

## How To Expand The E4 To A 48" Cut Length Using The Parts In A Second X-Frame

Here's how I expanded the E4 CNC machine to a nominal 48" cut length:

1. Purchase a second E4 X-frame kit from BobsCNC along with ~ (100) M4x16 screws and nuts
2. Purchase longer 5/16" guide rods: The new guide rods can be sourced locally (HD or Lowes) but those rods are made of mild steel, they haven't been hardened, and usually they have the tell tale sheppard's crook at the cut end. .they aren't straight and they're usually not long enough

Here's what I used: <https://www.mcmaster.com/#8893k223/=1e9lq25> . These rods are annealed, cold rolled tool steel with a straightness tolerance of 0.0005" with machined ends and are wear resistant. ...which means they're straight and will last forever. **You'll need 4 of them 6 feet long.** I cut them to length with a Dremel cutting disk and chamfered the ends slightly.

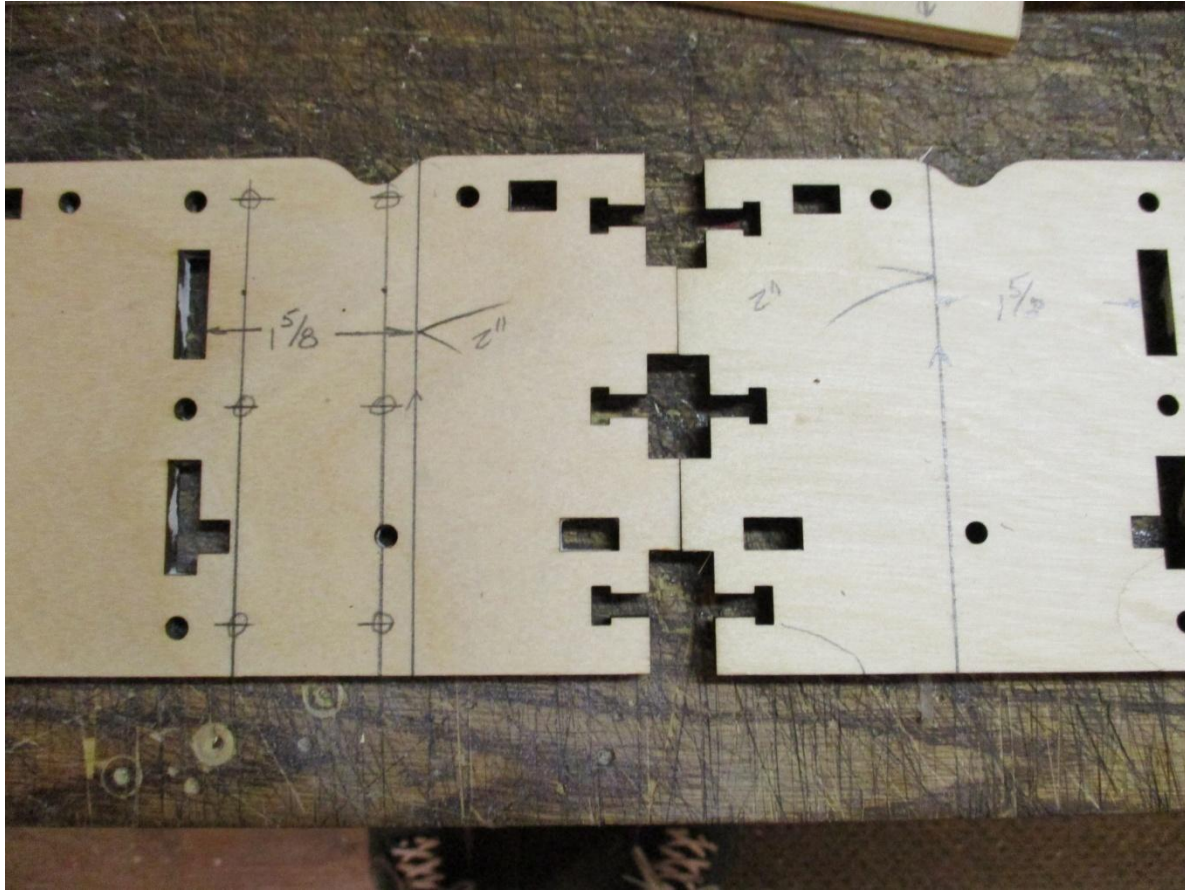
3. Purchase longer belts:  
[https://www.amazon.com/gp/product/B01E91K4N8/ref=oh\\_aui\\_detailpage\\_o08\\_s00?ie=UTF8&psc=1](https://www.amazon.com/gp/product/B01E91K4N8/ref=oh_aui_detailpage_o08_s00?ie=UTF8&psc=1)
4. You may have to purchase a longer USB cable. I bought this one: <https://www.bestbuy.com/site/insignia-10-usb-2-0-a-male-to-b-male-cable-black/5883001.p?skuld=5883001>
5. I recommend a Router Speed Controller:  
[https://www.amazon.com/gp/product/B001JHQ3G8/ref=oh\\_aui\\_detailpage\\_o09\\_s00?ie=UTF8&psc=1](https://www.amazon.com/gp/product/B001JHQ3G8/ref=oh_aui_detailpage_o09_s00?ie=UTF8&psc=1)
6. And finally, you'll have to either make a larger spoil board or get a second one from BobsCNC. I made mine in one piece out of 1/2" MDF.

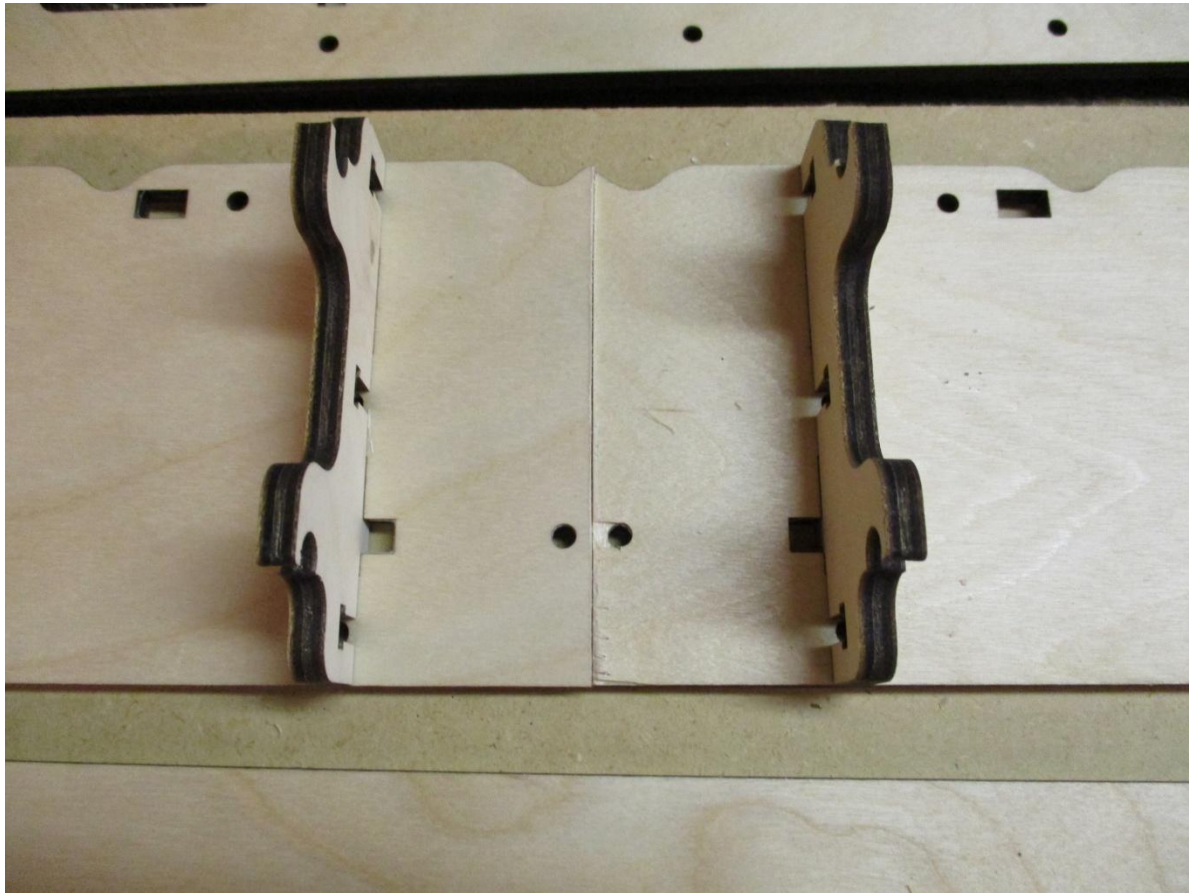
The assembly steps for the Z Spindle Mount, the Y Carriage, and the Y Gantry are the same as those in the E4 manual. Follow them exactly. With the exception of a few steps, the assembly of the X-Frame is the same as those in the manual.

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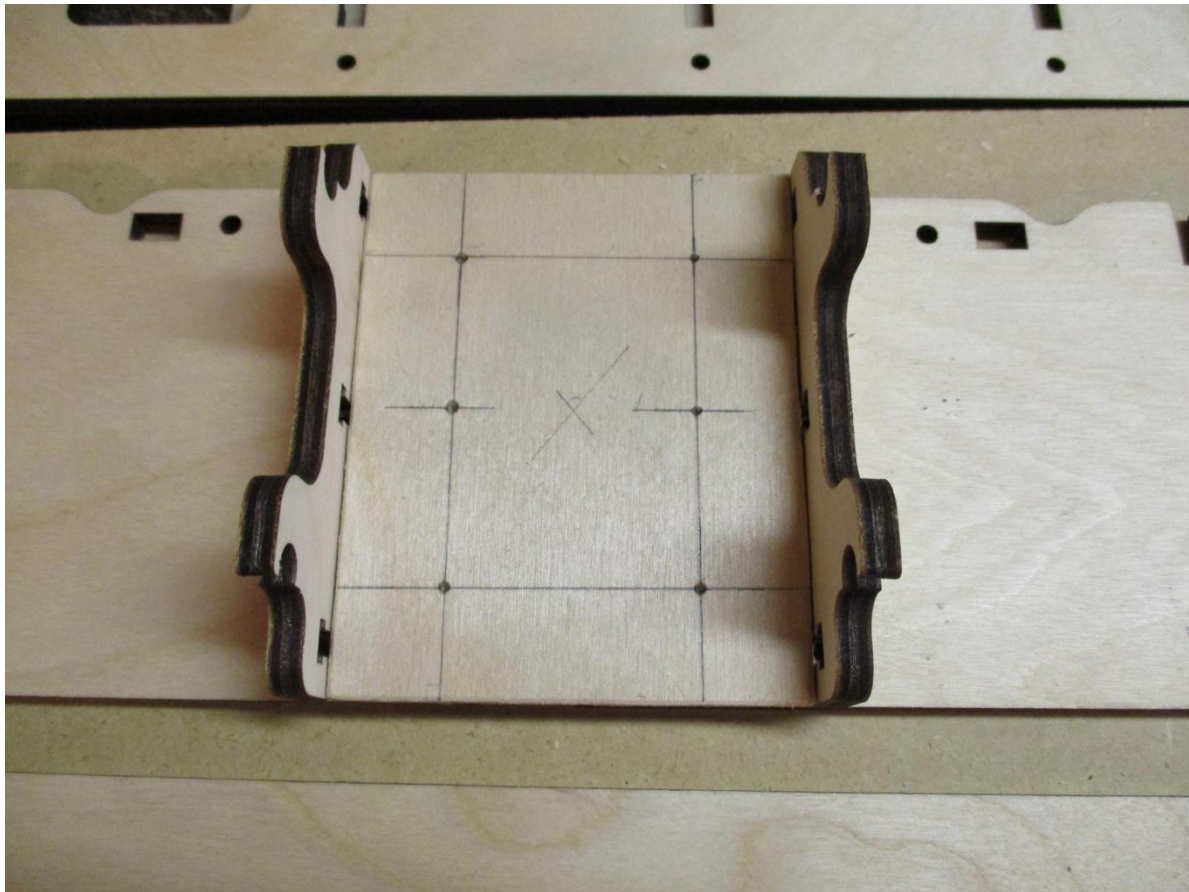
To make the E4 capable of a nominal 24"x48" cut area here's what I did:

1. Cut 2" off the "middle" ends of each of the (4) X5 Side Frames.



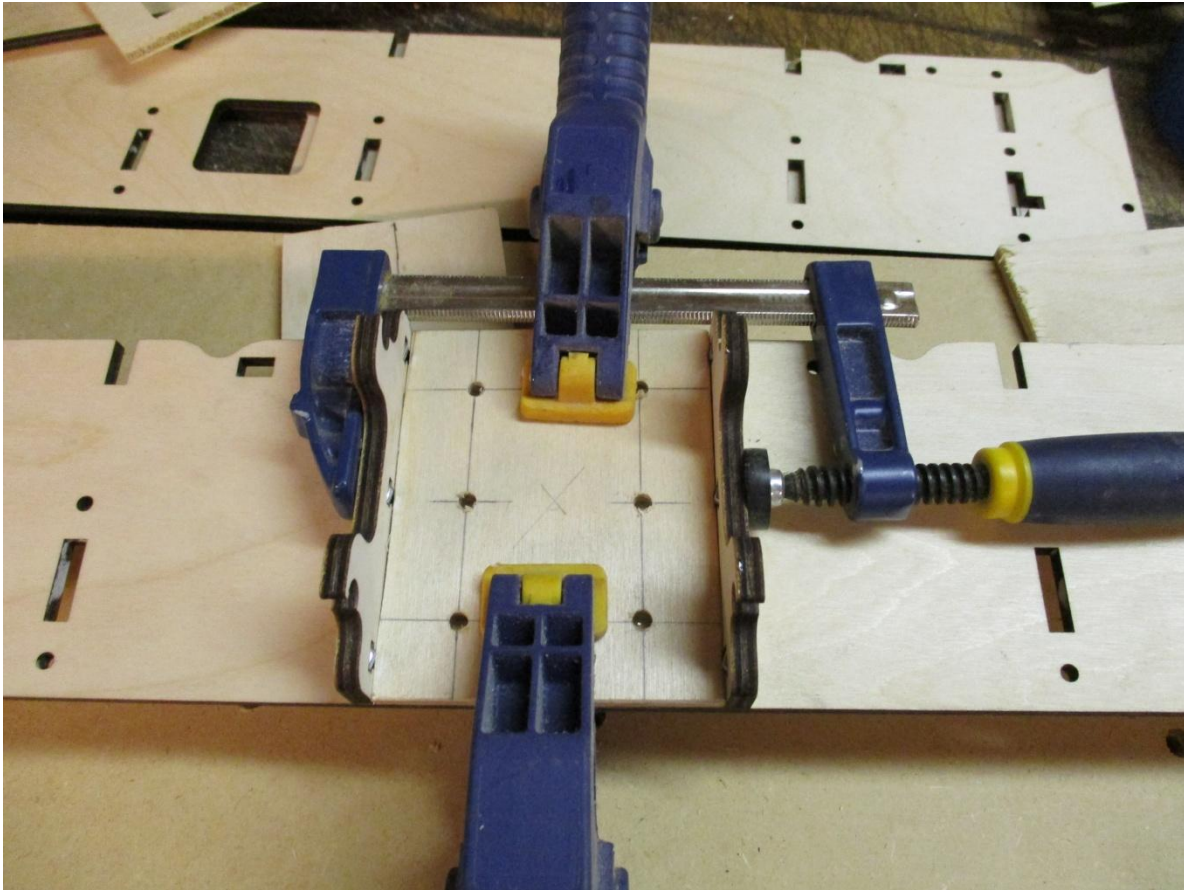


Cut (2)  $\frac{1}{4}$ "x3  $\frac{1}{4}$ "x 4" birch plywood splice plates and drill (6) 5mm holes in the plates for now. I got the plywood from Rockler.



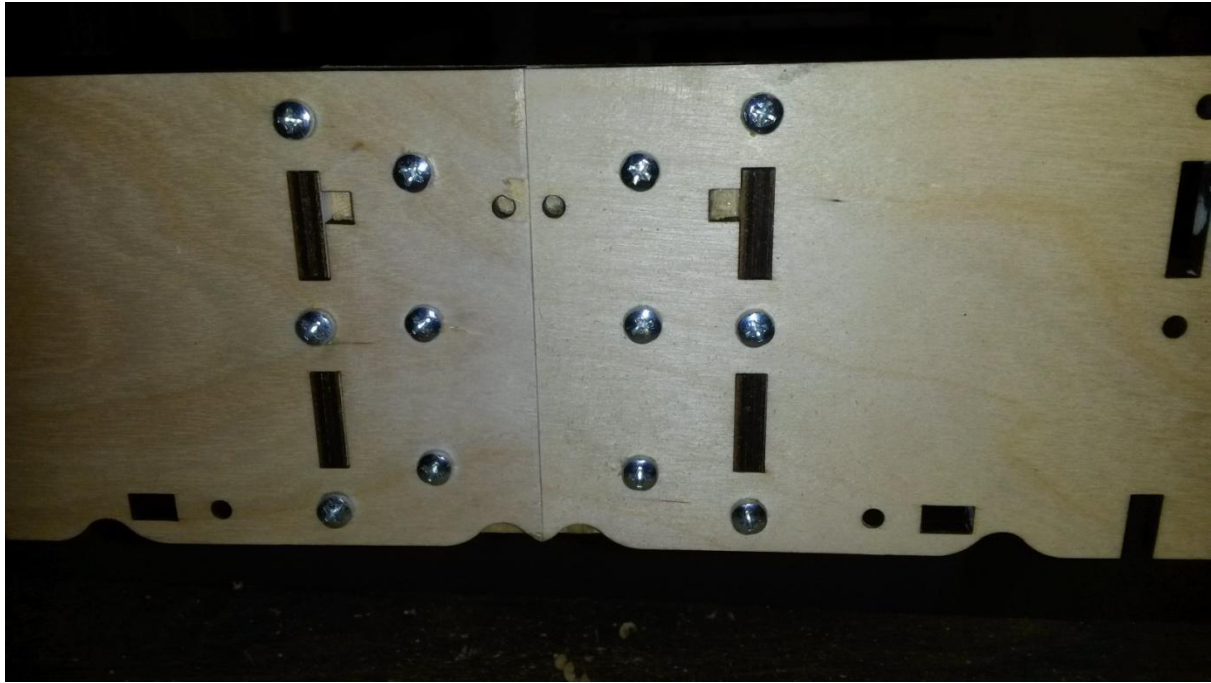


Secure (2) X1 Rail Supports with (6) screws, and epoxy the drilled plywood plate between the rail supports. Make sure the X5 frames match exactly. Clamp securely. I used Loctite 5 minute Epoxy. Let it cure completely.



Match drill the X-Frame side rails to match the splice plate and bolt together with (6) M4x16 screws and nuts. Tighten per the E4 assembly instructions (snug + 1 ½). Remember the Loctite Blue.





Now proceed with the assembly of the X-frame per the instruction manual.

I chose to make a one piece spoil board because I'll mount a vacuum table to the top of it. Spoil board is  $\frac{1}{2}$ "x26"x56 $\frac{1}{2}$ ", drilled to match the M4 nut recesses in the Frame Mid Supports (X4) and the Frame End Supports (X6).



The picture above is for illustration purposes only.

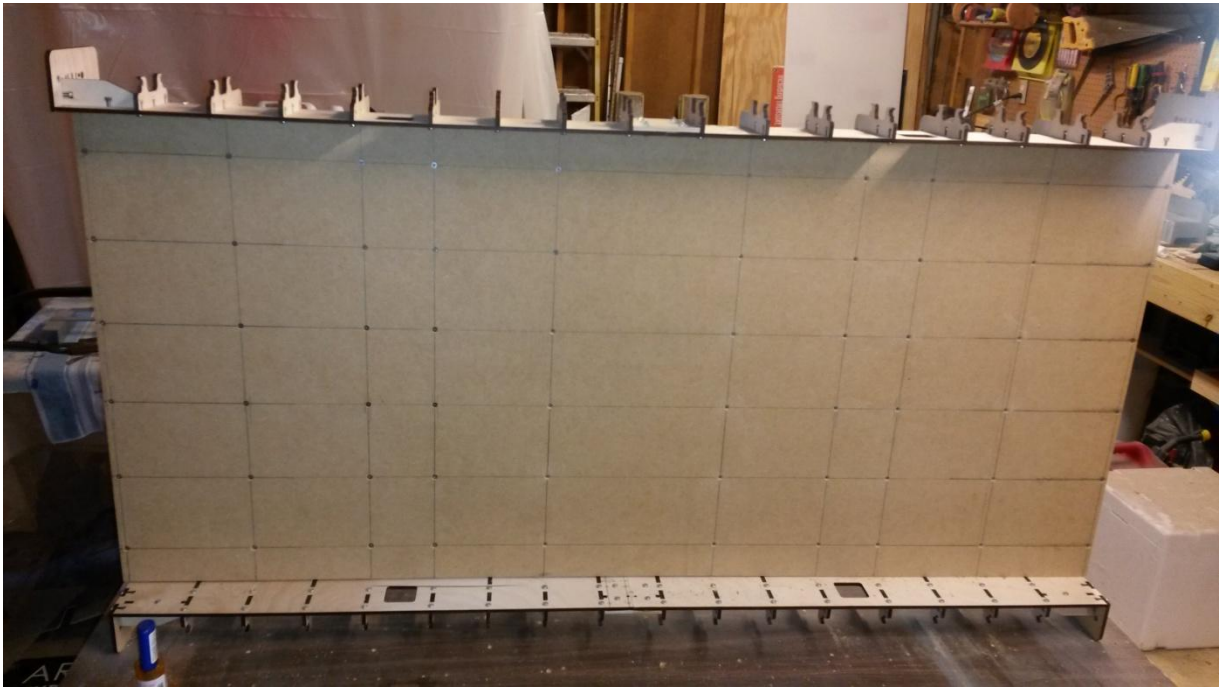
You can purchase (1) extra spoil board kit from BobsCNC and trim the middle of each to match the extended X-frame bolt pattern. And if it were me, I'd stagger the seams.



Frame ready for guide rods:

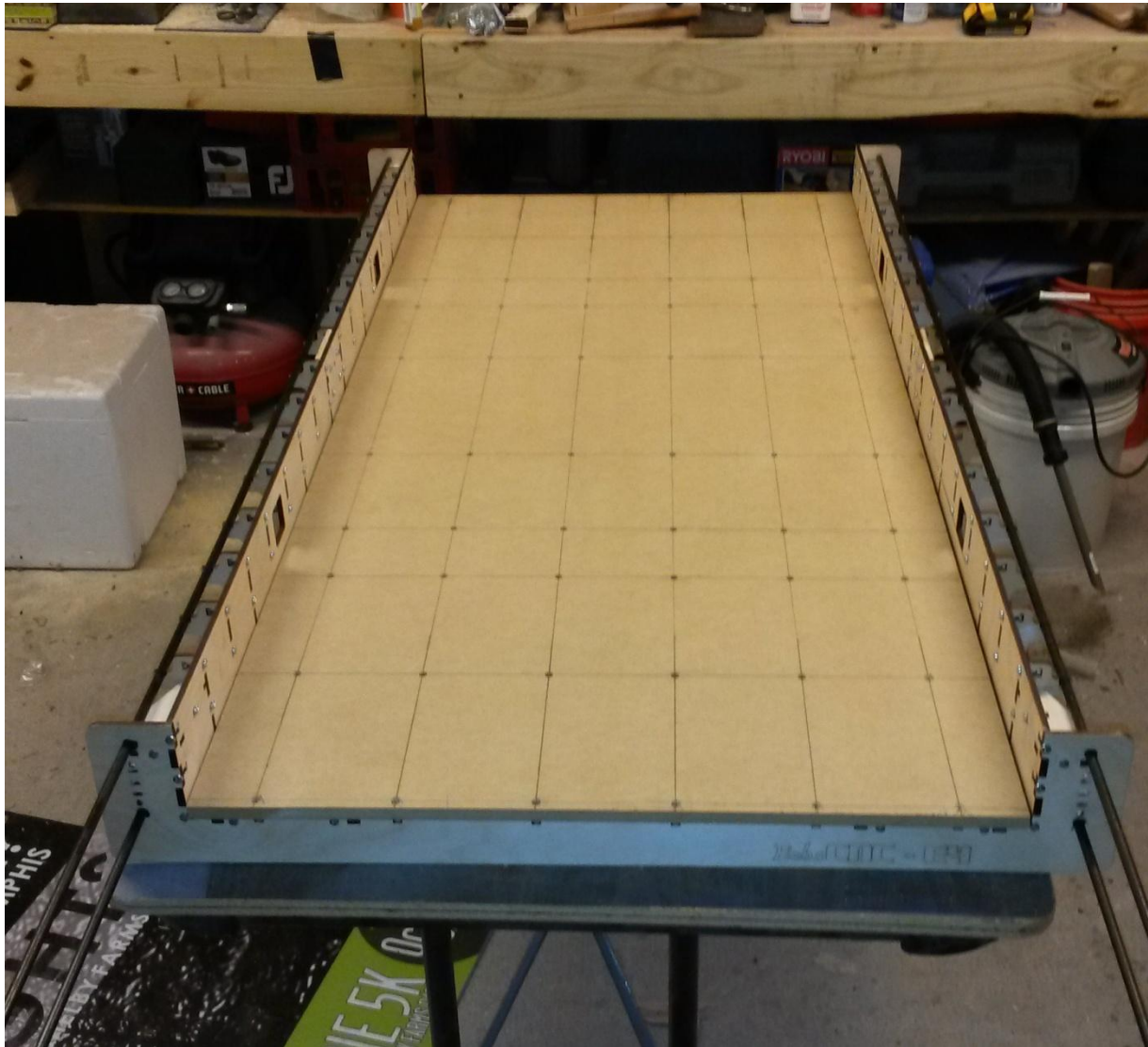


I chose to secure the spoil board at this point..I match drilled the spoil board and countersunk the holes to accept M4x16 flat head machine screws.



Here's a tip for holding the nuts in place on one side while tightening the screw from the other...use a spring clamp





Cut 4 new guide rods to length.....mine will be 55.95".... I cut them to length with a Dremel cutting disk and chamfered the ends slightly.

That's really all there is to it....in a nutshell, I cut 4 inches out of the middle of 2 X-Frames, made plywood splice plates, and cut a new spoil board.....

Follow the rest of the installation instructions.....

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## Optional Enhancement: X- Belt Tensioners

If you're like me, those of you that have lengthened your E3 or E4 found it very difficult to make sure the X-belts were at the same tension, especially since my hands aren't calibrated enough to make sure the belts were equally tight.

I've been arguing with myself (engineers do that a lot) about the simplest way to adjust the tension in the belts, that 1) doesn't cost a lot of money, and 2) only uses the parts and pieces that came with the machine.....

Very early in my career, one of my mentors taught me to "look at the problem bass ackwards" when the first solution was too complicated or too expensive.....My first design involved bearing plates, guide rods, springs, and a drilled and tapped tension plate....NOT !

So here's what I came up with.....and it seems to work

To keep from having to restring the belts I made a little keeper out of one of the long work piece hold downs.

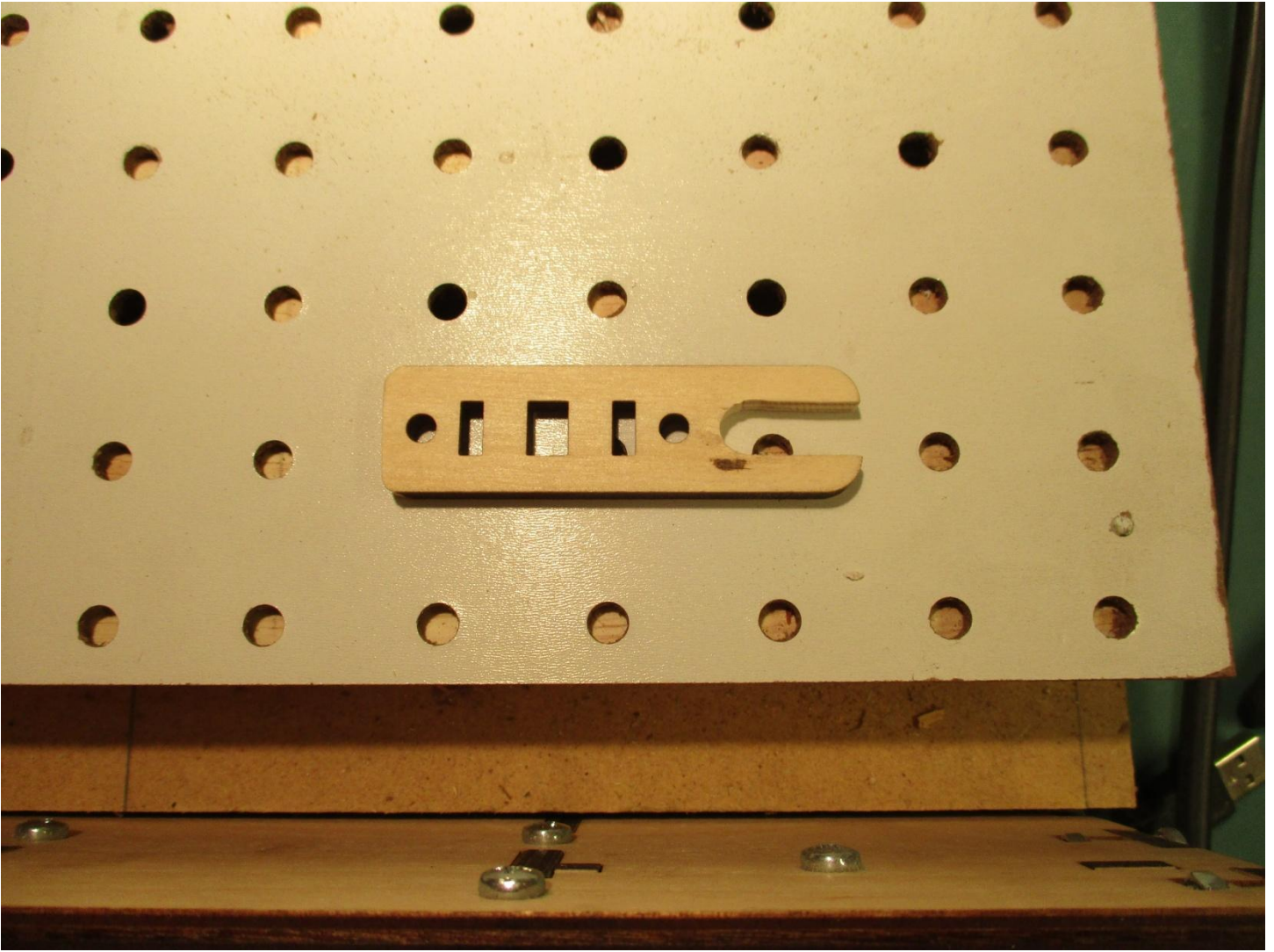


Next I slipped that over the belt, clamped it in place and then trapped the belt with a pair of forceps.



I cut the zip ties holding the belt in place and removed the screws of the X-rail Stop.



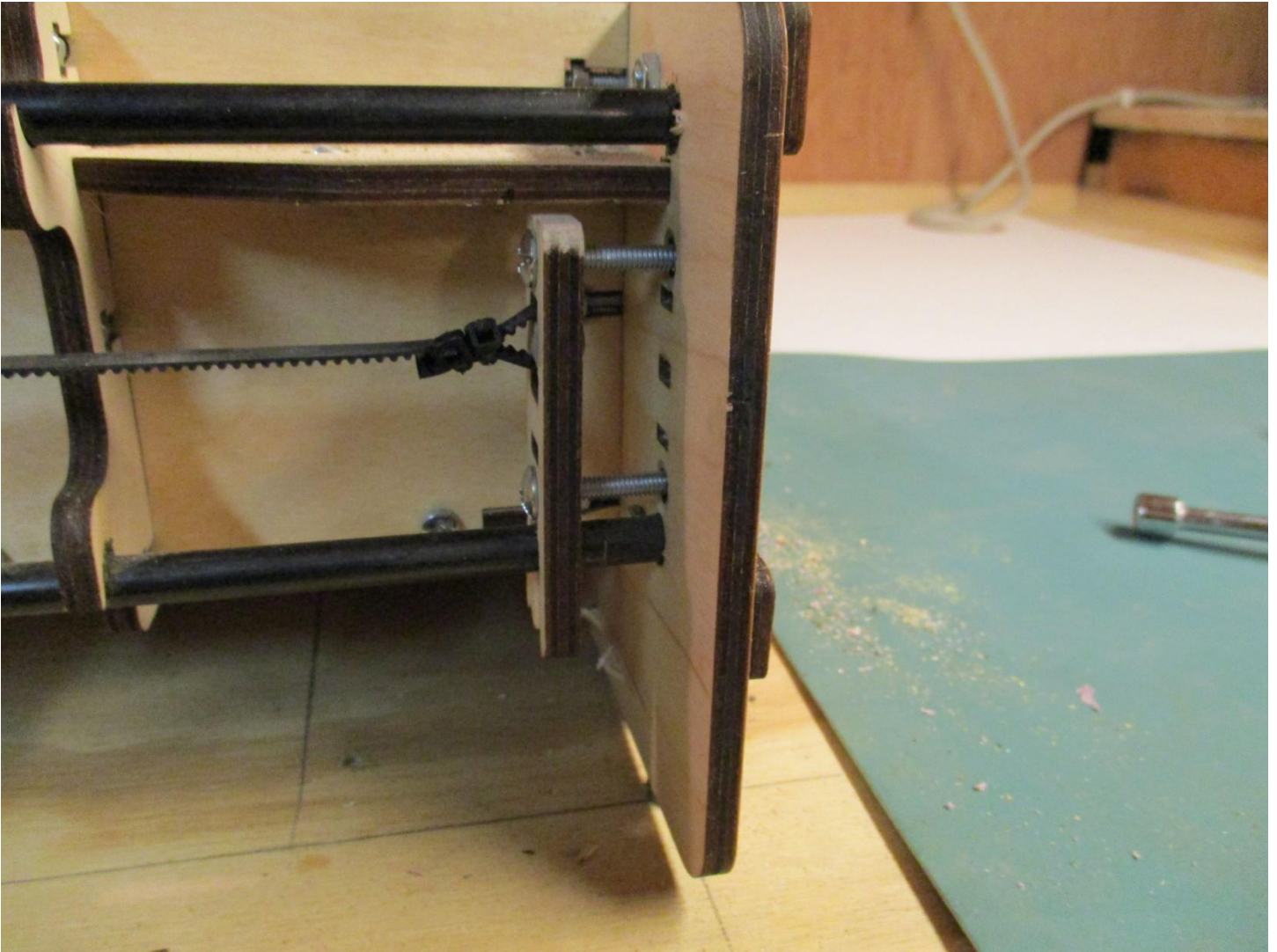


I then modified the X-rail Stop so that it would fit inside the end frame, under the top brace, and over the lower guide rail..I cut enough off the top to miss the bottom of the brace, and drilled a 5/16 hole. The slot was cut using a band saw...





.....a little sanding and the piece fit right in.

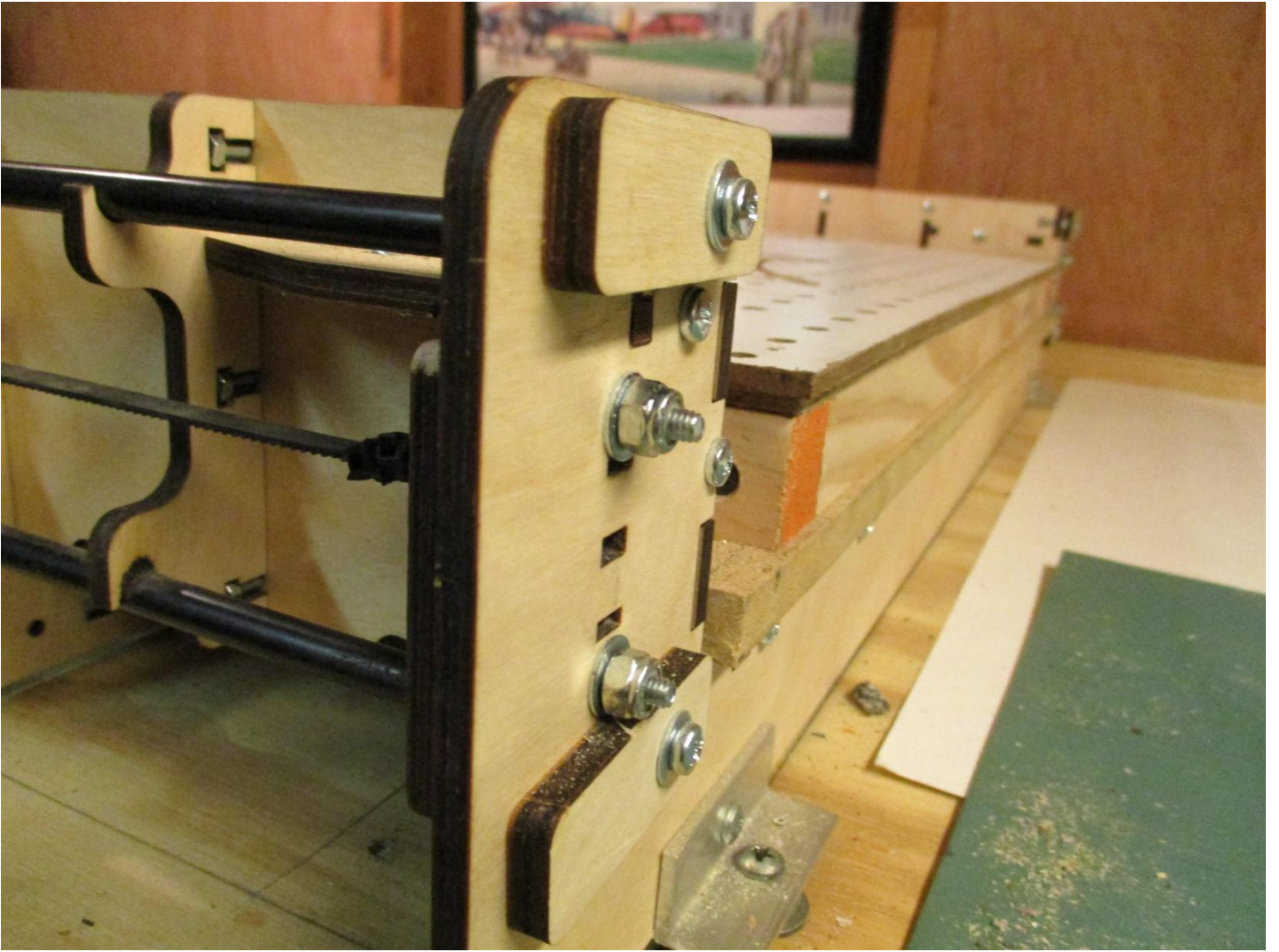


Next, I installed (2) #8x32 x 1 ½" machine screws, each with (1) Nylock nut, with the threads extending outside the frame, and positioned so that I had maximum travel for tension adjustment....then the belt was threaded through the holes and secured with (2) zip ties, with the belt turned tooth to tooth....it won't slip that way

Note, I'm sure that 1" long screws will work, and not leave as much bare screw exposed, but since this is the first iteration, I decided to err on the conservative side. Besides, my fat little fingers won't fit.....

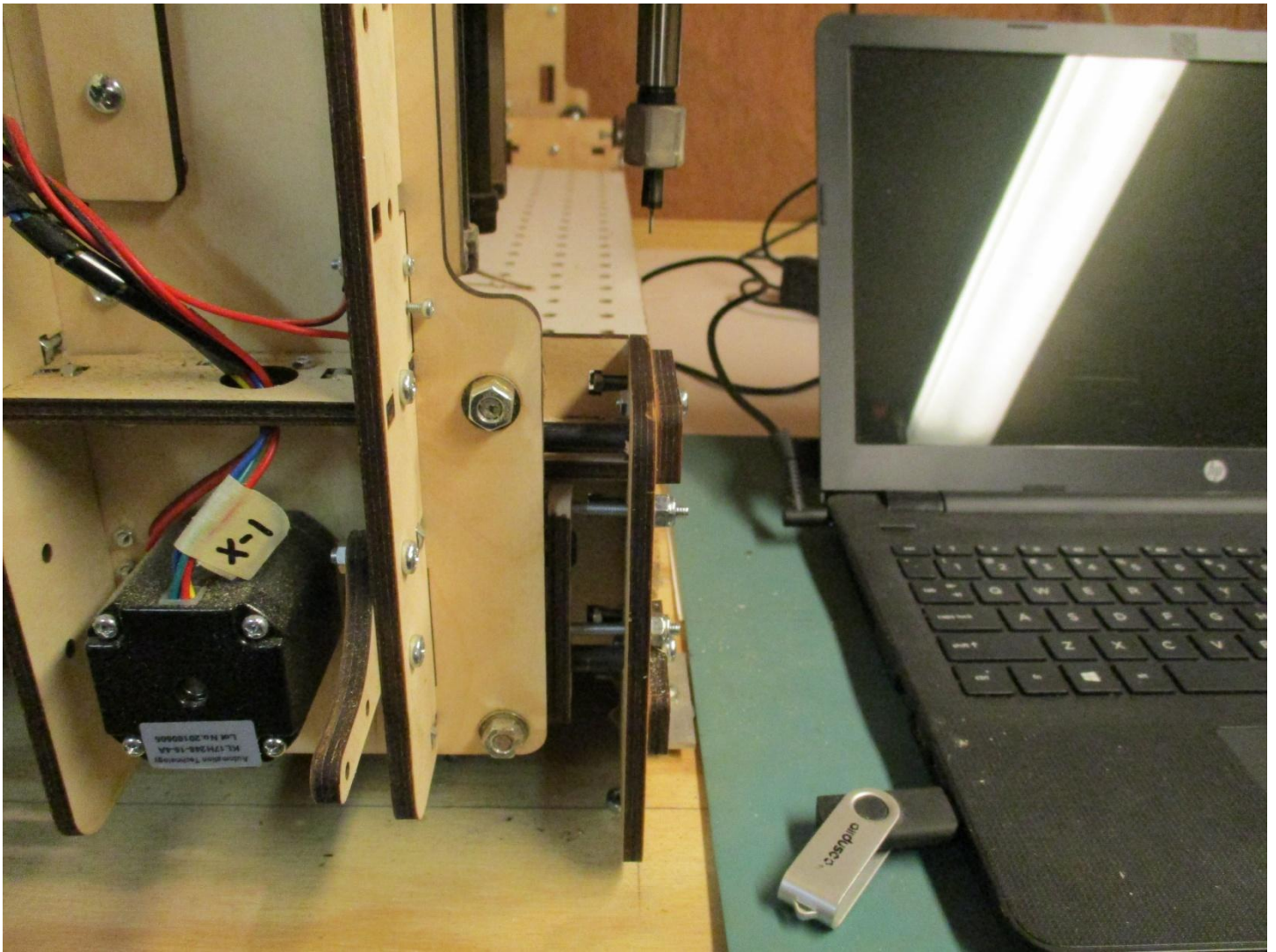
Then I just started slowly tightening the Nylock nuts until the belt got tight.....





Lastly, I used (2) of the short work piece hold downs as rail end stops.





End travel is not affected by the tensioner....

In a nutshell, I cut off the top of the X-belt stop, drilled a hole (and slot) in the bottom, and installed (2) screws and (2) nuts, for less than \$2, using the parts that came with the machine in the first place, without interfering with the overall travel of the Y-gantry in the X direction.



The only way I have to “measure” the tension in each belt is by sound.....I used one of my guitar tuners to adjust the “note” of each belt until each of them vibrated with the same frequency....I thought of Robert Laughton when I came up with that idea.....

That D# (Eb) is vibrating at about 77 Hz, or the same note as the second string on a stand up bass.

Note, it’s a D# because the graphics on my tuner can’t display the flats (b)