

brandeismakerlab

How to upgrade your Ender with a lab upgrade package

How to use one of the lab's upgrade kits to upgrade an Ender 3 printer

Written By: (Kat)herine





TOOLS:

- [Hex Keys in inch pattern](#) (1)

Set

- [Wrench and/or Wire Strippers](#) (1)

(A set of stamped steel wrenches would be better, but I didn't one at the time)

- [Set of Pliers and Flush Cutters](#) (1)

One of each

- [Large Philips Head Screwdriver](#) (1)
- [Screwdriver with a 6mm Hex head adaptor](#) (1)
- [Hand Files](#) (2)



PARTS:

- [Upgrade Kit](#) (1)

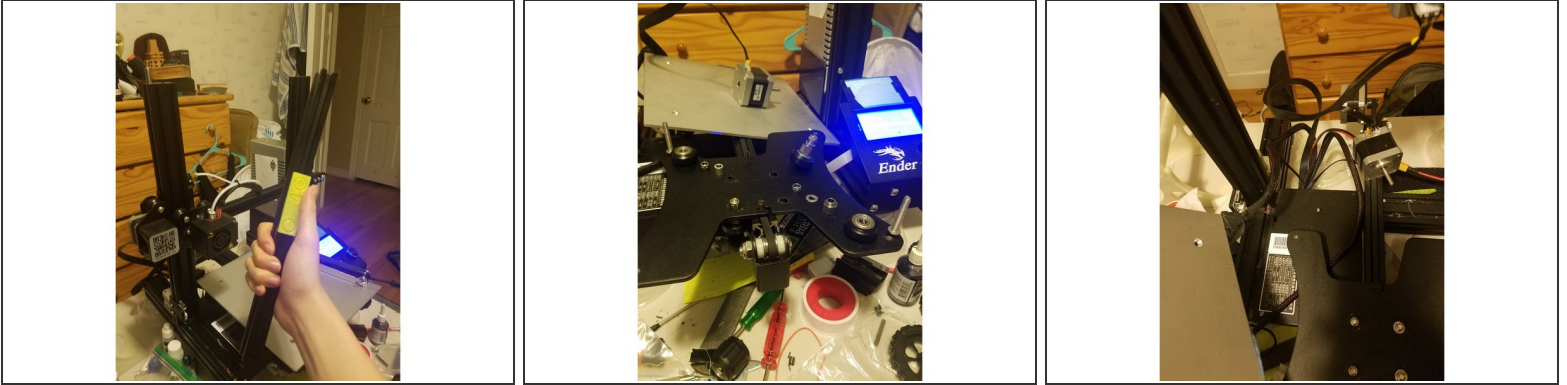
- [Electrical Tape](#) (1)

Roll

- [WD-40](#) (1)

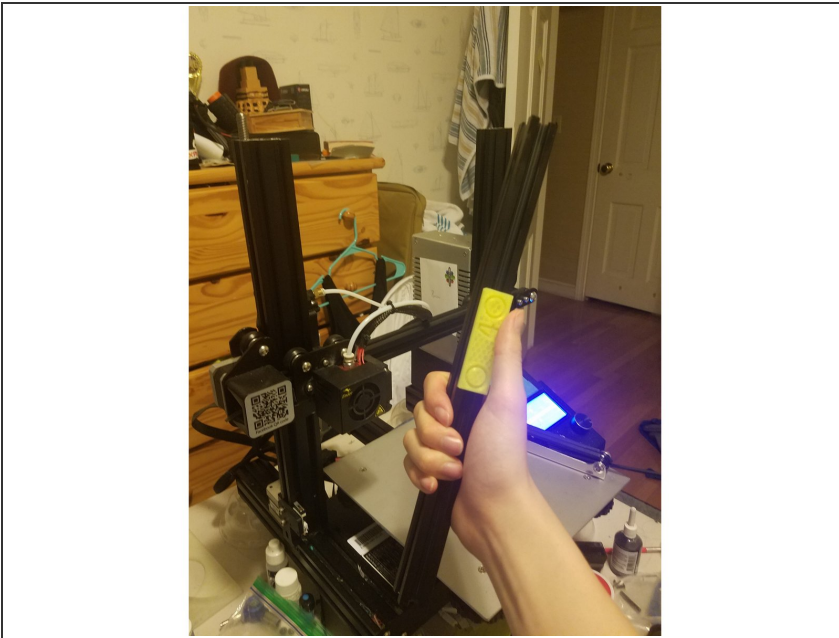
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Step 1 — Disclaimer



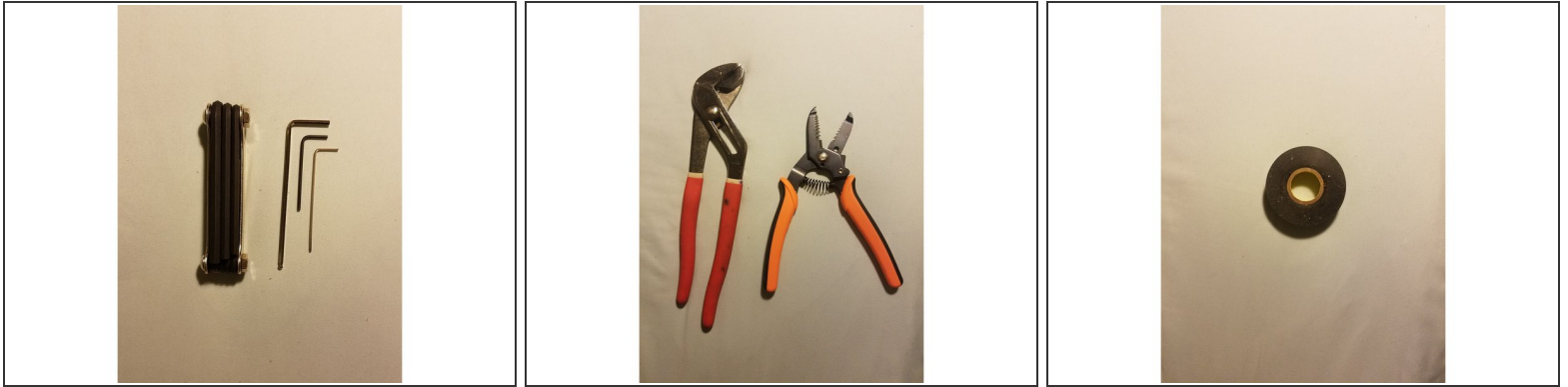
- I recommend not jumping in and pulling the entire printer apart at first like I did, mostly because doing so makes it very difficult to figure out where everything goes, and exponentially increases your chances of losing something important.
- Doing this looks cool, and makes for some great snap streaks, but I'm pretty sure I have a couple screws loose because of it.

Step 2 — Disclaimer Part 2: Printer Boogaloo



- Make sure that your printer is turned off and doesn't have any filament in it before you start disassembling it.
- Don't make my mistake the first time around and take it apart while it's still plugged in

Step 3 — Toolkit (1/3)



- Please bear in mind that these were things I managed to snag on my way off campus as the quarantine went into effect, as well as a bunch of miscellaneous tools I found around my house, some of which I didn't even know we had. Hopefully your toolkit will be more complete.
- This is also just a visual re-tread of the tools section, so skip it if you already know what everything is
- Hex keys in inch pattern
- A wrench and wire stripper with gripping surfaces (A set of stamped steel wrenches would be better, but I didn't one at the time)
- Electrical Tape

Step 4 — Toolkit (2/3)



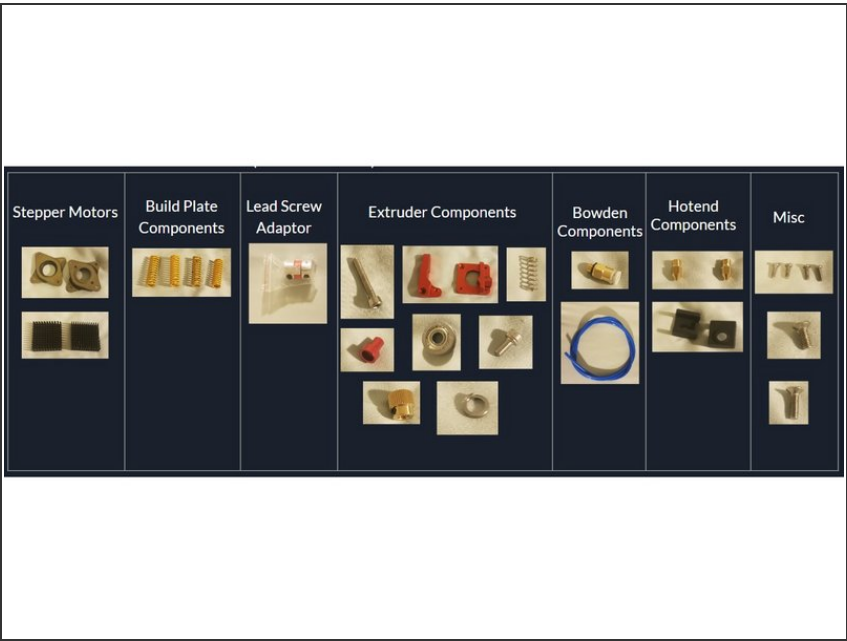
- Pliers and flush cutters
- A large phillips head screwdriver
- A screwdriver with a 6mm hex socket adaptor

Step 5 — Toolkit (3/3)



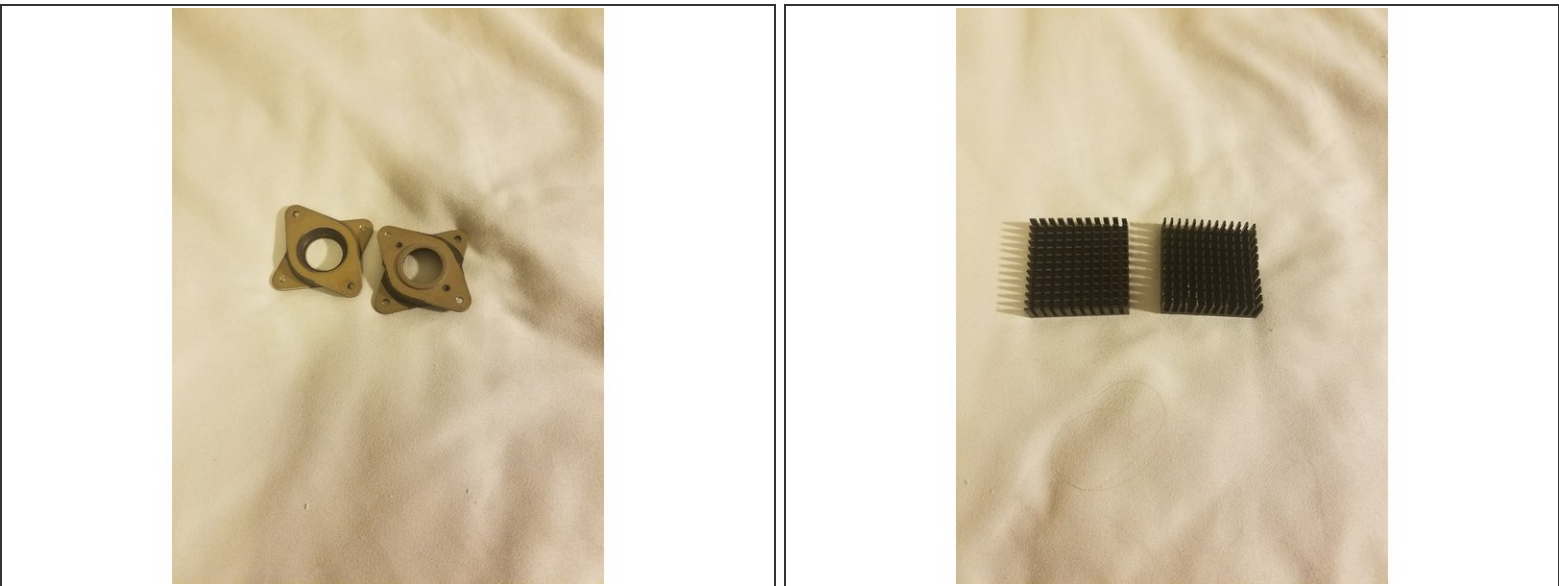
- WD-40
- A set of hand files (you really shouldn't need these, but I had to use them in one place. Even in that situation, a dremel would have been better)

Step 6 — Parts Included (1/10)



- Here is a basic overview of everything the kit contains and will be elaborated upon in the upcoming steps

Step 7 — Parts Included (2/10): Stepper Motor Components



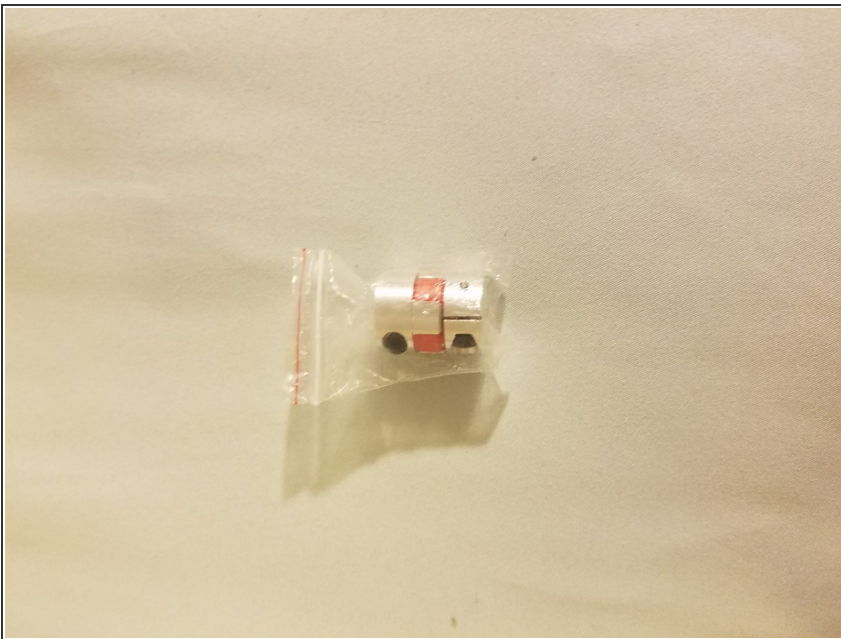
- 2x Motor dampers
- 2x Heat sinks

Step 8 — Parts Included (3/10): Build Plate Components



- 4x Bed leveling springs

Step 9 — Parts Included (4/10): Z Axis Component



- 1x Lead screw adaptor

Step 10 — Parts Included (5/10): Extruder components (1/3)

- 1x Extruder base and idler arm
- 1x Idler hinge Screw
- 1x Idler arm bearing

Step 11 — Parts Included (6/10): Extruder components (2/3)

- 1x Filament bearing screw
- 1x Filament bearing shim
- 1x Filament bearing

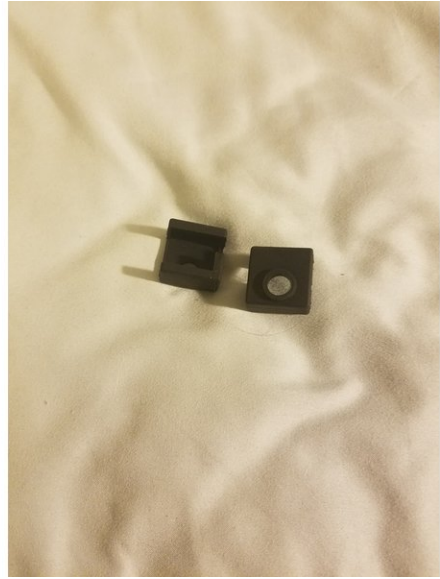
Step 12 — Parts Included (7/10): Extruder components (3/3)

- 1x Idler arm spring
- 1x Filament drive gear

Step 13 — Parts Included (8/10): Bowden components

- 1x Tube coupling
- 1x Replacement bowden tube

Step 14 — Parts Included (9/10): Hotend Components

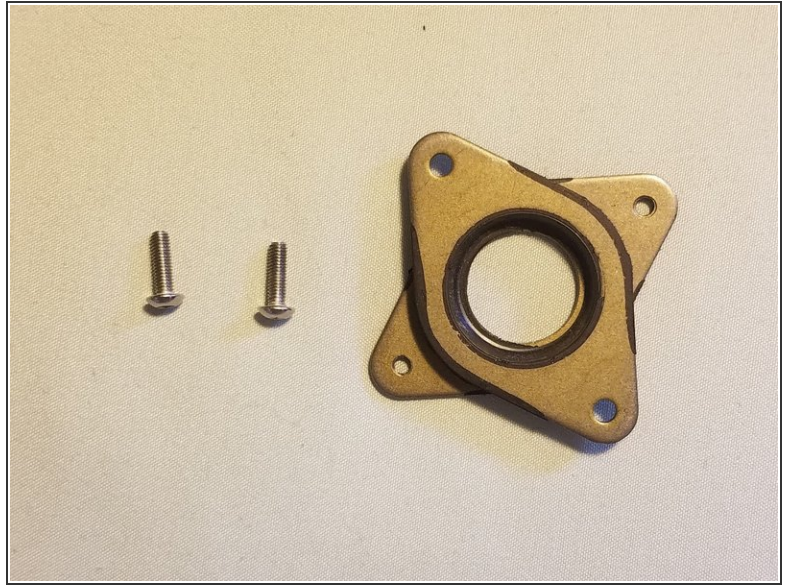
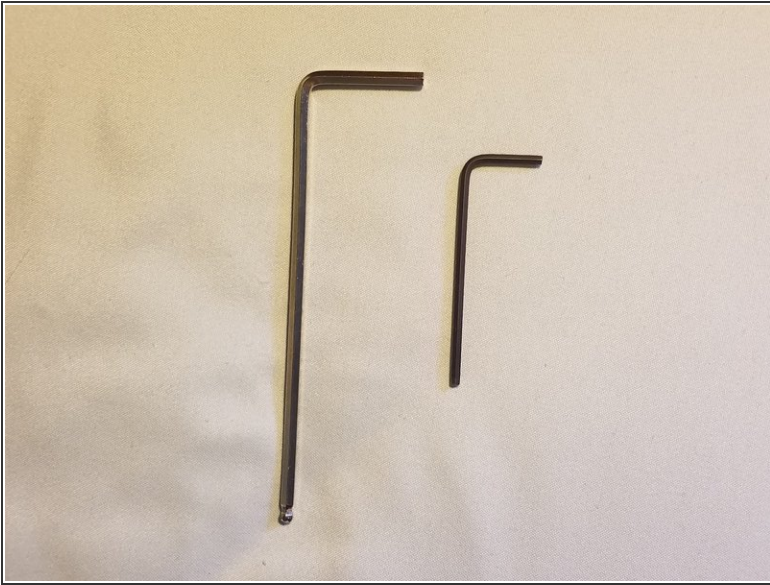


- 2x 0.4mm nozzles
- 2x heat socks

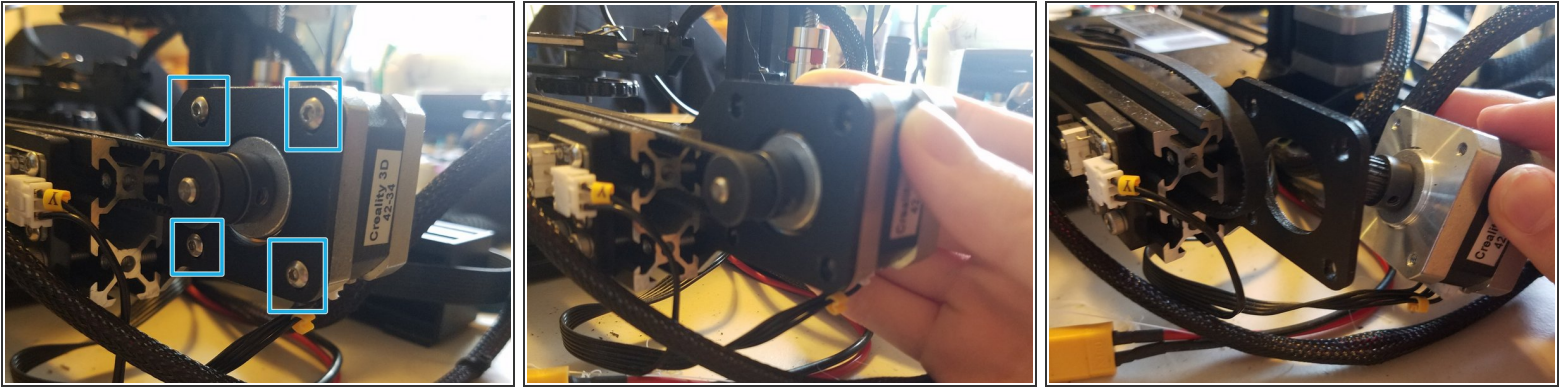
Step 15 — Parts Included (10/10): Misc Components



- 4x hex screws
- 1x short countersunk screw
- 1x long countersunk screw

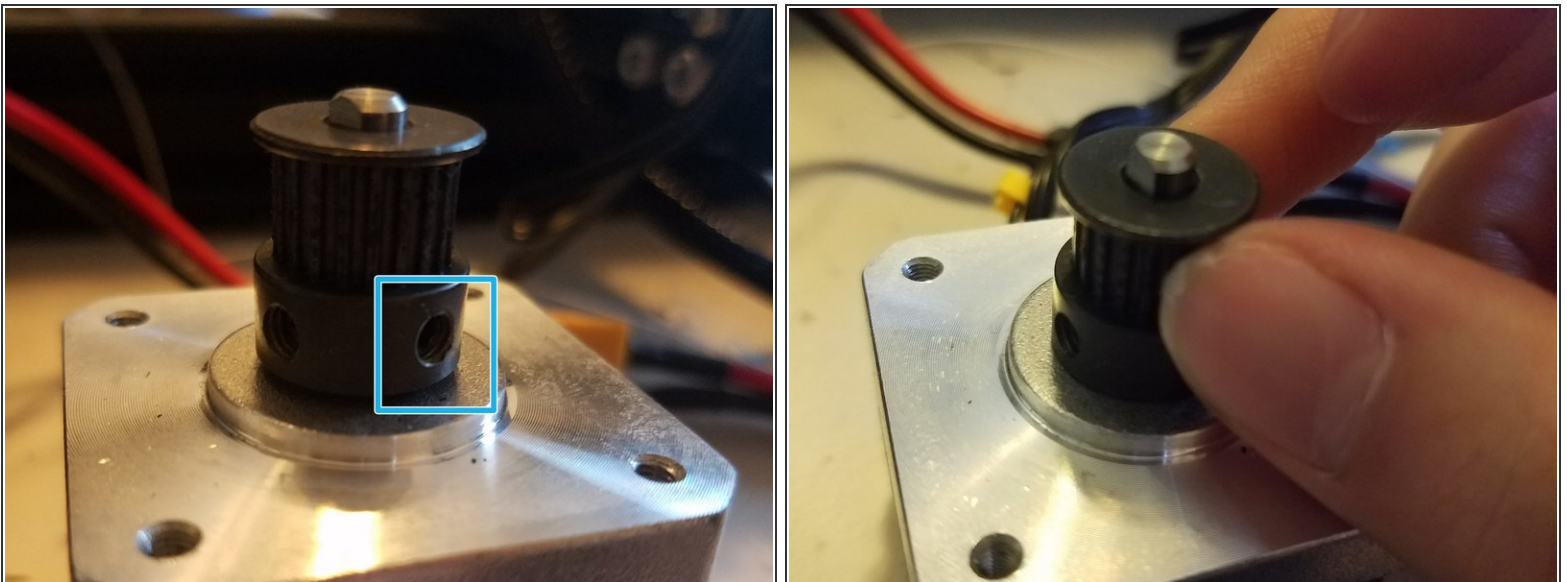
Step 16 — Upgrading the Ender (1/5) X/Y Axis movement (Y axis movement (1/8))

- For this section you'll need:
- Two Allen keys from your set
- Two of the four rounded hex bolts and one motor damper

Step 17 — Upgrading the Ender (1/5) X/Y Axis movement (Y axis movement (2/8))

⚠ Warning: The motor is under tension from the belt, and might fly out of its bracket, off the table, and down a well if something doesn't hold it in place

- Undo the four hex bolts while using your hand to hold the motor in place.
- Gently tilt the motor housing backwards and out of its bracket, then disconnect its wire and put everything in a safe place

Step 18 — Upgrading the Ender (1/5) X/Y Axis movement (Y axis movement (3/8))

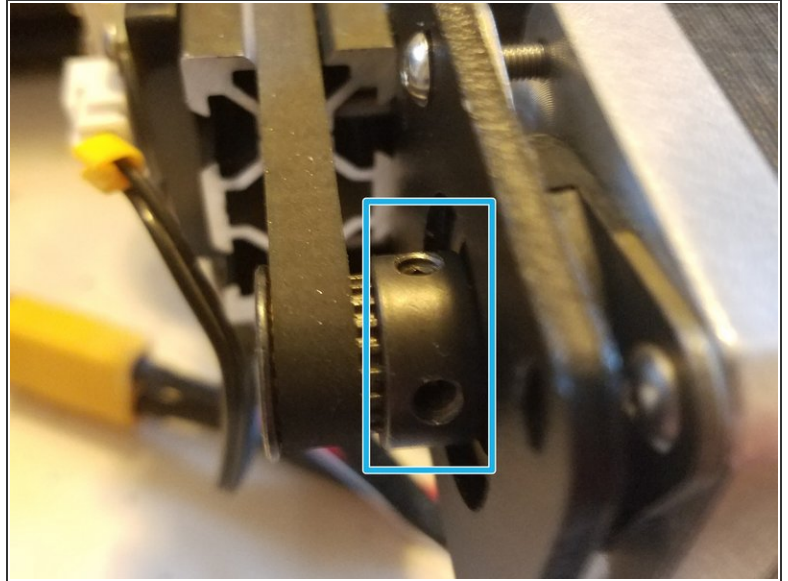
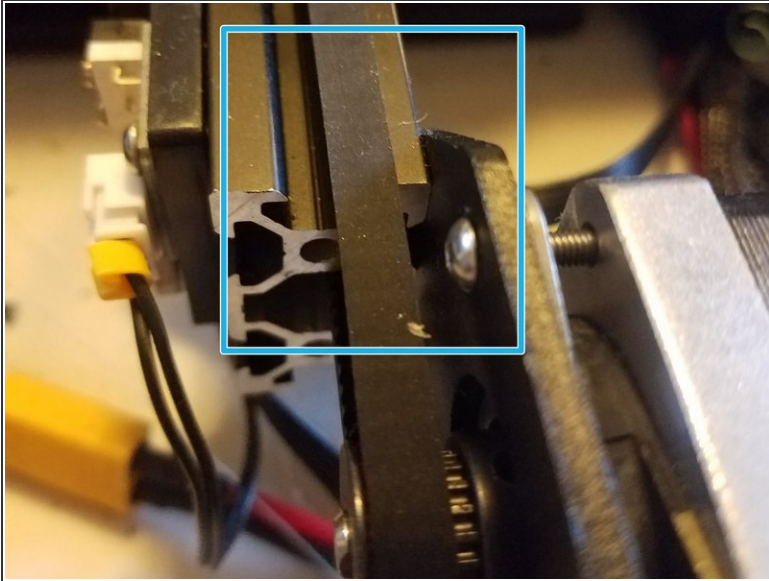
- Loosen this grub screw on the stepper just enough so that the gear can be smoothly moved up and down by hand. There may be a second grub screw set at about 90 degrees from the first one, loosen that one too

Step 19 — Upgrading the Ender (1/5) X/Y Axis movement (Y axis movement (4/8))

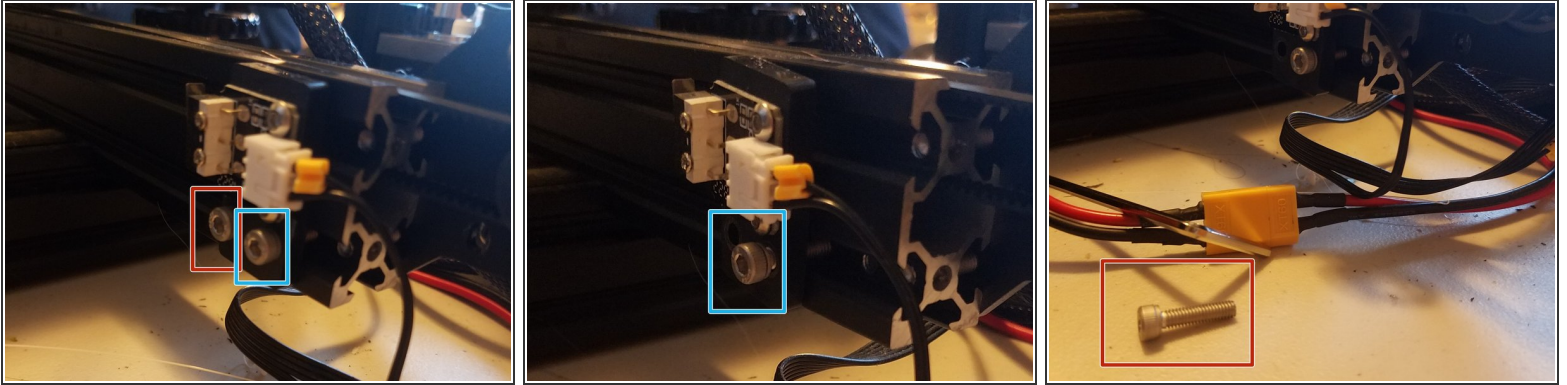
- Place the sunken side of the damper onto the stepper motor so that the raised section on the other side faces upwards.
- Fasten the two corners of the damper in contact with the motor with two of the screws originally used to hold the motor in place.

Step 20 — Upgrading the Ender (1/5) X/Y Axis movement (Y axis movement (5/8))

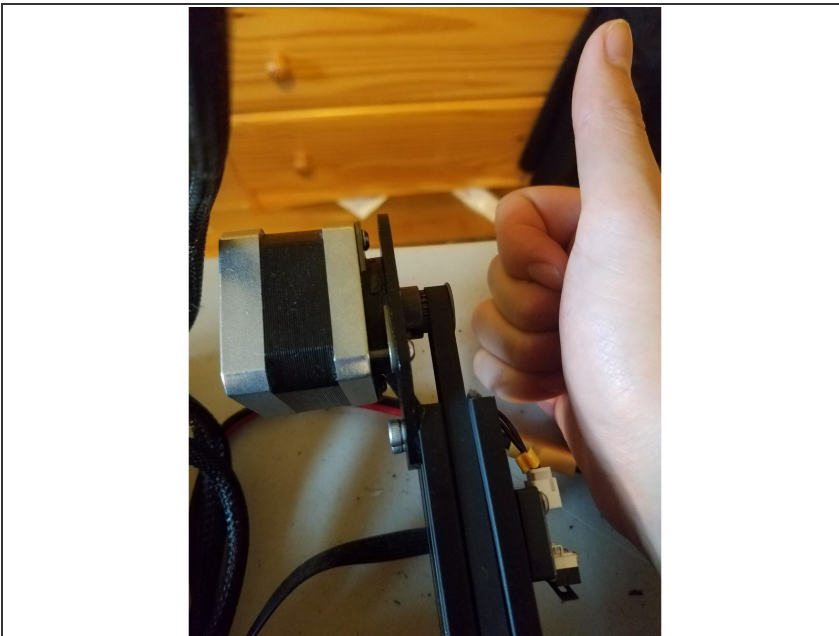
- Place this new arrangement back into the bracket
- Loop the belt over its gear, then tighten the motor and damper back into place using two of the screws from the upgrade kit

Step 21 — Upgrading the Ender (1/5) X/Y Axis movement (Y axis movement (6/8))

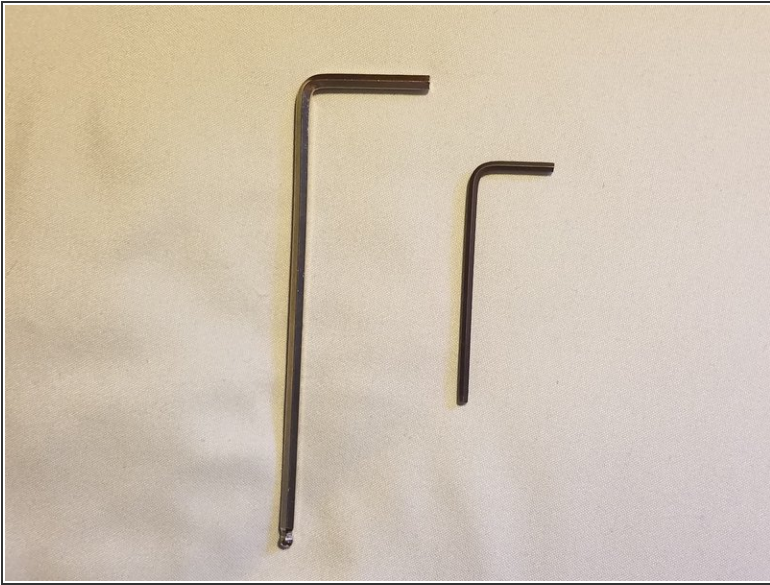
- Push the build plate back and forth a couple of times to make sure the belt will run smoothly in the middle of the gear and won't touch the bar it runs through.
- If it doesn't do this, move the gear along its axle until it does, then tighten it down so that all movements made by the stepper will also translate to the belt

Step 22 — Upgrading the Ender (1/5) X/Y Axis movement (Y axis movement (7/8))

- Undo the two screws holding the Y axis end stop in place
- Move it forward so that screw B is in screw A's spot. Make sure to tighten this enough so the endstop won't rotate when the build plate hits it.
- You will end up with an extra screw that I recommend you keep in a safe place in case you want to undo the process (This step sacrifices a couple millimeters' worth of print volume in order to give the motor space)

Step 23 — Upgrading the Ender (1/5) X/Y Axis movement (Y axis movement (8/8))

- With that last step, you've finished installing the motor damper on the Y axis!

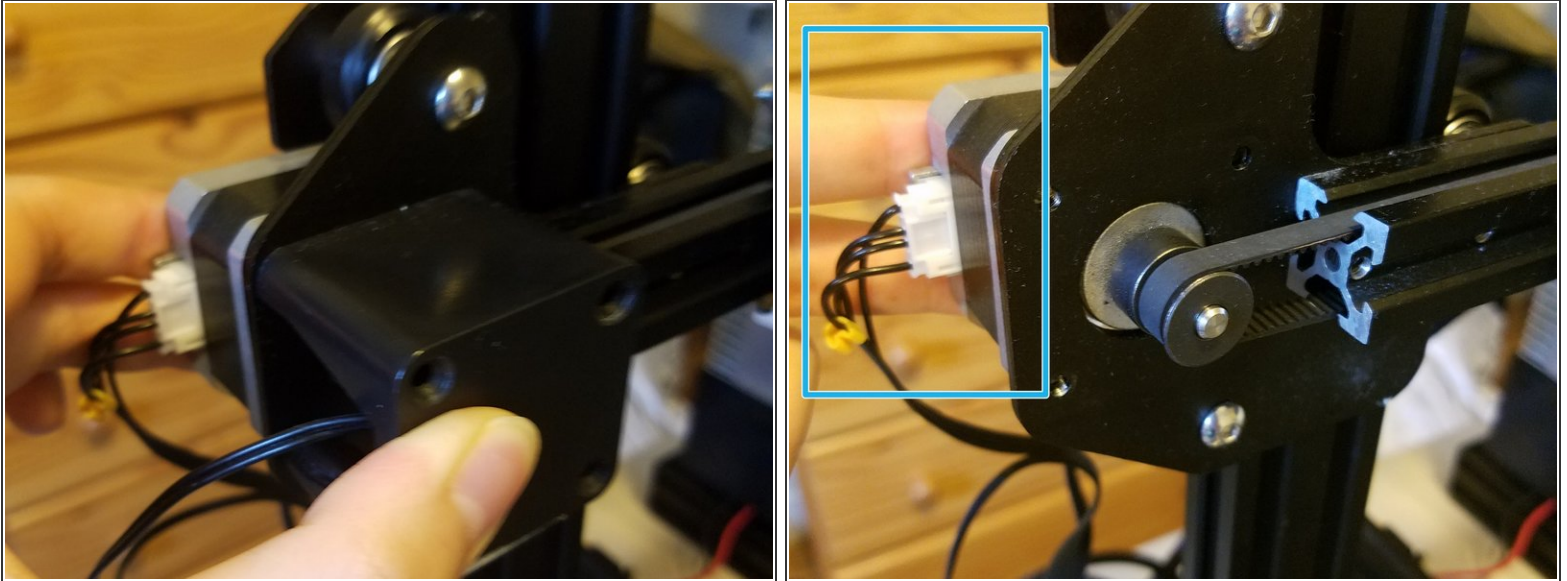
Step 24 — Upgrading the Ender (1/5) X/Y Axis movement (X axis movement (1/6))

- For this section you'll need:
- The same two Allen keys from your set
- The other motor Damper

Step 25

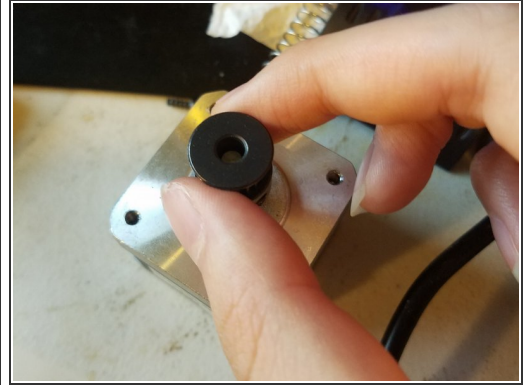
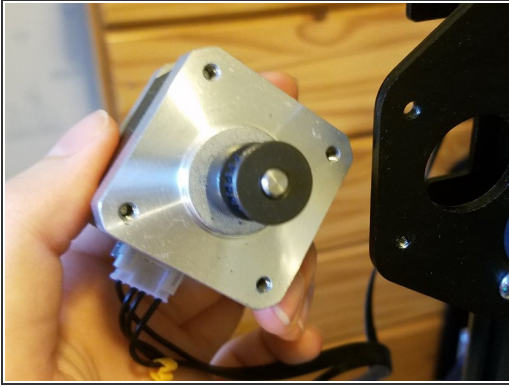


- Start by removing this sticker on the left side of your X axis gantry to reveal the four screws holding this stepper motor in place.
- I opted to just chuck the sticker, but you can keep yours to put on later or store away.

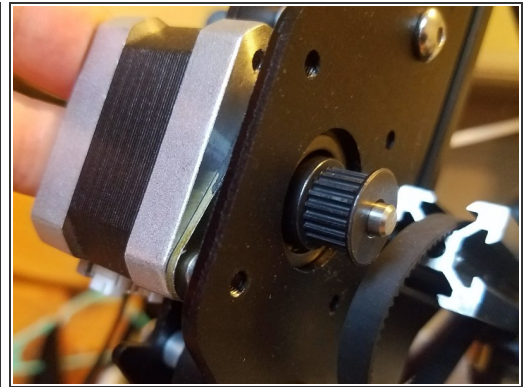
Step 26 — Upgrading the Ender (1/5) X/Y Axis movement (X axis movement (3/6))

⚠ Warning: This motor is also under belt tension, as well as potentially being significantly higher off the table than the Y axis motor

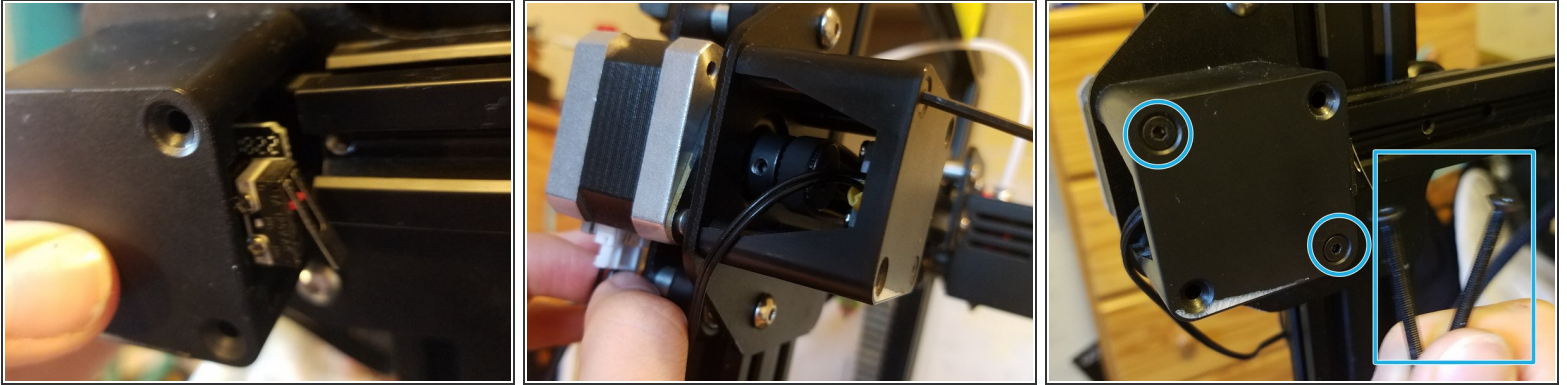
- Remove the four screws holding the motor in, making sure to hold both it and the black cover in place while doing so.
- Once all four screws are gone, you can let the cover dangle by its wire and just make sure the motor doesn't drop out of its spot

Step 27 — Upgrading the Ender (1/5) X/Y Axis movement (X axis movement (4/6))

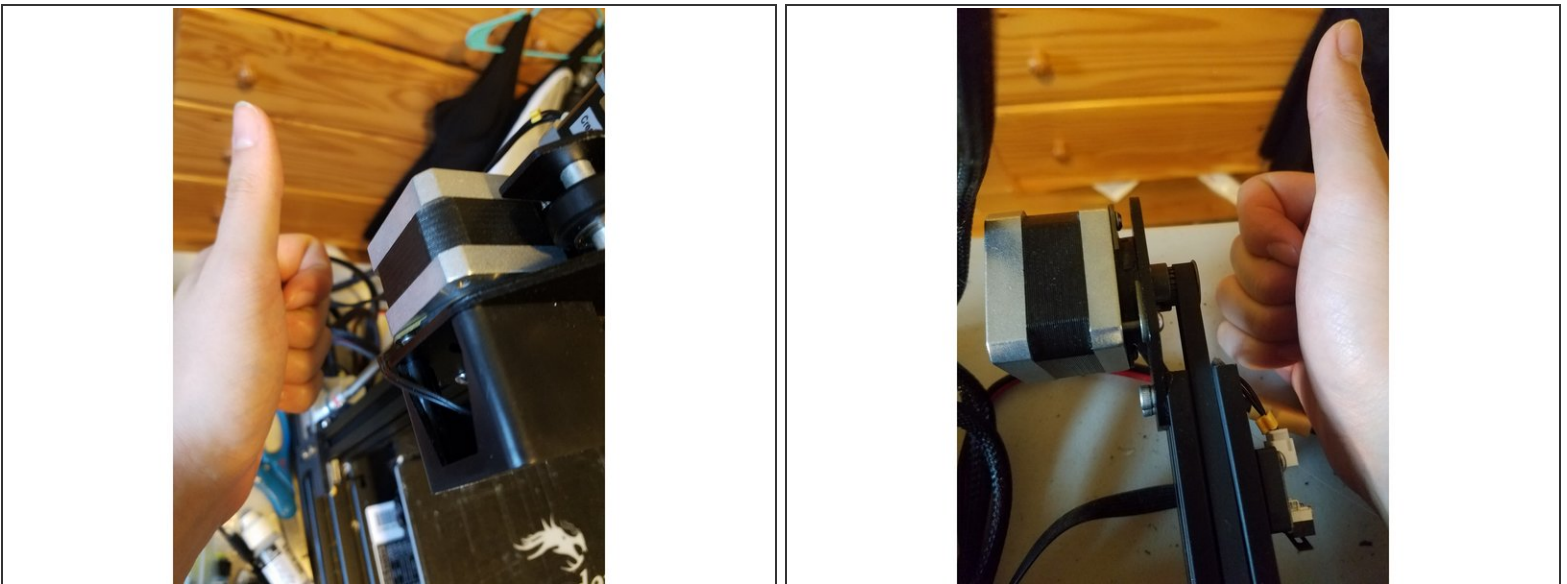
- Repeat the process with the other stepper motor
- Pull it out of its bracket, this time disconnecting it from the printer so you can set it down on the table.
- Loosen the grub screws on the gear just enough so that it travels up and down freely

Step 28

- Same as last time, place the damper on the motor so that the raised side faces up.
- Attach the damper to the motor using the two screws you took from the Y axis motor.
- Fit the entire assembly back into its bracket, looping the belt over the gear and tightening its grub screws.

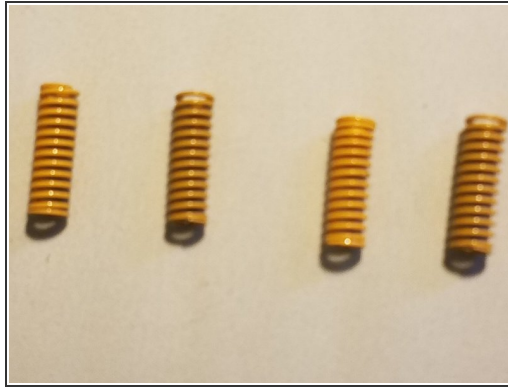
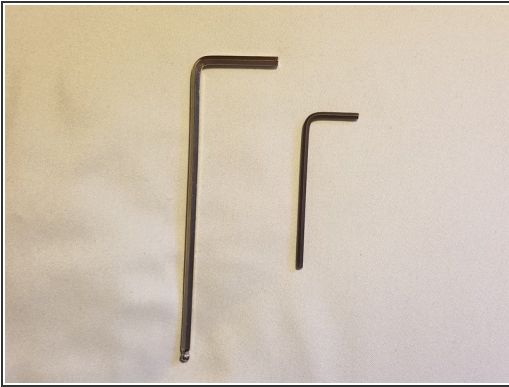
Step 29 — Upgrading the Ender (1/5) X/Y Axis movement (X axis movement (6/6))

- Hold the motor and the black cover steady, with the end stop facing inwards towards the nozzle carriage.
- Tighten two of the original screws into the corresponding corners of the dampers, then reconnect the motor.
- You'll have two extra long screws that you should put away.

Step 30 — Upgrading the Ender (1/5) X/Y Axis movement (Complete)

- With that done, you've officially completed the first step of the upgrade process!
- Ok enough celebration, there's still work to be done

Step 31



- For this section you'll need:
- The Allen key you used to move the end stop
- The four bed springs
- A large Philips head screwdriver (Section A only)

Step 32 — Upgrading the Ender (2/5) Build plate upgrade (1.5/7)



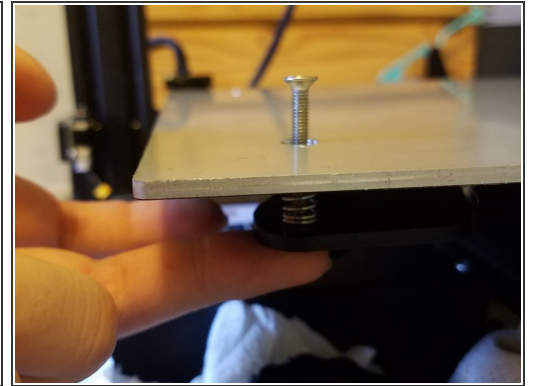
- There's an A section and a B section in this part of the guide.
- The A section pertains to Ender 3s with print beds that can be easily removed from the underlying metal plate via binder clips or something
- The B section pertains to ender 3s with print beds that have some component that is glued to the underlying metal plate
- This section took me about 4 minutes

Step 33 — Upgrading the Ender (2/5) Build plate upgrade (2A/7)



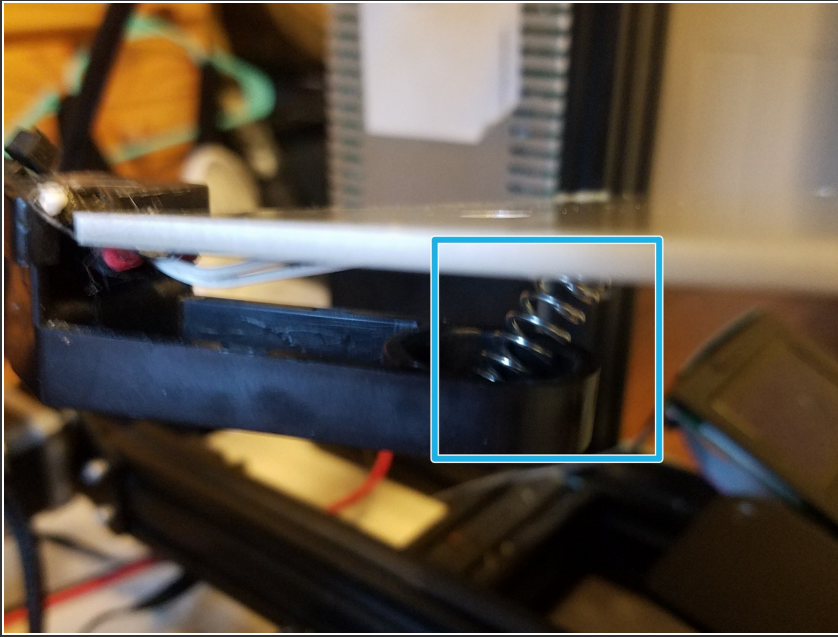
- THIS IS SECTION A
- Start by removing the print bed on top of the metal panel
- For me this meant pulling the four binder clips off of the corners and then removing the whole thing

Step 34 — Upgrading the Ender (2/5) Build plate upgrade (3A/7)



- THIS IS SECTION A
- Use the screwdriver to hold the screw in place while you undo the level adjustment wheel so that it comes off of the printer entirely.
- Once it's off, you can simply push on the screw from below and remove it from the printer.
- At this point, the spring will also be loose, so make sure you store that away as well, even though it won't be needed from now on.

Step 35 — Upgrading the Ender (2/5) Build plate upgrade (4A/7)

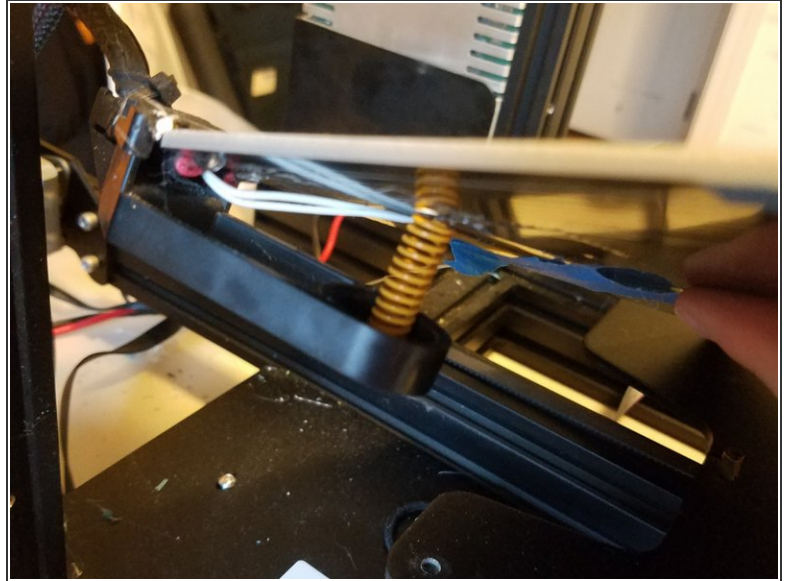


- THIS IS SECTION A

⚠ Be Careful while removing the Build Plate.

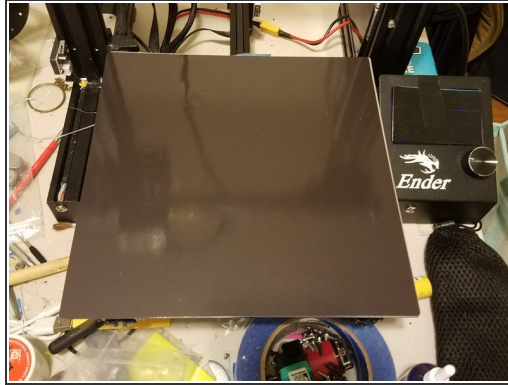
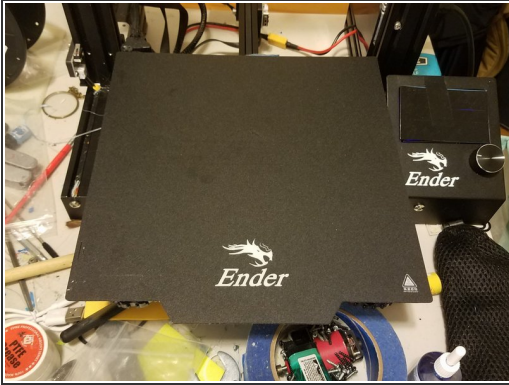
- The plate spring for the far left corner will be held within the same bracket that holds the wiring for the thermistor and heater cartridge.

Step 36 — Upgrading the Ender (2/5) Build plate upgrade (6A/7)



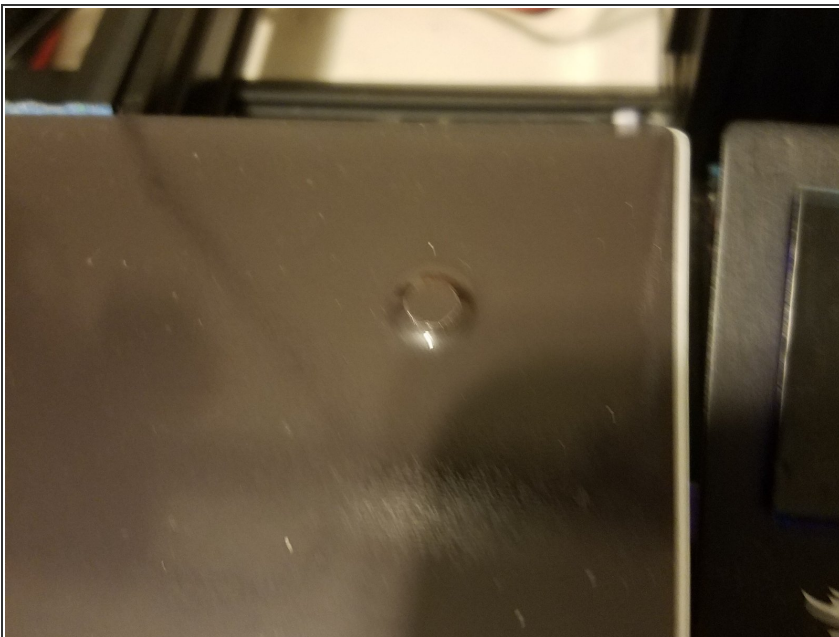
- THIS IS SECTION A
- Reverse the steps that you took to remove the build plate
- Place each spring between the build plate and the metal gantry, then snake a screw through all three and thread it in place with the tuning wheel.
- Take care when finessing a spring into the bracket holding the thermistor and heater cartridge wires.

Step 37 — Upgrading the Ender (2/5) Build plate upgrade (2B/7)



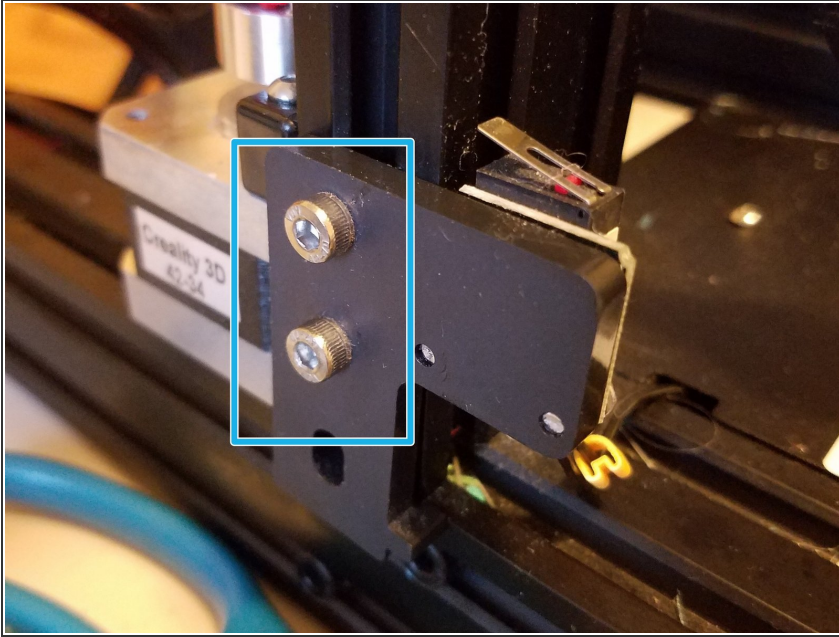
- THIS IS SECTION B
- If you have a print bed with a component that's glued on like this new magnetic print bed, you won't be able to access the screws without either damaging the bed, or the adhesive.
- So instead of stabbing a screwdriver through the bed, just press down on each corner to relieve spring tension, then undo the corresponding adjustment knob

Step 38 — Upgrading the Ender (2/5) Build plate upgrade (4B/7)



- THIS IS SECTION B
- When re-installing the plate, remember to get all of the screws through the gantry before you start tightening down adjustment wheels. Otherwise, you'll end up with screws poking up into the print bed.
- Otherwise, the previous few steps are universally applicable

Step 39 — Upgrading the Ender (2/5) Build plate upgrade (7/7)



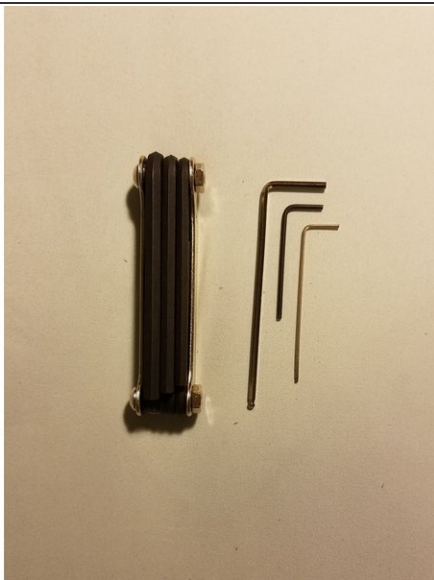
- BOTH SECTIONS END HERE
 - Due to the new bed springs being longer when compressed, I found it necessary to shift the Z end stop up by a couple millimeters. Not doing this caused my nozzle to dig into the bed.
 - To do this, auto home the printer as if to level it, then move the gantry up about 4 millimeters, loosen the two screws on the side, and fiddle the end stop upwards until it clicks. Tighten it back down once you're done.
- i** Note: You may need to repeat this steps a couple times so that the endstop is high enough that you can do all of the normal leveling actions.

Step 40 — Upgrading the Ender (2/5) Build plate upgrade (Complete)



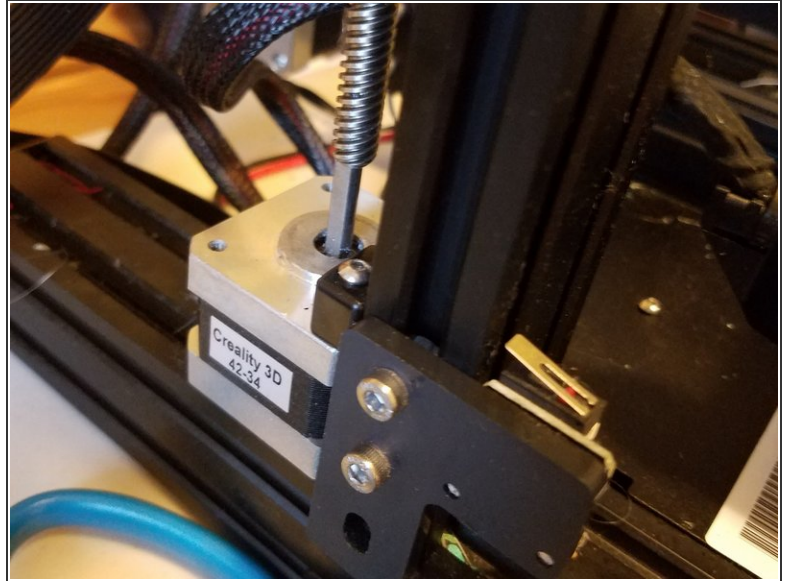
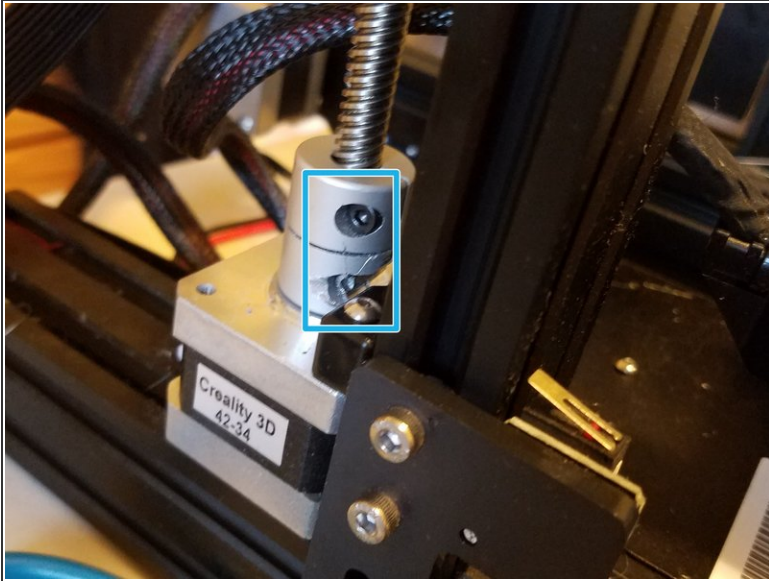
- Congratulations! You have now finished section 2

Step 41 — Upgrading the Ender (3/5) Z Axis upgrades (1/3)



- For this section, you'll need:
- One of the larger Allen keys: in my case, that meant getting the multitool out
- The lead screw adaptor

Step 42 — Upgrading the Ender (3/5) Z Axis upgrades (2/3)



- Loosen the two screws on the stock adaptor, then simply pull up on the lead screw, causing the piece to separate from either the printer itself, or the screw.
- Remove the adaptor from the machine entirely and just let the screw sit on the motor shaft for now

Step 43 — Upgrading the Ender (3/5) Z Axis upgrades (3/3)



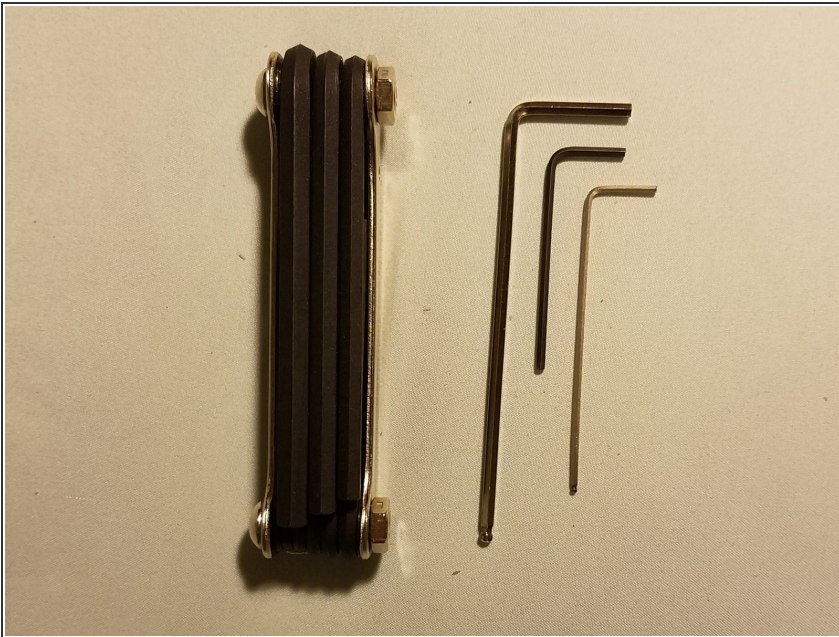
- The new adaptor has a large hole end and a smaller end.
- Loosen both screws on it, and slot the smaller end over the motor shaft with the lead screw running into the larger hole.
- Tighten both screws.

Step 44 — Upgrading the Ender (3/5) Z Axis upgrades (Complete)

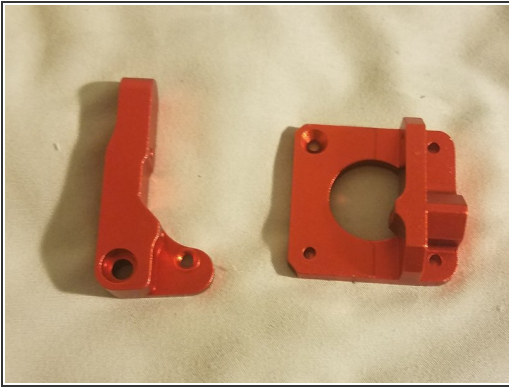


- This section was only one upgrade part, but it should allow your printer to avoid damage if for some reason the nozzle was forcefully jammed down on a hard object like a print.
- Either way, congratulations on completing it!
- I forgot to take a thumbs up pic for this section

Step 45 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (1/16))



- For this section you'll need:
- Three of your Allen keys, and the next 4 slides' worth of parts

Step 46 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (2/16))

- Parts needed:
- Extruder base and idler arm
- Idler hinge Screw
- Idler arm bearing
- You'll also need one of your countersunk screws, the ones with the flat top and triangular silhouette

Step 47 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (3/16))

- Parts needed:
- Filament bearing screw
- Filament bearing shim
- Filament bearing

Step 48 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (4/16))

- Parts needed:
- Idler arm spring
- Filament drive gear
- 2 of your hex screws from earlier

Step 49 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (5/16))

- I recommend laying everything out in roughly its correct placement.
- Plus, this section requires the assembly of a couple small bits before you can actually put it on the printer.

Step 50 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (6/16))

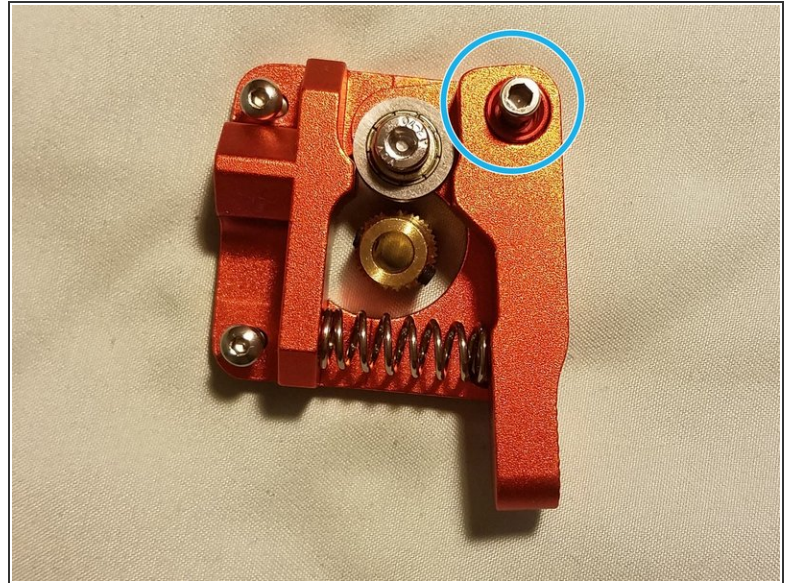
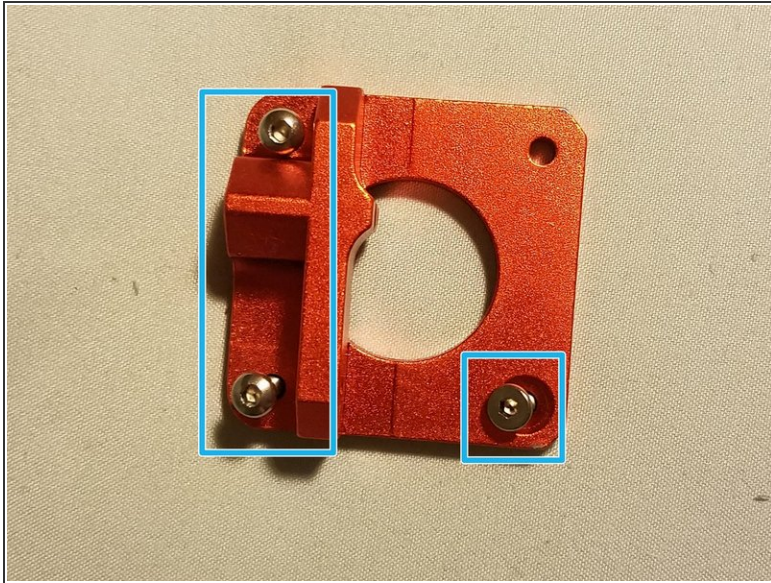


- We'll start with the idler arm and its components.
- Arrange the following parts as shown and listed:
- Filament bearing screw, filament bearing shim, and filament bearing on the left
- Idler hinge screw and arm bearing on the right

Step 51 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (7/16))

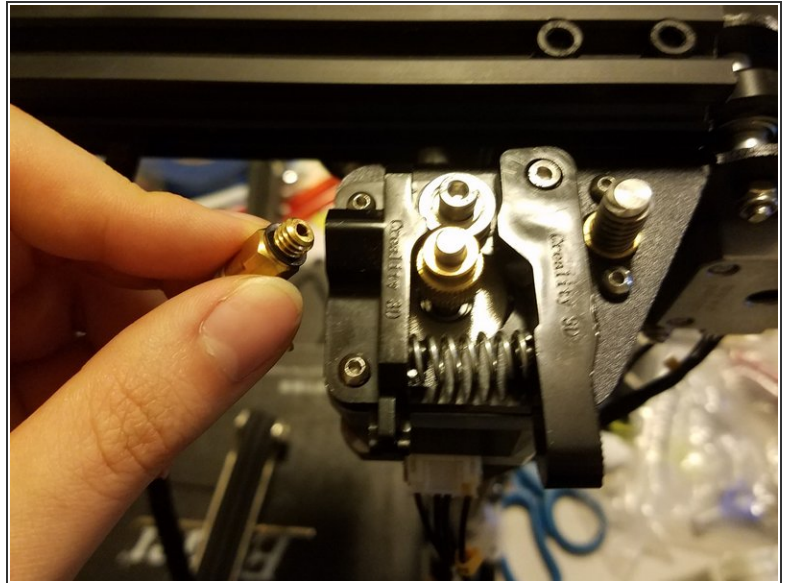
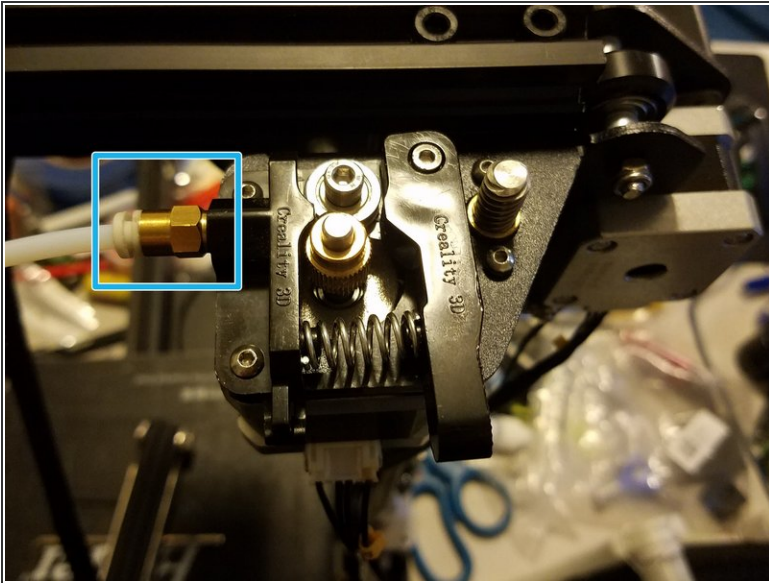


- Put each screw through their respective parts as shown in these and the previous image, then place them into the arm.
- Note: The filament bearing screw will need to be screwed in, but the Idler hinge screw can just sit loosely for now

Step 52 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (8/16))

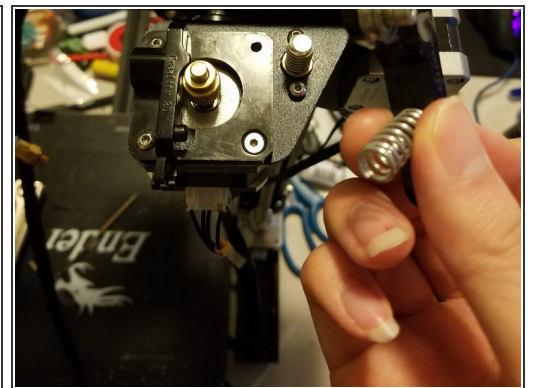
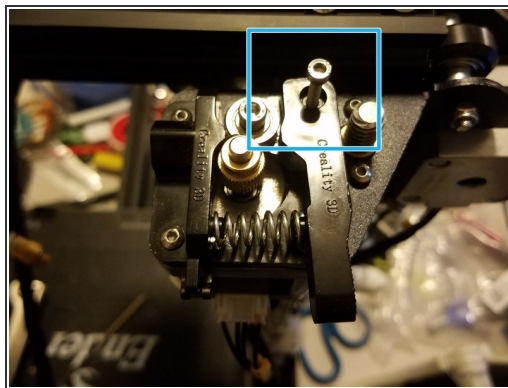
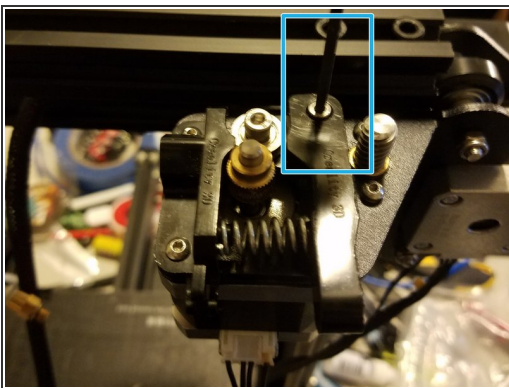
- Stage everything together for convenience.
- Your two hex rounded hex screws should be on the bowden side of the frame, with your countersunk screw going in the bottom right corner.
- The Idler arm hinge screw fits through the top right corner
- You'll note that the idler arm spring is still loose, and will be held in place with screws taken from the printer itself.

Step 53 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (9/16))



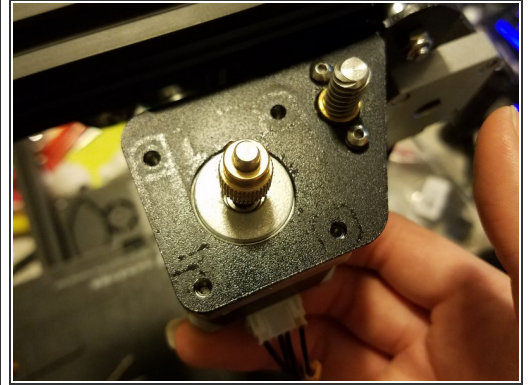
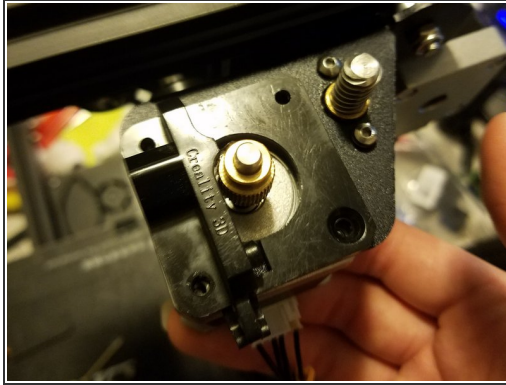
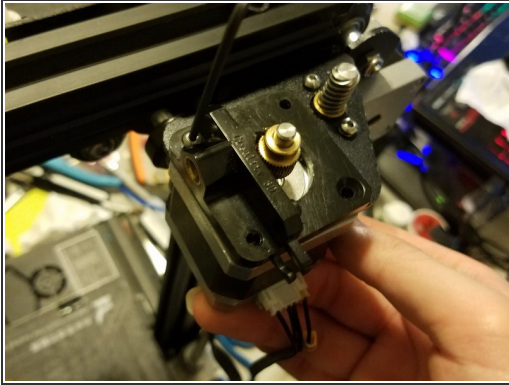
- Start by pulling the gantry to the top of its travel.
- Removing the bowden coupling. (You should be able to just unscrew it by hand)

Step 54 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (10/16))



⚠ Note: The idler arm is under spring tension and will fly off to Narnia if you don't hold it in place

- Undo and remove the idler arm screw while holding it in place.
- Once the screw is gone, slowly remove the arm up and out, making sure not to let the spring fly off into oblivion

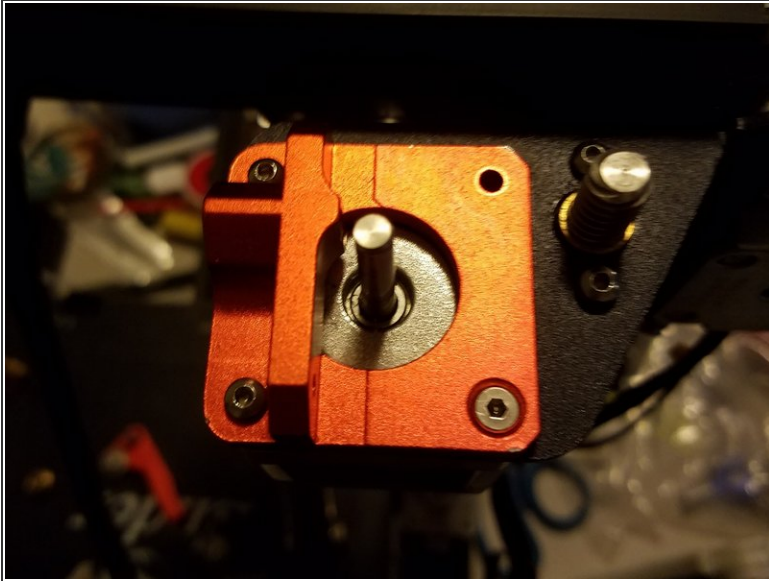
Step 55 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (11/16))

⚠ Note: The Extruder motor is held up by three screws and nothing else: Removing these screws will cause your motor to fall to the table

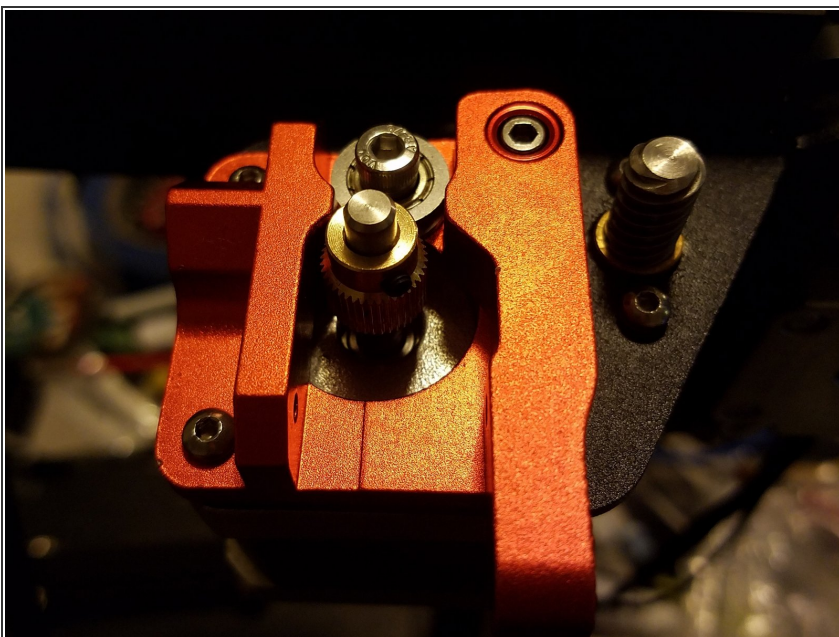
- Holding the extruder motor in place, undo the three remaining screws securing the frame in place.
- Once that's done, you can just remove the frame and the motor

Step 56 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (12/16))

- With the motor out, loosen the two grub screws holding the drive gear in place, and remove it.

Step 57 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (13/16))

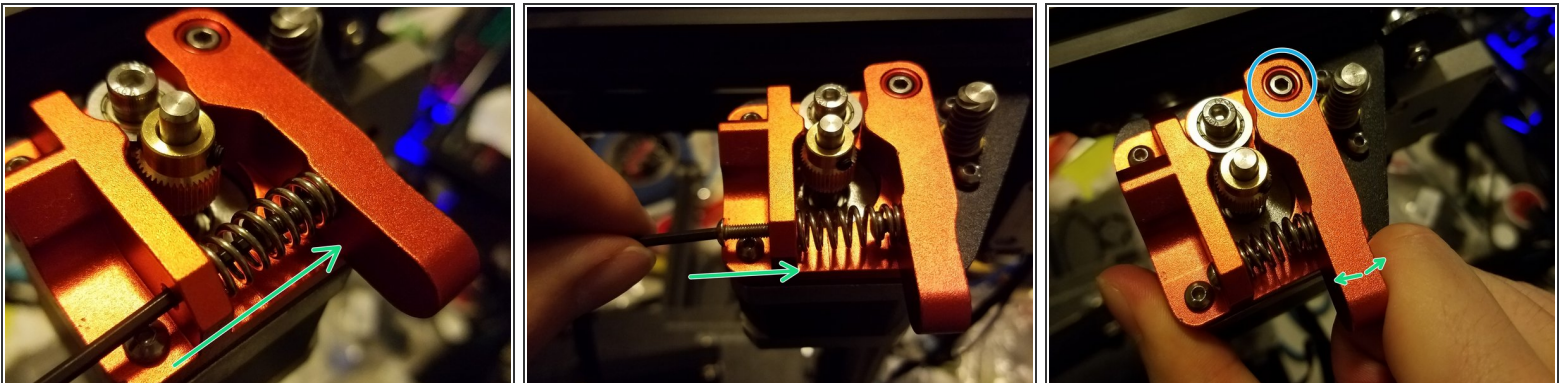
- Place the motor and its frame against each other, then tighten the screws through the frame and into the four attachment points on the motor.
- The first three screws can be tightened down, but the idler hinge screw should be just tight enough to move but not tight enough to inhibit the idler's ease of motion.

Step 58 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (14/16))

- Place the filament drive screw onto the shaft, and hold it high enough so that the teeth and the bearing are at about the same height.
- Tighten the two grub screws.
- Note: The motor shaft has a flattened section that one of the grub screws should be tightened into and against, thereby helping to keep the gear from rotating on the shaft

Step 59 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (15/16))

- Place one of the hex screws you removed from the stock motor frame inside of the new spring, then compress it and slide it into position between the idler arm and frame.

Step 60 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (16/16))

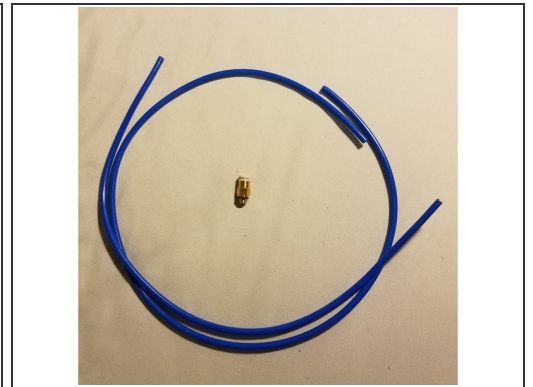
- Place your allen key through the outside screw hole to tighten down the first hex screw into the idler arm.
- Then take another rounded hex screw from the stock frame and tighten it into the outside hole.
- Lastly, test the mechanism by squeezing it a couple times. The arm should swing smoothly along its screw and bounce back into place. If it's stiff, loosen the hinge screw. If the arm has space to flop up and down, tighten the hinge screw.

Step 61 — Upgrading the Ender (4/5) Extrusion upgrades (Motor Upgrades (Complete))

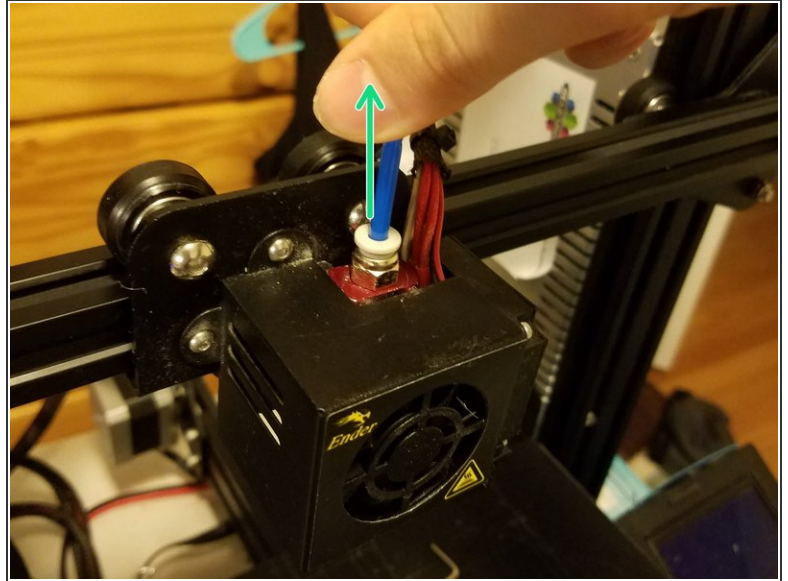
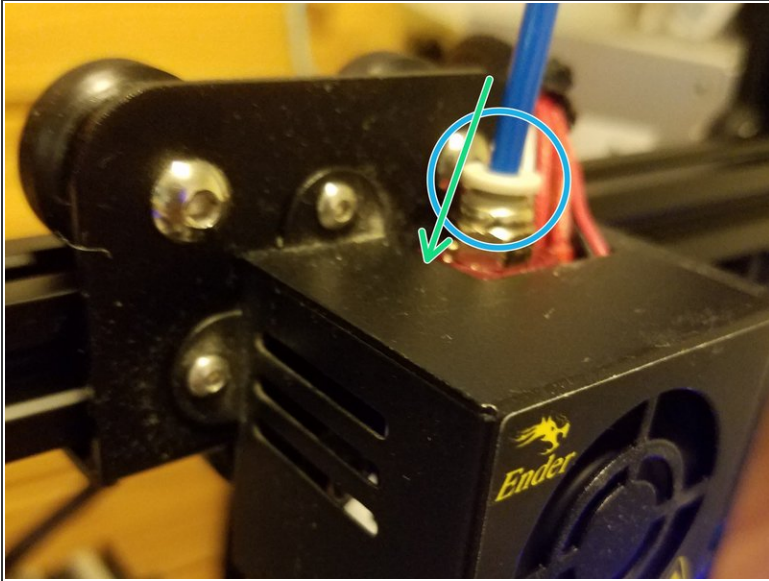


- With that last step done, you've completed the first of three Extrusion upgrades for the Ender 3

Step 62 — Upgrading the Ender (4/5) Extrusion upgrades (Bowden Upgrades (1/5))



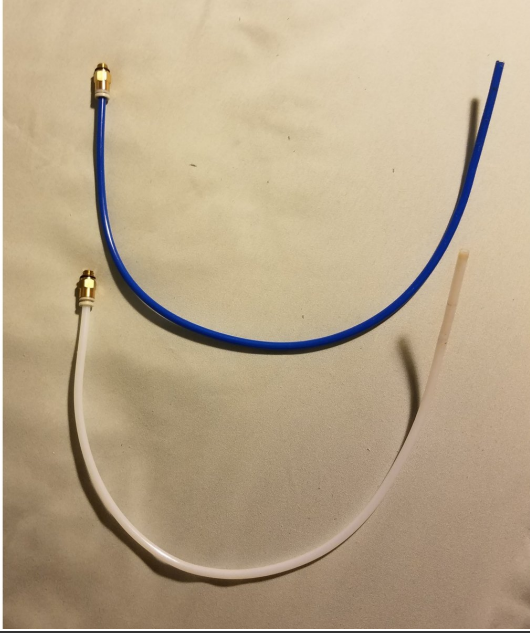
- Tools and materials needed:
- A wire stripper with gripping surfaces, and a flush cutter (If possible, switch these a flat metal wrench and a sharp knife, but I had neither of those so this is what I used)
- Electrical tape (Zip ties work too)
- The new bowden tube and coupling

Step 63 — Upgrading the Ender (4/5) Extrusion upgrades (Bowden Upgrades (2/5))

⚠ Safety note: While doing this, hold onto the fan housing and not the gantry arm to avoid burning yourself

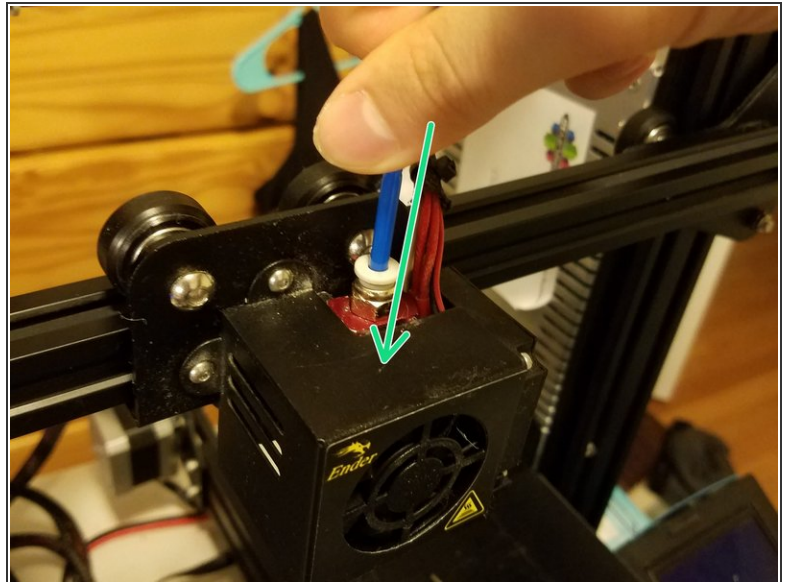
- Turn on the printer and heat it to about 210 C, push the plastic ring at the top of the hotend coupling down, and pull the bowden out.
- Operational note: My coupling was old and worn in, so I had to unscrew it with the wire strippers and pull the coupling out before separating the two pieces.

Step 64 — Upgrading the Ender (4/5) Extrusion upgrades (Bowden Upgrades (3/5))



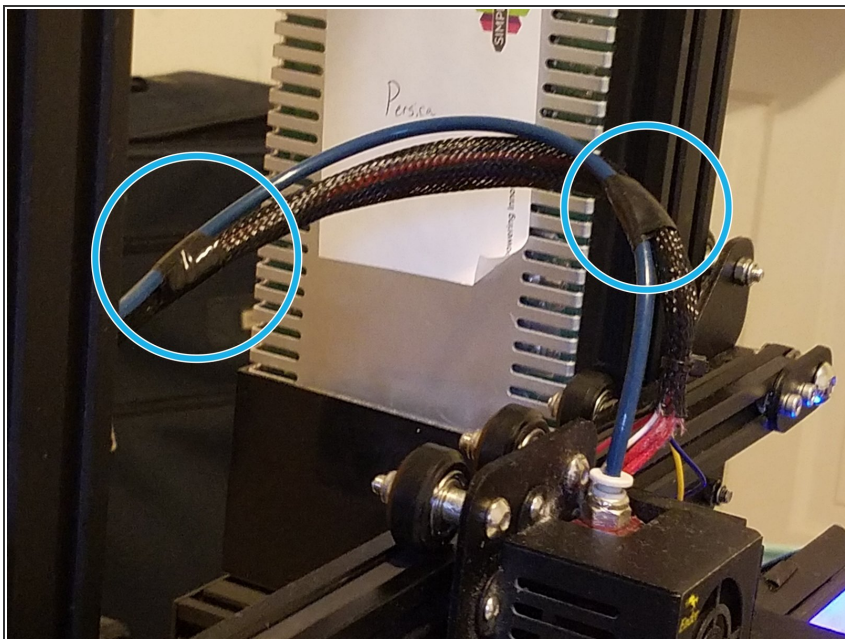
- Connect the coupling to the tube by just inserting the bowden into the little plastic ring. That ring should be compressed towards the brass section and accept the tube. Both parts should now be stuck together without any space for the bowden to move in and out.
- Then measure out the length you want the bowden to be at, about the same as the stock bowden, and carefully cut it to as flat as possible.

Step 65 — Upgrading the Ender (4/5) Extrusion upgrades (Bowden Upgrades (4/5))



- Fit the new bowden into the coupling while the hotend is still being heated.
- Make sure that it goes in as far as it will go, since air gaps between the bowden and the nozzle will cause issues.

Step 66 — Upgrading the Ender (4/5) Extrusion upgrades (Bowden Upgrades (5/5))

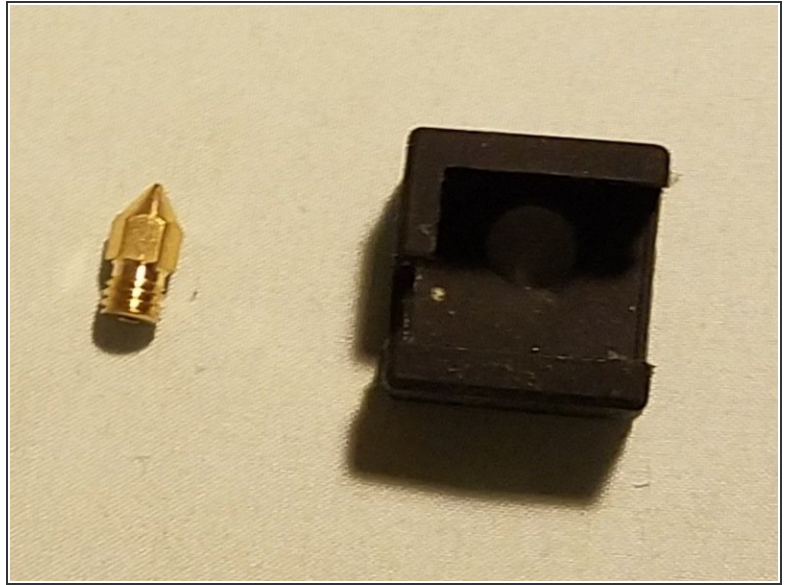


- Use Electrical tape or zip ties to secure the wiring for the hot end electronics to the bowden tube so the both are angled together and neatly out of the way of the print bed.

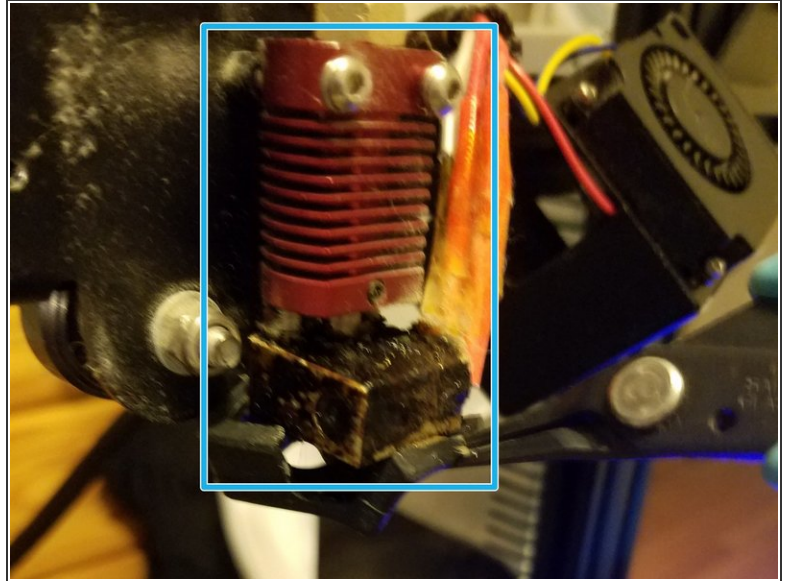
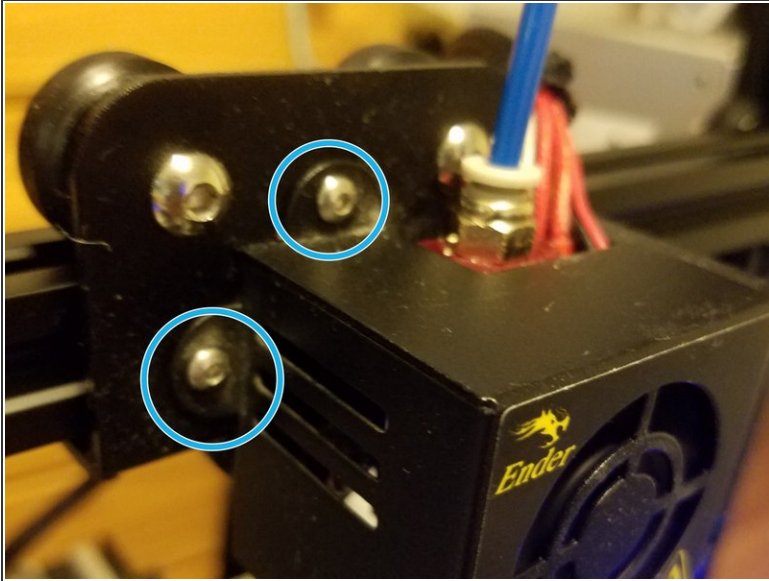
Step 67 — Upgrading the Ender (4/5) Extrusion upgrades (Bowden Upgrades (C))



- You have now completed the second of three extrusion upgrades. Congratulations.
- Don't turn your printer off yet, this next upgrade needs a heated nozzle.

Step 68 — Upgrading the Ender (4/5) Extrusion upgrades (Hotend Upgrades (1/5))

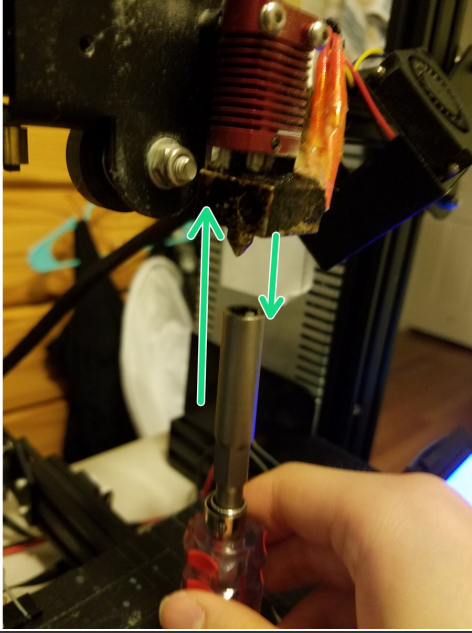
- A screwdriver with a 6mm hex socket adapter, a pair of pliers, and one of your Allen keys
- A nozzle (optional) and heat sock from your upgrade kit

Step 69 — Upgrading the Ender (4/5) Extrusion upgrades (Hotend Upgrades (2/5))

⚠ SAFETY NOTE: Do not touch any part of the vertical extrusion column. You will burn yourself

- Undo the two hex bolts holding the fan housing, then swing it out and to the right to reveal the extrusion column

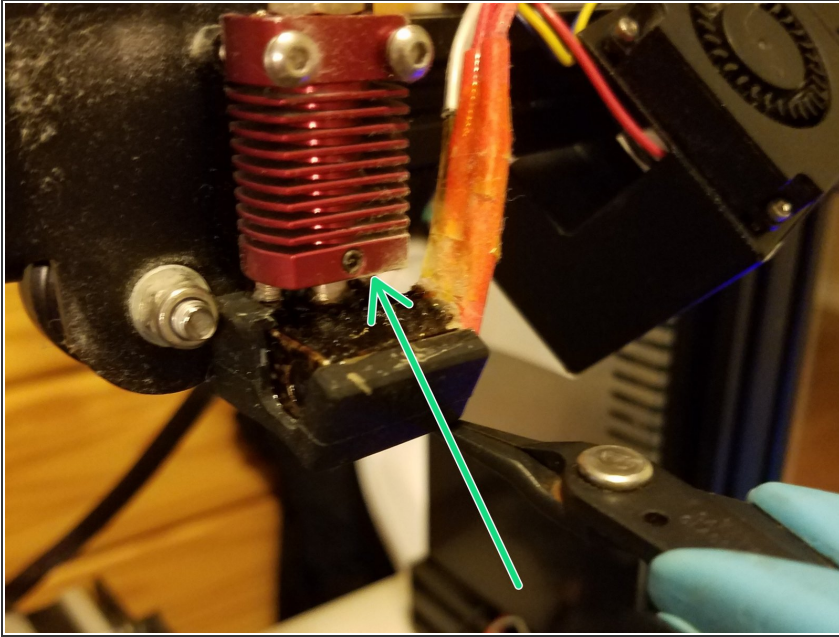
Step 70 — Upgrading the Ender (4/5) Extrusion upgrades (Hotend Upgrades (3/5))



⚠ SAFETY NOTE: The nozzle is more than hot enough to boil water, don't let it touch you

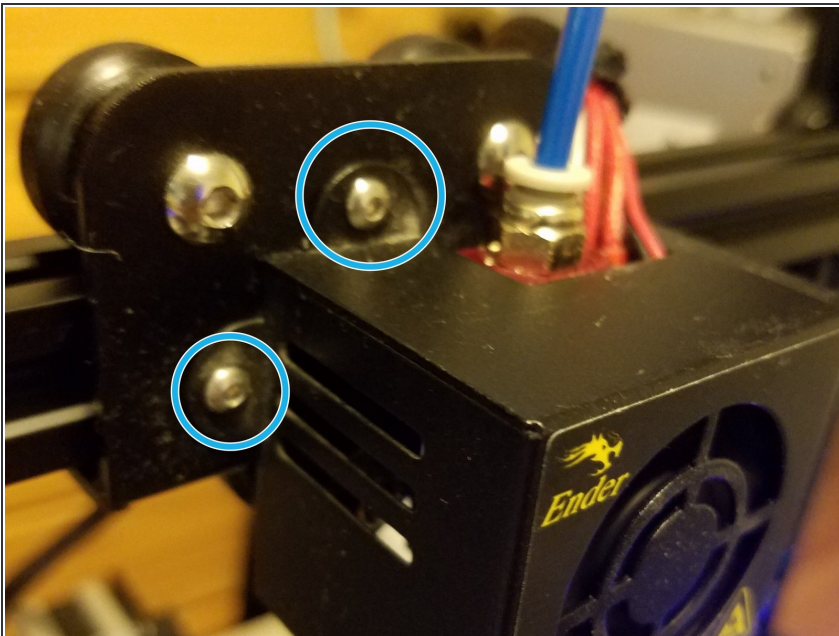
- Use the hex screwdriver to unscrew the nozzle
- ⓘ Note: Mine came out inside of the screwdriver, but yours may just fall out if you use different tools, so be cognizant that it's still hot and don't try to catch it as it falls
- Using your pliers, place the new nozzle into the heat block, tightening it just enough that it doesn't fall out, then tighten it the rest of the way using the screwdriver.

Step 71 — Upgrading the Ender (4/5) Extrusion upgrades (Hotend Upgrades (4/5))



- Using your pliers, gently place the heat sock over the heater block, then nudge it into place.
- The big rectangular cut should face to the right in order to make space for the thermistor and heater cartridge wires.
- Even with the cut, my heat socks were just weirdly shaped enough to not fit perfectly, and one end kinda dangles a bit. As long as it doesn't go past the nozzle, it should be fine

Step 72 — Upgrading the Ender (4/5) Extrusion upgrades (Hotend Upgrades (5/5))



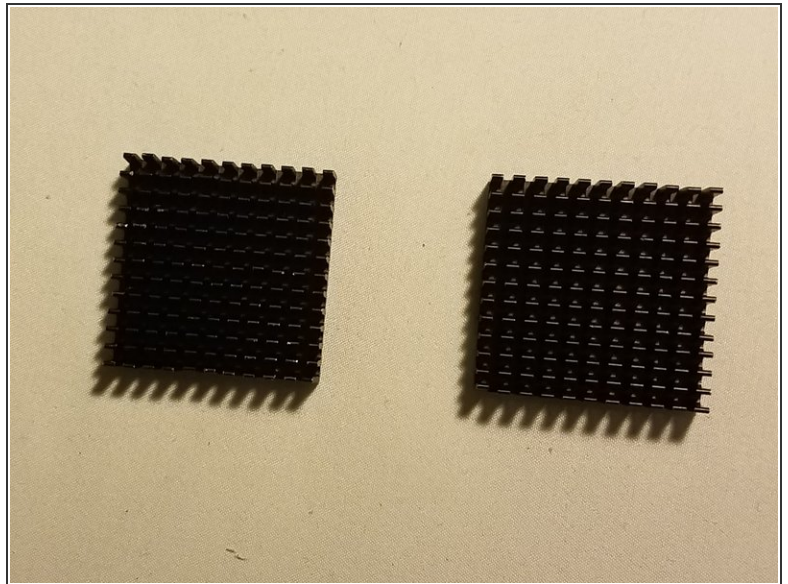
- Keeping away from the extrusion column, swing the fan housing back into place, and re-affix the hex screws in place.

Step 73 — Upgrading the Ender (4/5) Extrusion upgrades (Complete)



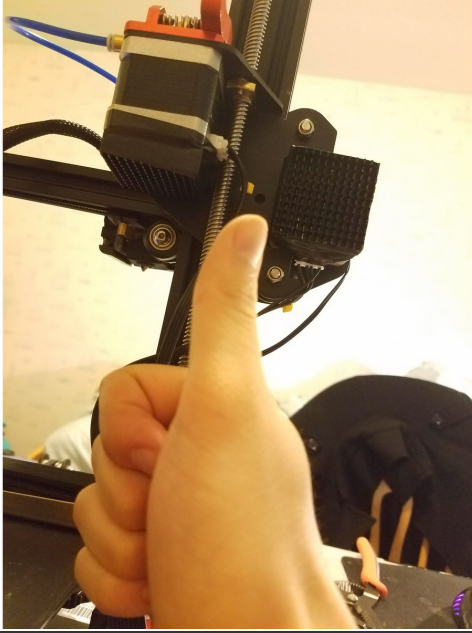
- With that done, you have finished the three upgrades to the Ender 3's extrusion process. Congratulations

Step 74 — Upgrading the Ender (5/5) Misc upgrades (Heat sinks (1/2))



- Tools and materials needed:
- Electrical tape and something to cut it with
- Both heat sinks

Step 75 — Upgrading the Ender (5/5) Misc upgrades (Heat sinks (2/2))



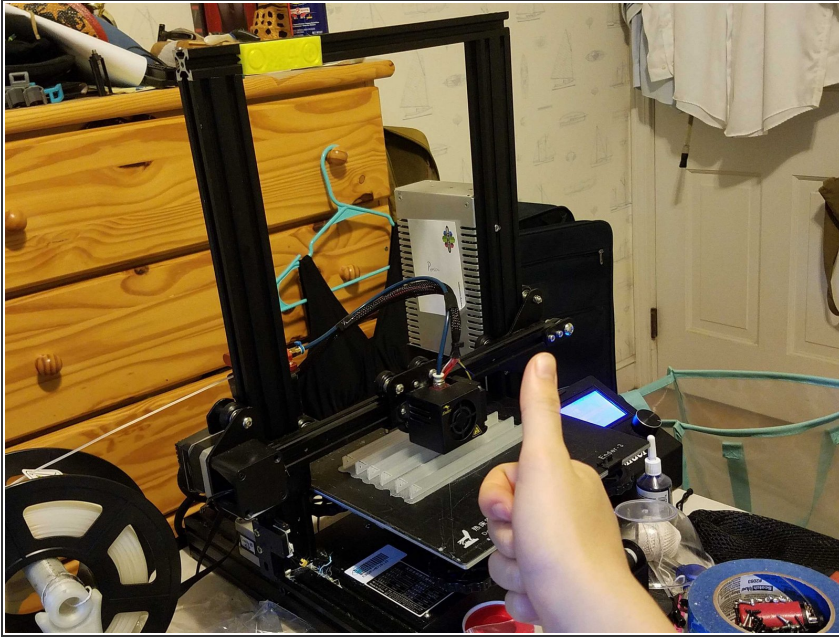
- I'll be honest, it was kind of weird for the makes of this kit to just send smooth backed heat sinks without any mounting solutions.
- Because of this, I opted to just tape them to the two stepper motors with space behind them, those being the extruder motor and the X Axis motor.

Step 76 — Upgrading the Ender (5/5) Misc upgrades (Heat sinks (Complete))



- Well that was simple, congratulations on finishing the last step

Step 77 — Upgrading the Ender (Complete)



- And with that, your upgrade process is complete! (For now, who knows what else you'll be inclined to slap on your printer)
- If you have any questions, feel free to stick a comment down at the bottom.
- Hey look we're back to doing thumbs up pics