29/06/2019 - Mounting the horizontal stabilo to the fuselage - 8h30

Category: 3.11. Empennage mounting
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Today was another milestone in the build process, the mounting of the horizontal stabilizer to the fuselage. A quite critical job that needs attention to a lot of details.

I did some preparation work the last days and one of them was making some reference lines on the fuselage aft deck.
A good resource to get familiar with the procedure is the dvd from Les Bourne on mounting the wings and empenage. It's for sale on the Van's store.

I started by making some lines on the F-714 aft deck.
First I marked the center line on the deck. Did this by measuring between the outer sides of the longerons and at multiple locations marking the center point. Then connected the dots and rechecked. These are critical measurements that will determine how your airplane will fly so be as accurate as possible and measure twice (at least).

Then I made some markings to indicate the location of the F-710B angle which sits on top of the F-710 bulkhead. The forward spar of the horizontal stabilizer will lay on top of this but it's actually invisible as the aft deck covers it.
Measuring this is a bit of a pain. The goal will be to estimate edge distance later. I used my steel ruler and slipped it underneath the lightning holes. The ruler goes under the F-714 aft deck and you but it perpendicular against the F-710B angle, You let the ruler come out of the lightning hole on the other side. Now, with a sharpie, make a marking of the circle of the lightning hole on the ruler. If you lift the ruler out and now lay it on top of the aft deck, you can align the circle radius again with the lightning hole. The other side now shows the exact location of the F-710b angle. Do this through the 2 front lightning holes and now you have 2 reference points. Connect the dots and there is your top location line. Do the same left and right side of the aft lightning hole for the aft line.
Finally measure carefully the centerline on the longeron where the bolt will attach the bottom angle of the horizontal stabilo through the aft deck, longeron and F-710 angle.
This is a critical one so be very carefull. Mess this up and you'll be replacing you longerons and that is a big time No-No.
You can simply take the centerline of the AN470 rivets but I though that's not accurate enough as you also don't remeber if those were in dead center when you drilled them. They should but there's usually the theory and the practice so better be safe than sorry.
The longeron is 3/4th or 0.750.The remaining available horizontal part if you subtract the vertical leg of the longeron will be 5/8". So your bolt should be in the middle of that 5/8 (0.625") which is 0.3125"
But it nog possible to measure from the inner side of the longeron, only the outer side of the longeron is exposed for measurement with

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the caliper.
So add the vertcal leg width (0.750 - 0.625 = 0.125) to your mid point and you end up with 0.125 + 0.3125= 0.4375" from the outer edge of the longeron.

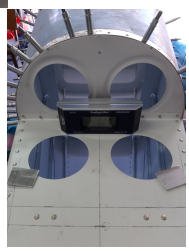


I also made markings on the angle of the horizontal stabilzer and center lines on the F-711 attach bars.
Final preparation was making the F-798 sims that slide beneath the front lower angle of the stabilo and the aft deck. (no pictures)

Then started taking a lot of pictures. Most of them are thre to remind myself the fuselage was level when I did this job :) (read: peace of mind)

I bought this new inclinometer which is incredibly accurate in the readings. It's so accurate that you even get slight diferences in the readings in different close locations.
You can see that in the images below. The inclinometer reads level 0.0degrees on the attach bars station and reads 0.20 on the F-709 bulkhead and in the vertical direction.





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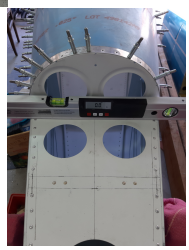
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So I thought: "how is this even possible. The slightest deviation in the aft deck plate would off course already cause 0.20 degrees.

So I took the digital level out that I had always been using and positioned it on the same places on the aft deck. Here I read 0.0 every where. Very weird.









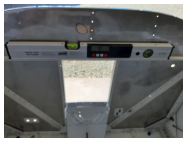
Then rechecked the forward side of the fuselage along the longerons on the canopy decks, and F705 bulkhead and firewall angle.All read perfectly level with the digital level.

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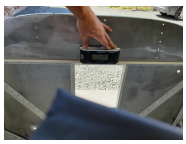
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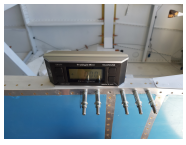

Out of curiousity, I did the same measurement with the inclinometer. On the F704, pilot side canopy deck and fuselage, the reading is perfectly 0.0



On the right side canopy deck, I see small deviation whether I measure on the beginning, the middle or the end of the canopy deck.

The front (left picture) reads 0.0, the middle reads 0.20 the end also 0.20.



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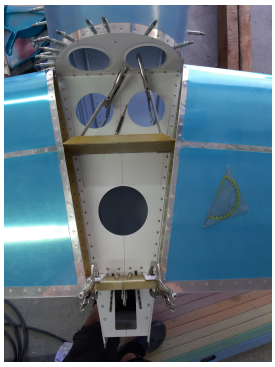
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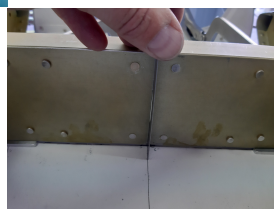
This confirms my earlier idea that since the inclinometer is shorter, it reacts more sensitively on small uneven surfaces.
So decided this is as good as it gets and started mounting the horizontal empenage to the aft deck. I had to grind of some more of the left F-711C bar with the die grinder and a small 1" scotchbrite wheel.

Then clamped the stabilo in place making sure the center lines on the parts of the stabilo ligned up perfectly with the center line on the aft deck.
Make sure that the F-798 shims are positioned in place. They align with the sides on the angle of the stabilo and are aligned with the angle on the front side of the angle.



To verify, I aligned my steel ruler with the middle of the aft spar (joint of the two parts) and projected the ruler on the centerline on the aft deck. (left) Same thing on the forward spar (right)



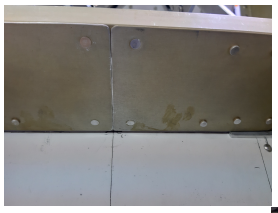


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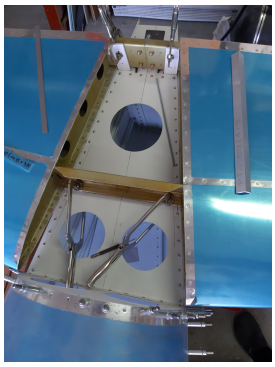
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Looking good





Everything now thightly clamped in place and ready for drilling the first holes.
We will start by drilling the two outer bolts on the forward spar of the stabilo. You can see in the image I also have drawn a centerline on the lower angle of the stabilo and you notice also that the lines on the aft deck align perfectly with the F-710B angle lines so edge distance will be on the bottom side as well if we drill on our centerline.



Next, and very critical again is projecting the center line on the longeron on the lower angle of the horizontal stabilo forward spar. Then used a center punch to mark the location of the hole and measured couple more times to convince myself all is good to go.
As I said, you are drilling through the longerons here, misdrilling here means new longerons or living with a non secure stabilo attachment.

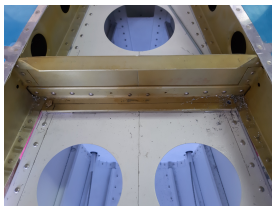
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I started by making a #40 pilot hole and verified the result. It's very difficult to judge as you can hardly see underneath the aft deck. My first impression was that the hole was a little to much on the outside of the longeron which would lead up to hole too close to the edge of the F-710Bangle underneath. So I gently made the hole a bit oval moving to the inside and then started updrilling again. This slightly moved my pilot hole but enough to make it right on the next upsize drilling. Then updrilled to #30, reamed that to #19 and then finally reamed to #12. The picture below shows the result of both holes drilled to full size. (no pictures in between as I was sweating too much)



Close up view of the pilot side hole through the lower angle of the stabilo.

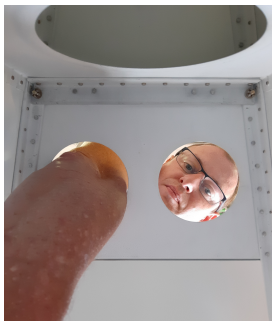


You make a lot of funny pictures when you build an airplane, the one below is definitly one of them. To have a better idea how the result looks like, I took a picture from the inside underneath the aft deck upwards to check on the alignment of the two bolts through F-710B angle.

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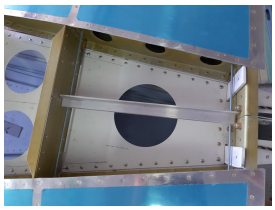
Here's the close up look. Both bolt look real good. This is about the best you can get this and I'm very satisfied with the results on this very critical job.



Next I started working on drilling the aft 4 AN3 holes which connect the back spar of the stabilo to the F-711C attach bars. I had already drilled pilot holes when I made these parts and I hoped this would turn out right.

The exercise here is to make sure that - now that the front side is attached to the deck with the spacers underneath - the chordline of the horizontal stabilo is at 0.0 degrees in alignment with the fuselage.
The fuselage is fully level, we checked that before. Now we have to measure the horizontal stabilo angle in relation to the fuselage.

There is a little trick to measuring the chordline angle. Use 2 long #30 drill bits, or some rod ends linke in my case of about 4mm. The reason I used the rod ends is because I did not have 2 long #30 drill bits and the #40 drill bits are too thin. They bend a liittle if you put some weight on. The 4mm rod ends are straight as hell and can handle some weight. You can insert your #30drill bits int he tooling holes and form a kind of platform on which you can lay a straight piece of angle.



Now, we can measure the chord line of the stabilo in relation to the fuselage. Our reading is 0.0 degrees. Perfection !

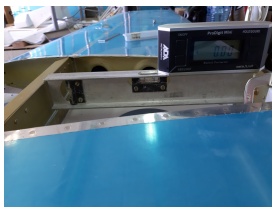
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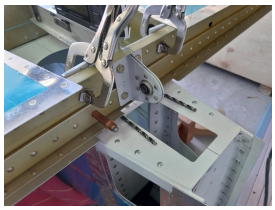
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As I'm being anal all the time, I also used a short analog bubble level and verified both. The bubble couldn't be more in the middle.



Clamped it in place, remeasured and backdrilled through the F-711B pilot holes through the after spar of the horzontal stabilo.
Holes came out nicely centered on the reinforcemenent bars.



Drilled the two bottom ones, updrilled one to final size and put a bolt in. Then updrilled the other one to final size.



Put another bolt in and then drilled the two upper onces and bolted them.

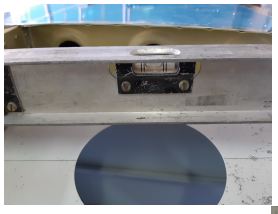
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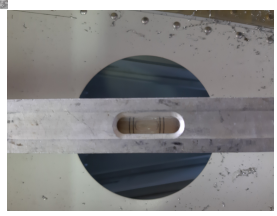
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Measuring again after drilling and the supporting drills removed: still perfectly level !





Could not possibly have any happier with how this turned out. Two more holes have to be drilled on the forward spar side but that will be for a next session.

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