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Do you have an Endurance Laser and a Shapeoko 3? This, bud, is for you!

by John Walker

So, now that you have your laser, how on earth are you going to attach it to your [Shapeoko](#)? (Mine is an XXL.) Well, you DO have a CNC, so why not just machine some brackets? Or, if you have a 3D printer, why not print some?

Well, to be honest, I haven't yet cut any aluminum on my Shapeoko. At some point, I'll get that motivated, but I want my shiny, new laser to work NOW. To machine or 3D print anything, I'd first have to do the part drawings, then the tool paths, then make sure my settings were just so... If I were mass producing something, I might go through all of that, but this is a one-off that I'd like to knock out in just a couple of hours, if possible.

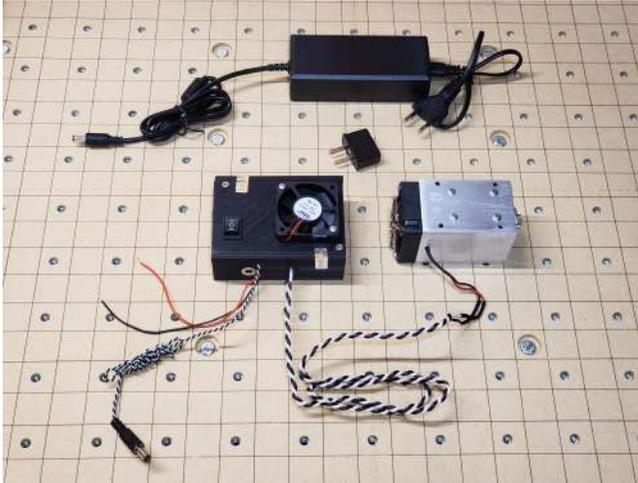
So, what follows is how I went about doing that. The most time-consuming part of the project was the planning stage. Being that this is all laid out for you, then, you should be able to have your laser mounted in 2 to 3 hours, not counting the shopping trips to Home Depot and Radio Shack.

I used no special tools, per se, so the average handyman will likely already have everything he needs in his shop. Materials wise, I only used a small portion of what I had to buy. So, while I had to shell out about \$80 for everything (not counting the air pump and tubing for Air Assist), I have plenty of leftovers for future projects. If you have any of this stuff already lying around, you'll get off cheaper than I did.

So, here's the step-by-step with materials list and photos:

What came in the box from Endurance?

Just to be sure we're on the same page, here's a picture of what I got from Endurance. At the top is the power supply, to the left is the control module, and to the right the laser itself.



The Plan

My idea was to be able to quickly attach and detach the laser as wanted or needed without using any tools. Being a bit leery about having magnets around electronics, I wanted to avoid those. So, barring adhesives, all I could think of was to use some sort of hanging mechanism.

I also needed to decide what I was going to do with the wiring. The length that came with the laser was insufficient to allow attaching the laser to the spindle mount, running the wire through the drag chain, and then mounting the laser's control box near that of the Shapeoko's. Because I didn't want to introduce any potential warranty issues by splicing in additional lengths of wire, and because the control box was lightweight, I decided to affix the bundled wires and the box to the laser module. Then all I would have to do is run the TTL line back to the Shapeoko's box.

The Result

Honestly, the construction was ridiculously easy. Basically, what you wind up with are two brackets: one to attach to the front of the spindle mount, and the other to the laser module. Simply cut some stock to length, clean up the edges, drill a few holes, pop a few rivets, bolt on the brackets, run your TTL line, and tidy up everything with some cable ties.

Parts Used

Here is a list of what I bought for the project, divided by Hardware (which I got at Home Depot), Electronics (from Radio Shack and Ace Hardware), and Misc. I'll introduce the product photos as they are used later in these instructions.

Hardware

Qty.	Description
Aluminum Length Stock	
1	1-1/2" x 1/8" x 48" Aluminum Angle
1	2" x 1/8" x 36" Flat Bar Aluminum
1	Hangman Picture Hanging System
To Replace Original Screws in, and to Attach Half of Mounting Bracket to, Carbide's Spindle Mount	
1	Package of 2 Socket Cap Screws M5-0.8 X 60 mm (or 65 mm, if you use my Air Assist bracket)
1	Package of 4 Lock Washers M5, Class 8- Split, Zinc Plated
To Attach Other Half of Bracket to Laser Module	
2	Packages of 2 Machine Screws M4-0.7 x 60 mm
2	Packages of 2 Hex Nuts M4-.7 mm
1	Package of 4 Lock Washers M4, Class 8- Split, Zinc Plated

Electronics

Qty.	Description
To Connect TTL Line from Laser to Shapeoko Control Board	
1	1/8" Mono Audio Plug
1	1/8" Mono Audio Jack
9 feet	Stranded, 18 Gauge (or smaller), 2-Conductor Wire

If using Air Assist

2	1/4" Cable Wire Plastic Mounting Clamps
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Miscellaneous

Qty.	Description
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For Bracket Assembly

4	1/8" Dia, 1/8" Grip (aka "Short"), Aluminum Pop Rivets
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If using Air Assist

1	1/4" Dia. Stainless Steel Drinking Straw
12 feet	1/4" I.D. Flexible Tubing
1	Air Pump/Compressor, 60 Liter Output

Getting Started

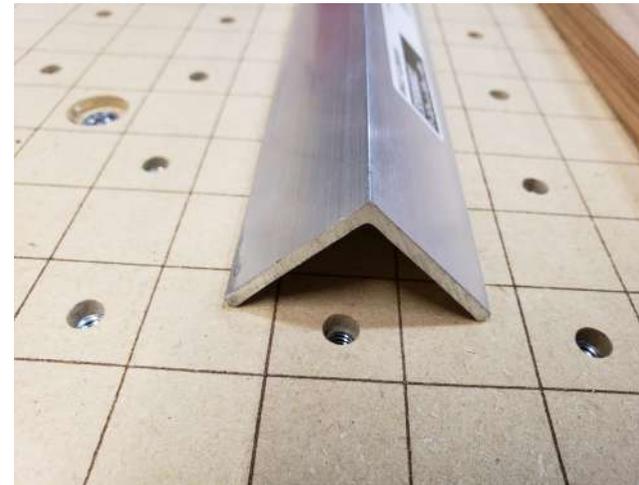
First, you're going to want to cut your stock to length. What follows are the approximate dimensions I used. You'll want to double check your equipment's dimensions and, if necessary, adjust accordingly. If in doubt, check the photos, below, before you cut.

Cut List

Length	Material	Notes
Bracket Assembly for Spindle Mount		
4"	Aluminum Angle	This length corresponds to the width of my Spindle/Router Mount.
3-1/4"	Tallest/Widest Component of the Hangman Picture Hanging System	This is the piece that will attach to the Aluminum Angle.
Bracket Assembly for Laser Mount		
3-1/2"	Aluminum Bar	This is as long as the laser module is tall, measuring from the top of the fan to the bottom of the laser's 2" tubing.
2-3/4"	Narrowest Component of the Hangman Picture Hanging System.	Originally, I cut both pieces of the Hangman system alike, but then lopped off 1/4" from each end to allow for some manual X-axis adjustment of the laser.

Make and Assemble the Bracket for the Spindle Mount

Find your Aluminum Angle and take a 4" piece of it.



Now, remove about 1-1/4" from one leg's width. This dimension isn't critical, because all you're trying to do is create a lip that will later rest on the top of the spindle mount to keep this bracket from dipping under the weight of the laser assembly. It should now look something like this:



Grab the Picture Hanging System (hereafter, simply "Hangman") and cut 3-1/4" from the wider of the two pieces. (Second pic, left piece.)



Initially, I cut both of the hanger pieces the same length. I later shortened the narrower piece by 1/2". (The holes you see were factory drilled.) Anyway, the piece we're dealing with now is the taller/wider of the two:



You'll now need to drill two sets of holes. Spot and drill the first set at a location and diameter that matches the bolts/holes in Carbide's Spindle Mount. They must align when our bracket piece is resting on top of the Spindle Mount and is flush with the left side when facing the router. I found it helpful to tuck the Angle piece into the split on the side of Carbide's mount and then use a drill slid into each of the bolt holes as a center punch. This at least got me my elevation.



The second set of holes will be made with a 1/8" drill, and then countersunk on the Angle piece with a 1/4" drill. These will be used to rivet together this plate and the taller section of the Hangman system. Be sure to countersink the Angle plate on the side shown. If you like, you can pair the two pieces when drilling the 1/8" holes to ensure alignment. The height of these two pieces wasn't a perfect match, so I made them flush on the bottom before drilling. (The pic on the right shows the completed assembly.)



NOTE: After I had already riveted this, the Spindle Mount half of the bracket, I later ran into some interference from the bolts in the other (Laser) half, making it necessary to remove part of the webbing on the wide section of the Hangman system. It will have to be done at some point, so how you intend to do it may determine whether it is best to rivet the two pieces before or after that webbing is removed. I used a fibrous cut-off wheel on my junk table saw, so found that I had more meat to hold on to (carefully!) by riveting first. (If/when you see that webbing in subsequent photos, ignore it.)



If you haven't already done so, rivet the two pieces together as shown, ensuring that the rivets enter from the countersunk side. You'll want the rivets' heads flush to ensure they won't act as a fulcrum when you torque the bolts. (The photo on the right shows the assembly with the top half of the webbing removed.)



This completes the Spindle Mount assembly.



Make and Assemble the Bracket for the Laser Module

Find the Flat Bar and lop off 3-1/2" inches, which is the height of my laser module, including the fan, but minus the fan grate.



If you haven't already done so, cut the narrower piece of the Hangman system to 2-3/4". (I tried to keep the factory holes centered.) This will be 1/2" narrower (1/4" per side) than the Spindle Mount's Hangman piece.



Use the laser module to spot the locations and diameters of the 4 holes for the 4 mm bolts. Then, spot and drill the rivet holes in both pieces, countersinking them in the bar stock.



After riveting, you'll have this:



This completes the Laser Module mounting bracket.



Attach the Spindle Mount Bracket

Carefully remove the Carbide 3D placard from the spindle mount's front. If you haven't already done so, remove the two clamping bolts as well.



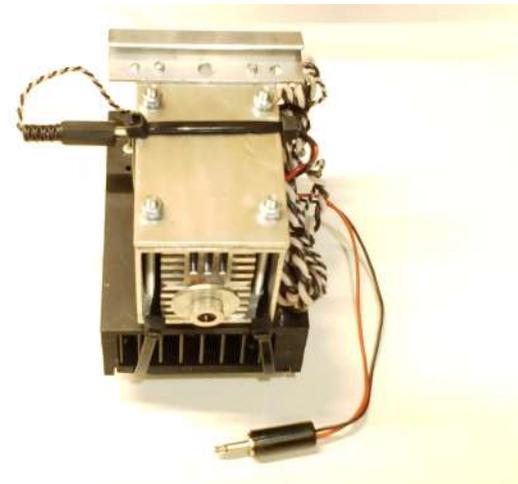
Use the 60 mm screws (or 65 if you're using my Air Assist idea, below) and lock washers to mount the Spindle Mount bracket to the front of the spindle mount. Tighten as you normally would.



Attach the Laser Module Bracket

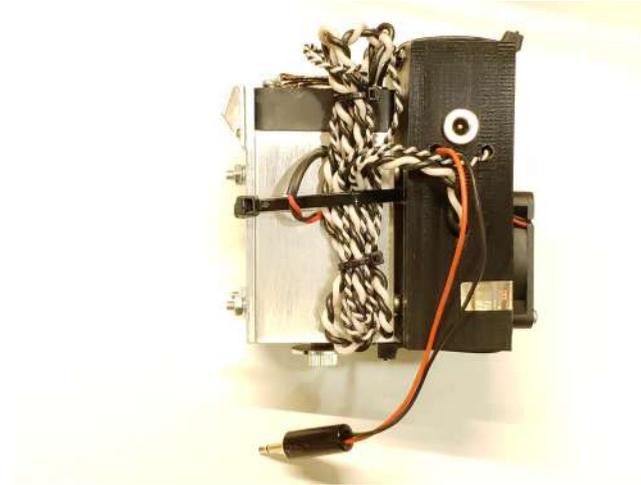
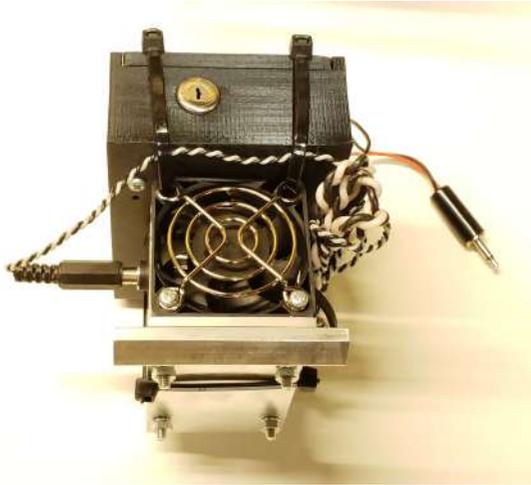
Use the 60 mm round head screws, washers, and nuts to attach the laser module to the bracket. As fate would have it, I apparently neglected to take a photo of this step, but included one of a more complete assembly to give you the general idea. (This isn't rocket science, right?) Just be certain to mount the bracket to the side that has no protrusions. In my case, the flattest side was the one where the holes were countersunk.

Also, I bought some Thermal Grease/Compound from Radio Shack and slathered some between the Laser Module and Mounting Bracket, just in case I could glean an additional fraction of a degree's cooling from the added mass of aluminum. Didn't take a pic of the compound, either, but it's the silver stuff.



Attach the Control Box to the Laser Module and then Bundle the Wires

My Laser Module had two vacant cooling fan holes, so I used those to feed through a couple of cable ties to secure the Control Box to the Laser Module. For reasons I won't go into here, I chose to orient the box with power switch up. I then bundled all of the wires out of the way, securing them with cable ties as well.



Now, for a Little Wiring

We're almost to the finish line. The only thing left to do, unless you'll be doing Air Assist, is to run the TTL line back to the Shapeoko's control board. Because I wanted to be able to remove the laser in as hassle-free a way as possible, I decided to use a plug and jack for a quick disconnect. Since there are only two wires, I opted for a 1/8" Mono Audio setup. (My Radio Shack didn't have inline 3/32", so I had to go larger.)

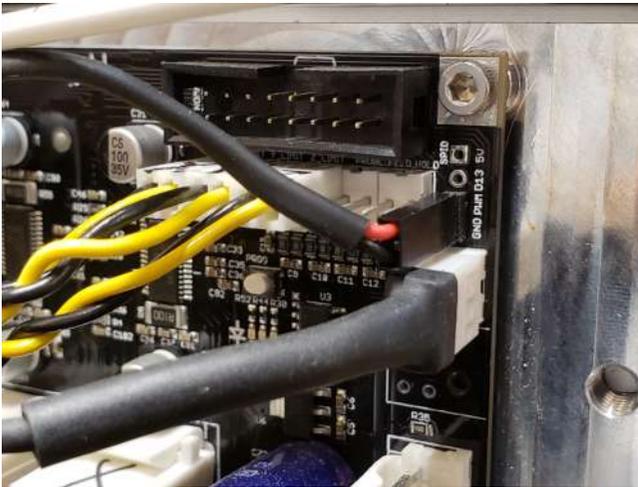
I got 12 feet (used 9-ish) of shielded, stranded, two conductor w/ground, 18 awg wire (seems lighter) to run from the laser, along the drag chain, and into the Shapeoko's control box. Because I already had a [JTech](#) 3.8 online, I used a switch to route the TTL signal to either it or the Endurance. I won't go into that, here, as I suspect most folks won't have two lasers installed on one machine.

Basically, I soldered the plug onto the laser, and the jack onto the wire. The tip of the plug carries the PWM signal from the Shapeoko's control box, and the bare strand carries the ground. Here's what I used:



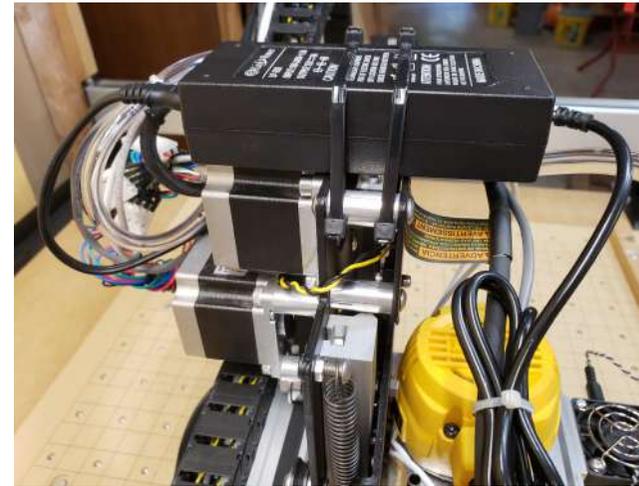


Once you have access to your Shapeoko's controller board, you'll find what you need in the upper-right corner - at least that's where mine is. You'll be looking for adjacent pins/holes labeled PWM and GND (ground). The laser's red wire goes to the PWM pin, and the black goes to the GND. It really is that simple.



The Power Supply

For lack of a better idea, I mounted the power supply on top of my Shapeoko's Z Motor and Limit Switch mounting plates. I simply used a couple of cable ties, and then bundled the excess wire going to the laser's control box. I then ran an extension cord along the drag chain from the power supply's 120 volt input back to a power strip.



Air Assist

I'll be using Air Assist, so I took a few extra pics to show my setup. I used a bracket that I had left over from my JTech mount's prototyping, and added a couple of cable clamps (from Ace Hardware) and a stainless steel straw (from WalMart) to serve as an air nozzle.



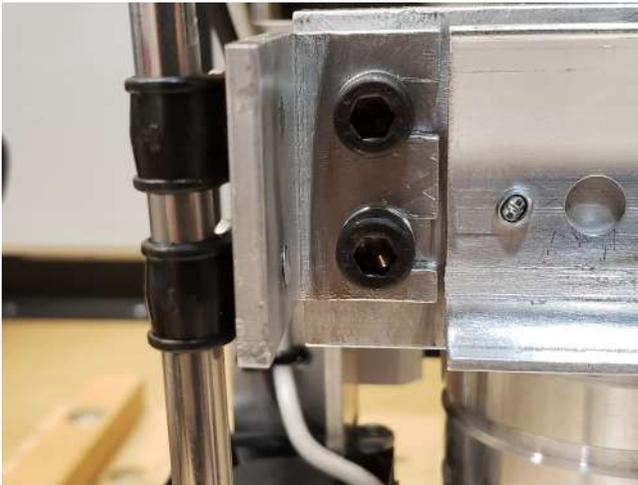


There are many ideas and great explanations on Air Assist that can be had in the forums, so I treat the subject lightly, here. Basically, I have a 32 watt, 60 liter Air Pump that I bought on Amazon, which I then connected to the stainless straw via 12' of 1/4" I.D. clear, flexible tubing.

Here is the bracket and straw assembly:



Here it is, mounted to the Spindle Mount (using the 65 mm screws):



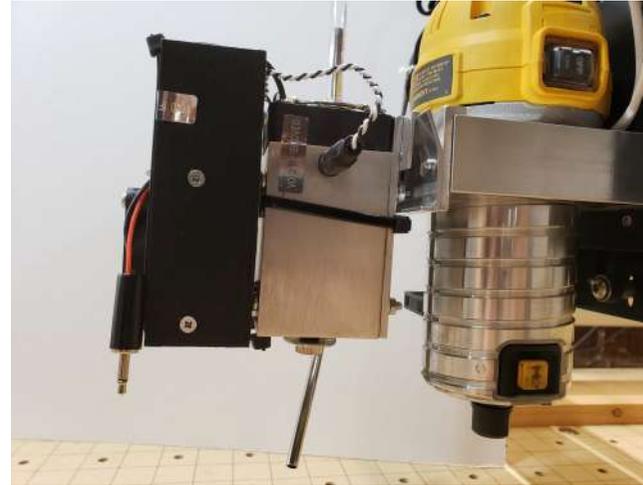
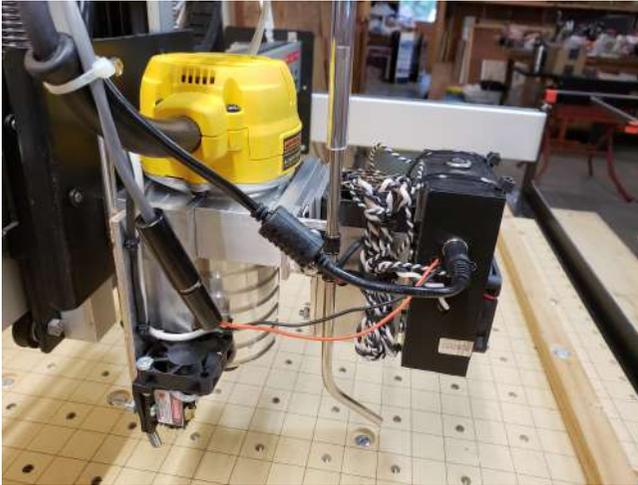
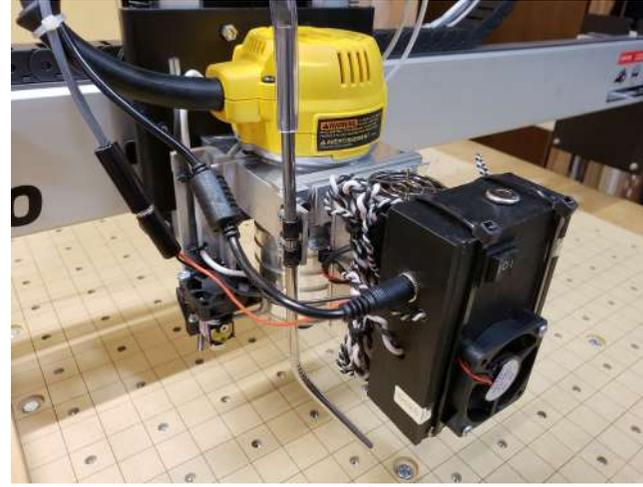
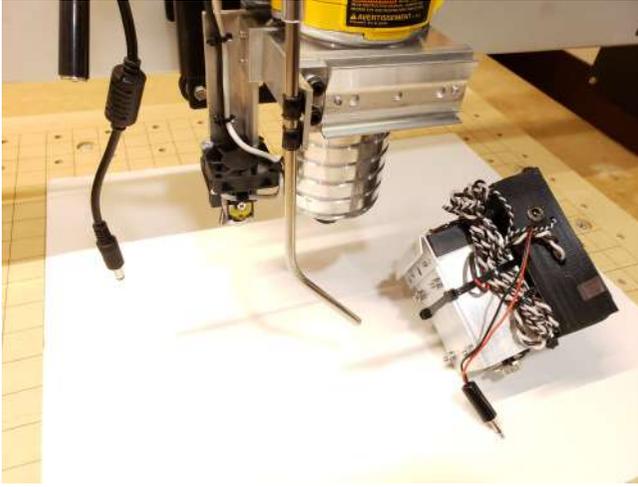
Dust Boot Compatibility

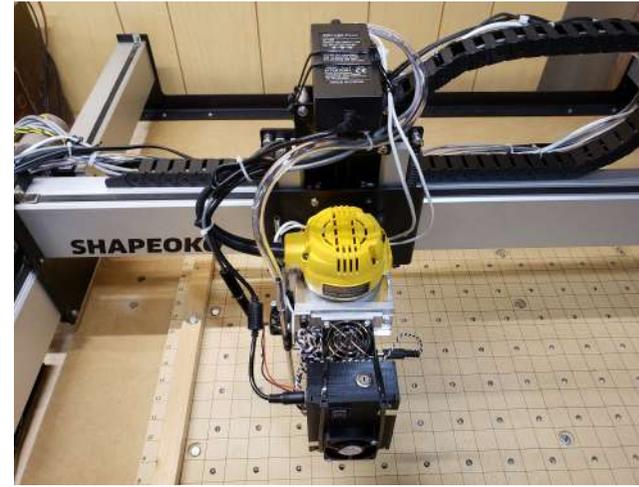
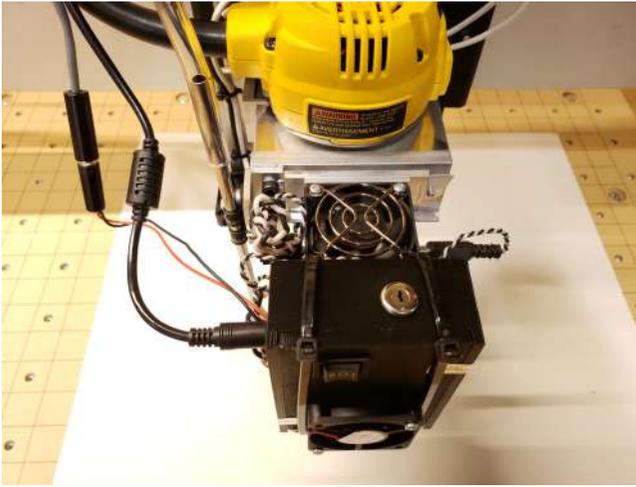
I used to use a Reality 3DP, but can no longer recommend it. After attaching the part of this project that stays affixed to the Spindle Mount, I threw on the dust boot. Although it hit the very bottom of the leading edge of the bracket, it would not have affected the boot's function. Still, I wasn't entirely happy with it, so I took off maybe 1/8" from the top of the boot, where the hose connects. That was all it needed.

The Wrap

So, there you go. For a relatively small investment (with lots of leftovers), and half a day's labor or less, you can have a sturdy, ultra-convenient way to mount and dismount your Endurance laser. Now I can't wait to start cutting with this sucker!

Here are a few more pics of the whole setup. Good luck!





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