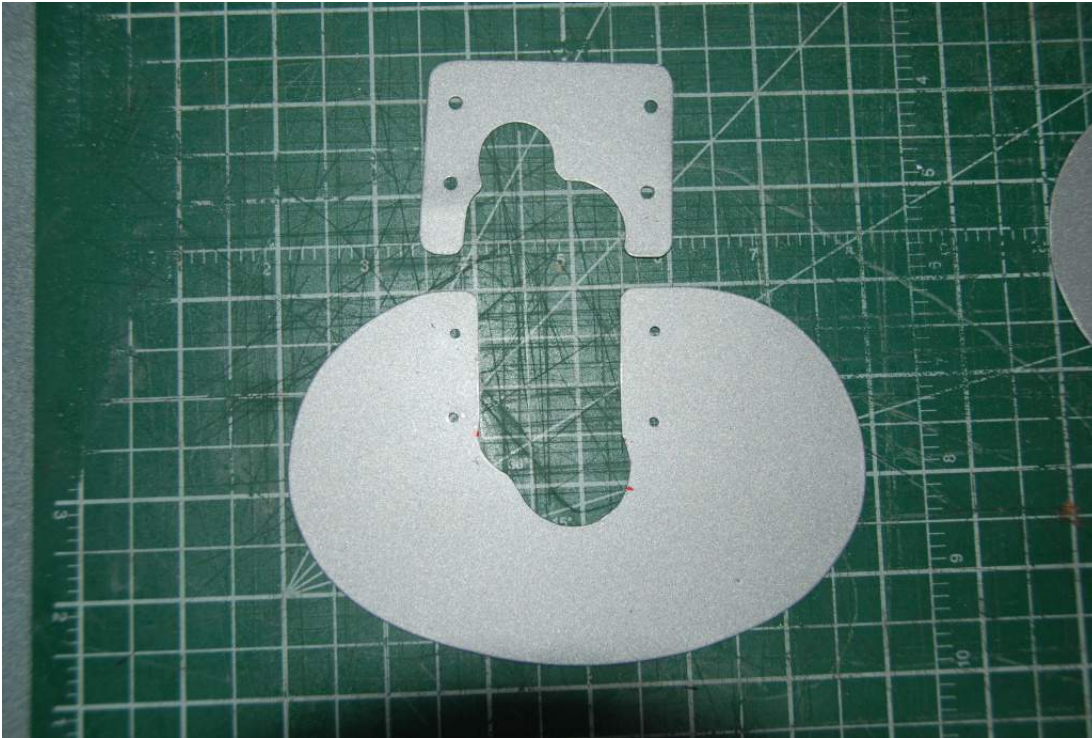


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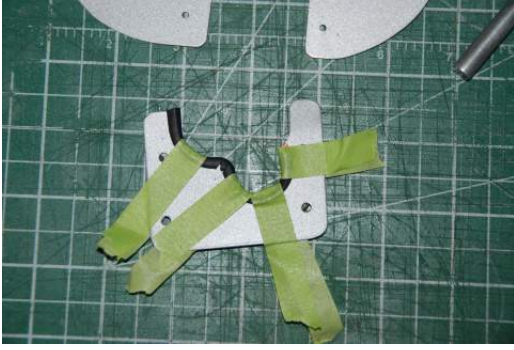
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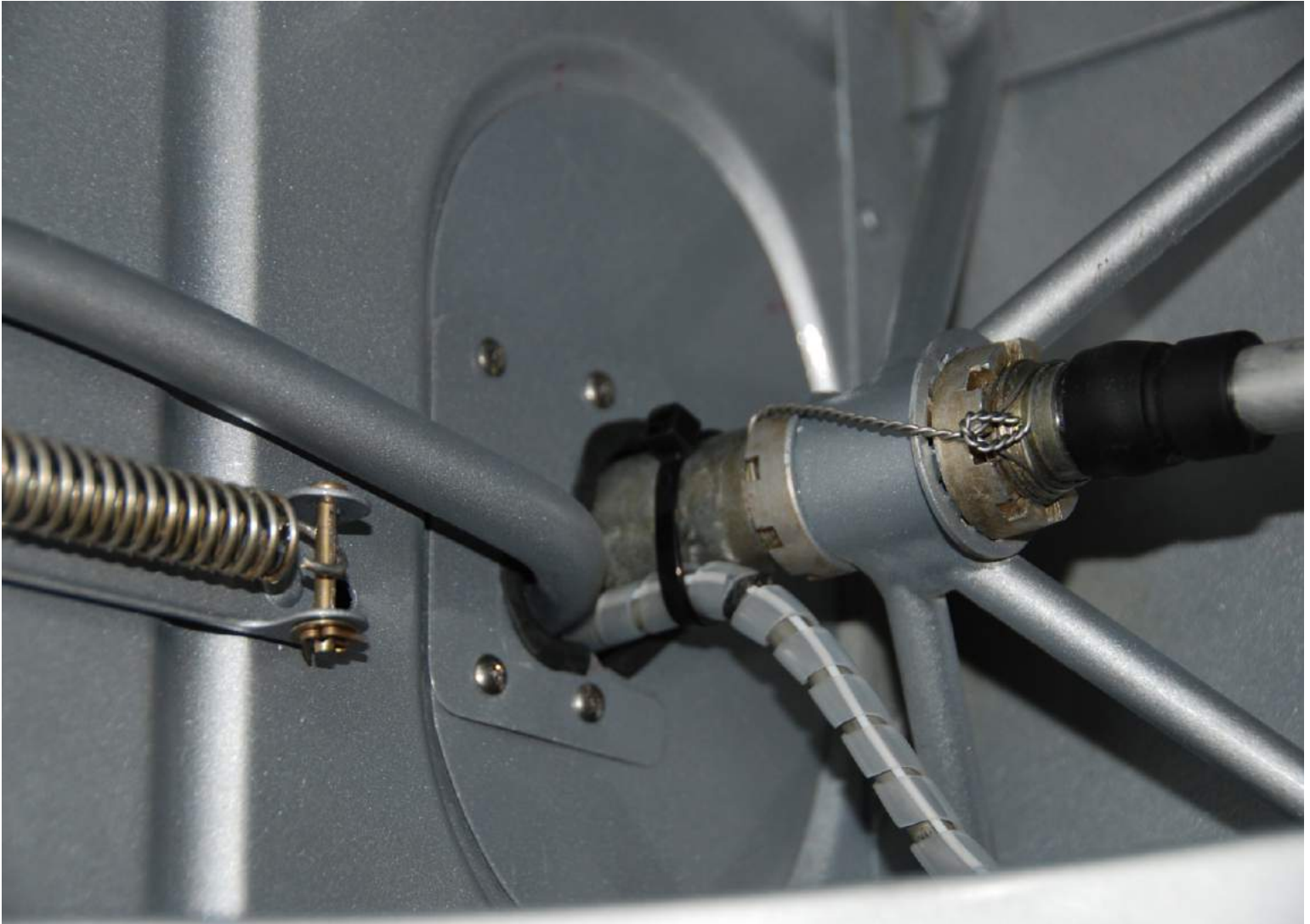
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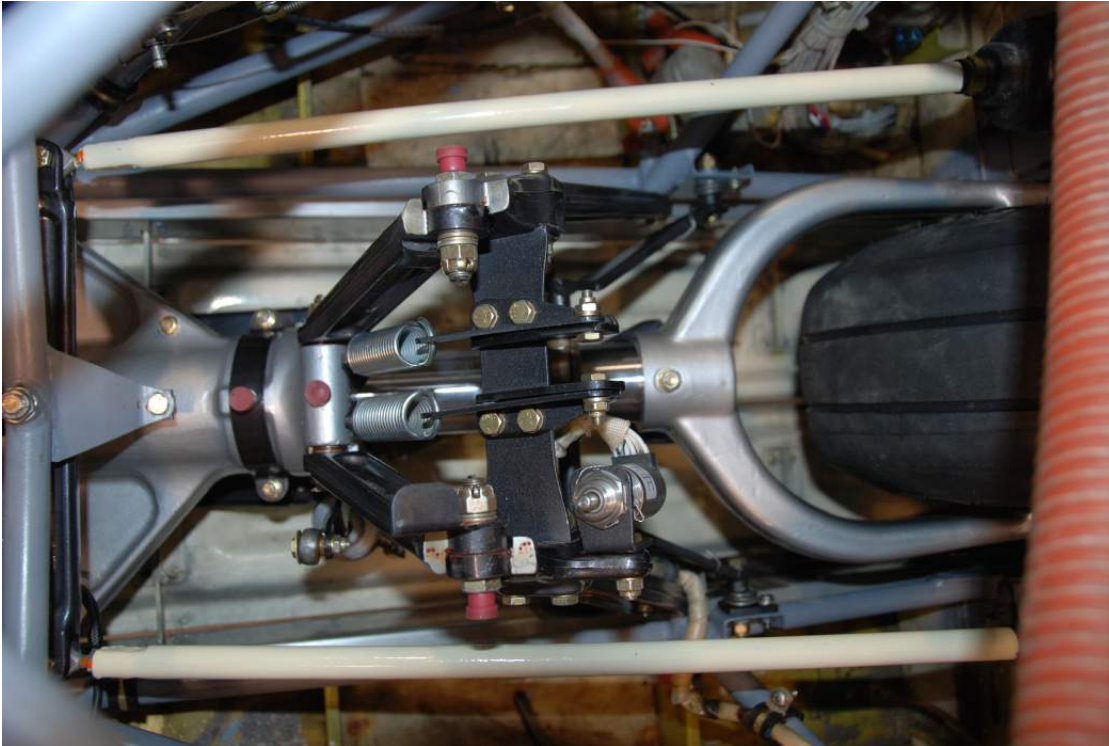
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I guess that I am ready for the “after” statement here :

*Cheers and may this inspire the adventurous soul !*



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