Help Guide with assembly, tuning, and troubleshooting tutorials.

For Creality3d Aluminum framed printers, and similar copy's

Author: **Luke Hatfield**

Editor: **Maikel Blewanus**

Special thank's to all the contributors of photo's of there problem components, etc.

This is provided free of charge. Many people have asked to be able to donate to appreciate my work on the guide and in the community help groups. To that end I can accept funds through Paypal @ Lukehatfield@hotmail.com

If you just want to pay it forward, share the information on where to find the guide with other users that may be in need of the help contained within. Or share your personal experience with others having similar issues.

You can follow the Author as OneBadMarine at Thingiverse and You Tube, and Luke Hatfield in the Facebook groups and other forums.

Happy Printings

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1. Precision assembly guide and path to your first print

1.1. New Assembly guide

Alternate process for step by step assembly based from the Official Ender 3 assembly instructions. You will be using both the original instructions as provided in the SD card and these instructions. These changes will help avoid assembly issues that cause problems with bed leveling and Z height repeatability.

These following steps are to go along with the factory assembly paper guide, or the pdf on the supplied SD card.

1. (Step One) Tighten the 4 M5x45mm bolts just to the point you can rotate the extrusions around with a medium force, twisting by hand. This will allow an alignment to be done later in the assembly process. This is an important detail to the future assembly and alignment of the x gantry assembly.
2. (Step Two) Tip: it is easier to install the ribbon cable to the led to port #3, before bolting it on the frame. The PSU, the big metal unit, should be close to the lower rail. If not flip right extrusion to correct.
3. (Step Three) We are going to install this as our last step. Reminder will follow the Alternate steps for X gantry assembly.
4. (Step Four) Do not install the stepper or the z drive rod at this time, will be covered in Alternate steps for X gantry
5. (Step Five) Take the two M4x16mm screws ½ to 3/4 turn past bringing snug, final tightening will occur in the Alternate steps for X gantry (DO NOT use the ball sockets of the Allen key for this tightening)
6. (Step Six) Skip this step will be installed at Alternate steps for X gantry assembly
7. (Step Seven) Skip this step will be installed at Alternate steps for X gantry assembly
8. (Step Eight) Skip this step will be covered in Alternate steps for X gantry assembly
9. (Step Nine) Due to the bracket this is sitting on being under bent, these screws need backed off 1 turn from tight. Later they can be replaced with longer screws and nyloc nuts, or double nutted to fix them from loosening more.
10. (Step Ten) Skip this step will be covered in Alternate steps for X gantry assembly
11. (Step Eleven) Assemble now, install on top extrusion after tightening the top extrusion when Alternate steps for x gantry assembly is finished

Step Twelve) These will be performed once all mechanical assembly is done. Note that the wire for the L.E.D. screen goes in socket 3 which when it is in final position will be closest to the center of the printer, or left side as you face the display. The X <<< end stop is hiding inside the box with the QR code on its face. The Bowden tube at the extruder fitting push in, holding in, pull back on the plastic lock collar then pull tube to set. Apply a zip tie to the coupler to prevent it coming unlocked. >>>>>
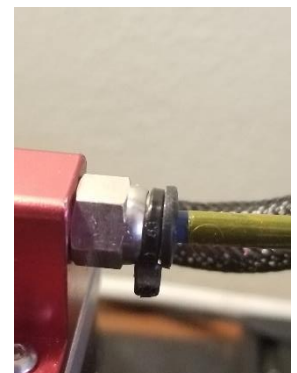
1.2. Alternate steps for x gantry assembly

You will see references to eccentric nuts. This is one with the wheel and bolt thru it removed. They will always be between a wheel and a bracket or frame, not on the end of a bolt, which would be the nut holding the whole assembly together. By rotating the eccentric nut, you are moving the attached wheel either closer or further from the extrusion it rides on. One item to note, if you rotate the nut clockwise as facing the retention nut, it will try to loosen the retention nut. And there is no consistency from the factory on which way they started them. So anti clockwise is better, monitor the retention nut and the assembly tightness as you make these adjustments. The wheels should never be so tight that if a trolley or carriage are held in place, that a wheel could not be spun, with a bit of force with 2 fingers.

1. Take the x gantry from step number 5 and place it on the left side vertical extrusion. See Bed Stabilization Mod for an item most easily addressed before assembly begins.

Continued next page

2. While supporting it from hitting the table adjust the eccentric nut shown in photo. Back the nut off until the crossarm can be moved easily front to back with the slop in the guide wheels. Then slowly tighten it, in small steps while moving fore and aft till the play in the wheels stops. No further, as this will cause problems later. Leave supported above the bed.
3. Put the x trolley on to the horizontal extrusion. Adjust the eccentric wheel until the trolley is loose when moved left to right. Then slowly tighten in small steps, until the play goes away.
4. Take the right-side trolley from step 6 and put it on the right-side vertical extrusion by itself. Loosen eccentric wheel till there is slop in when rotating it side to side. Slowly tighten in small steps until the play just stops. Note: excess tightening will prove to hurt proper function later.

5. Now position the right-side trolley in position like you are going to connect the two halves of the gantry together at the position you left the gantry supported at.
6. Then using the rotation of the vertical extrusions rotate both left and right extrusions until the mating surfaces of the two parts of the gantry assembly are parallel and just lightly touching with no forcing them together. Now mate the two together with the two m4 x16 screws from step 6.

7. We will now temporarily put the top rail in place, with the machined counter sink side on top.
8. Tighten the top rail bolts snug.
9. Put Z stepper from step 4 in position and loosely tighten the two provided screws into the extrusion as shown in diagram of step 4.
10. Prepare for this step by having the Z rod at hand. Bring the x gantry up near the top rail. Insert the Z rod by screwing it through the brass nut until it is in the coupler of the Z stepper. Lightly tighten the top grub/set screw of the aluminum coupler.
11. Now that Z rod is holding the weight, measure from the X gantry extrusion to the top rail on the far left, and again on far right. If there is more than 1 mm of difference in the measurements, adjust to correct. You had left the 2 screws holding the cross-arm extrusion not fully tight, so with a bit of pressure, you should be able to lift up or push down to level arm. ==Remember that you are putting force across the wheels of the z carriage, so do not use too much force.== (Note if it will not stabilize in level position because arm keeps dropping, take top rail off, undo the Z rod and remove. Pull assembly off the uprights, then tightening the two bolts nearest the extruder motor again, so that it still can be manipulated for adjustment. ==Repeat this step==).
12. Once leveled, support the X gantry, loosen the grub screw on Z coupler, remove Z rod and remove the top rail carefully lifting the X gantry off the vertical extrusions.
13. Final tighten the 2 screws nearest the extruder, very firmly now, but take care to not strip the threads or round out the screw heads. (DO NOT use the ball sockets of the Allen key for this tightening).
14. Place the X gantry back onto the vertical extrusions and support it with the work head off the bed surface.
15. We are now going to check the fit of the Z lead screw into the Z stepper coupler. Screwing it down to see if it easily enters coupler or if it will need shim between stepper and the rail to be in a natural alignment. If it freely enters, tighten the 2 screws holding Z stepper to the rail, and then make sure that after the Z rod goes fully in coupler to lift it up one to 2 mm so that the z screw end is not touching the stepper shaft inside the coupler. As a temporary stop gap, you can insert the two screws for stepper mounting one full turn and put folded up paper or other filler between the bracket, to be able to print the fixes available. If it does not fit properly see the shimming and alternate stepper motor bracket in the troubleshooting portion of this .pdf.
16. Install the top rail extrusion and take to firmly tightened.
17. Remove that support used earlier.
18. Tighten all bed screws down till tight moving them in pairs, front 2 then rear 2. Then back off 4 turns, again working in pairs.
19. Now move the nozzle manually to the front left corner of the bed, using the Z screw by hand lower and touch off to a piece of paper.
20. Take the Z end stop switch from step 3 and put the t nuts into slot, sliding it up until you hear the switch click. Tighten the 2 screws. ==Note , you will need to do a 4 point paper leveling once printer is wired and can be homed.==
21. Now run the belt from the x carriage around the x stepper gear, connecting it on the left side as you face the printer.
22. Put the end roller bearing on the end of the x gantry cross extrusion.
23. Run belt around it and attach the belt back to the carriage.
24. Pull the pulley directly away from the extrusion as hard as you can with one hand and tighten the left screw down.
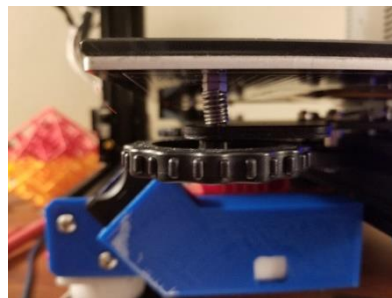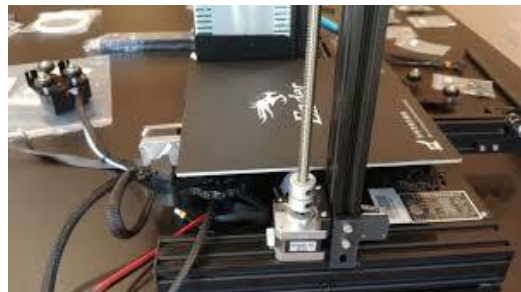
25. Slowly run the carriage left and right to see if the belt is tracking true, or offline hitting the extrusion.
26. If true, tighten the right screw. If not, you will need to find a shim to adjust the attitude of pulley so that the belt runs true. Shim usually would need to go between the extrusion and bracket on the right side of the right screw.
27. This conflicts with or must be done before 18-20, but it is best to adjust the Y trolley eccentric wheels, not covered in the original instructions. In case there was shipping damage, and just to know that it is done properly. Turn machine over for access. In this case loosen the 2 eccentric nuts, till it is loose, slowly tighten the eccentric nuts until the play is out of the carriage. Turn the eccentric nut 1/16 turn past the movement stop, as the leverage seen by this set is higher than all other axis. Note if you check the bed travel the following day, and you feel a bump occasionally, you have slightly over tightened the wheels. It deforms making a temporary flat spot. To fix back off a little bit on eccentric. Once properly adjusted over a few hours it will return back to its original shape.
28.   Return to step 12 in original instructions

1.3. Bed level

How to set bed height and adjustment.

We are going to adjust the bed spring tension. Set the z end stop height, and paper level the bed. Or use a gcode assisted leveling. What we are doing is actually bed tramming, which aligns the x gantry arm and the bed to each other.

1. Loosen and lower or remove the Z end stop. Shown in the photo at bottom of left vertical extrusion.
2. Working the knobs in pairs, front and back, tighten the bed down until the springs are fully compressed.
3. Back of the knobs 3 to 4 turns all 4 corners. Again, working in pairs. As pictured
4. Disable the stepper motors
5. Manually move the hot end up above the bed in front left corner. Using the z lead screw, and manually moving bed and x trolley.
6. Using z lead screw, slowly lower the the x gantry until a piece of paper moving back and forth under nozzle folds as you push the paper in.
7. Put Z end stop on rail,
8. Run it up until you hear the switch "click"
9. Tighten the Z end stop at this position.
10. If the little plastic nub is in the way, remove it using the provided flush cut pliers.
11. Activate the Home all on the machine controller
12. Alternate method Use the thingiverse file https://www.thingiverse.com/thing:2987803 this will take the hot end above bed coming down to zero at each corner lifting up and coming down, waiting until your

ready to push the control button to advance. This is done nozzle and bed heated. And once you go around bed twice, it will print a single layer .2mm thick test pattern of discs at all four corners and the center. Along with a skirt that can be measured. You can adjust each corner based on measured disc thickness from target size. Each 1/16 turn of the bed knobs is .04mm, this can fine tune the height.

13. Disable the steppers
14. Heat nozzle to 200` and bed to 60`.
15. Using the paper, move the hot end to each corner to set the bed to the paper move till it folds method. Note it may be higher at next corner you are headed to. Keep paper under nozzle, if you feel it getting tight as you move, lower the bed as needed to be able to move the nozzle to the corner. Do this to all four corners
16. Now do one more round of fine tuning, using the paper touch method as the other corners were affected by the adjustments made after you moved on from them.
17. Turn off hot end and bed by selecting cooldown from the menu.
18. You can slice a five point test to try, or a live level gcode file to give you a measurable first layer to final adjust the bed height. The bed knobs move the bed .04mm per 1/16 turn of leveling knobs.

Thingiverse pattern/gcode links Ender-3/ CR-20

https://www.thingiverse.com/thing:3118088

https://www.thingiverse.com/thing:3069292

https://www.thingiverse.com/thing:2948908

https://www.thingiverse.com/thing:3177424

Thingiverse pattern/gcode CR-10

https://www.thingiverse.com/thing:2898163

Continued next page

Thingiverse pattern/gcode CR-10-continued

https://www.thingiverse.com/thing:2748074

https://www.thingiverse.com/thing:2188146

https://www.thingiverse.com/thing:2187071

https://www.thingiverse.com/thing:2549082

1.4. PTFE Bowden fix

 This step is to try and prevent the Bowden tubing from getting pushed away from the nozzle inside the hot end. A common trouble with stock fittings.

1. Preparation; the hot end must have a clear path for the tubing to insert.

2. New printer with no evidence of test print continue to step 6.

3. If there has been any filament in the hot end, you need to remove nozzle with a heated hot end.

4. Remove the Bowden fitting, while hot use the ptfe to pass down completely thru the hot end clearing any plastic residue.

5. Re install nozzle, heat to 20` over your material temperature. Support the heat block insert and tighten the nozzle.

6. The fix is to back the fitting off by 1 turn push down on tubing, then holding, while pulling up on the Bowden lock collar. Reference video https://www.youtube.com/watch?v=mAU7cIZ0Hns&t=185s

7. Apply a zip tie to the fitting.

8. Tighten the Bowden coupler firmly seating the ptfe against nozzle.

9. Now mark the ptfe with permanent marker or tape at fitting to be a witness of any ptfe movement from the nozzle.

10. Select cooldown in the control panel.

Advanced technique print and install this: https://www.thingiverse.com/thing:3203831

1.5. Filament loading

3. Filament Loading

1. First let's prepare the filament to be loaded.
2. Remove the filament from the air tight packing.
3. Be careful that once you free the end from the tape or hole it has been secured with. That you do not let go, until it is in the extruder, or re-secured to roll. If you accidentally introduce an over wrap or knot. It will plague your filament being dispensed till the knot is removed.
4. It is general practice to use the flush cut pliers to cut a steep angle on the filament end before insertion.
5. Use one hand to release the extruder tension arm, using the other to feed the filament past the drive gear and guide roller. Sometimes it is helpful to not release too far, this lets the guide roller assist in lining up filament with extruder passage hole.
6. Keep feeding in the filament till you feel it hit the resistance of the hot end.
7. If it was already hot, push until you see filament being extruded.
8. If cold bring up to temperature and then push till it extrudes.
9. If changing color of filament, use the Extruder manual control in the control panel. It may take 45 to 100 mm to clear a previous color
10. Note if changing filament type, go to the temperature of the highest of the two being swapped. Extrude till you're sure the previous material has been cleared.
11. You are now loaded with filament.
12. Use control to select cooldown. Or start a print in a few minutes. We don't want to cook the filament for extended periods of time if we can help it.

Mods that help this.

A printed knob for the extruder to use with disabled stepper, so you can use knob to draw in the filament rather than the release. I still use release arm to then continue to push the filament to the hot end. https://www.thingiverse.com/thing:3005278

1.6. Finding .stl models

What is an .stl file? This is the file designation for a method of taking a model, and using a program to break it down into triangles that the Slicing software can use to make the parts we want. The hot shows me preparing an part for export and slicing. I chose low refinement of the triangle count to allow you to see the triangles involved. The finer detail you want in a finished part, the more triangles you will want at creation.
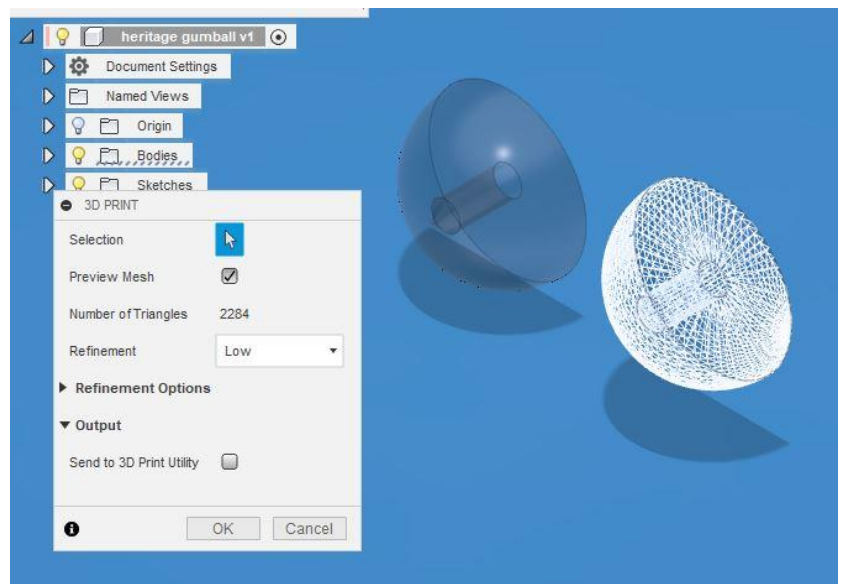
So you are not a 3d modeler, this is ok. We have hundereds of repositories of .stl based models that other people have created. Many free, some will ask for money for detailed, or copyrighted models.

Google isn't .st friendly, so where are these repositories? https://www.aniwaa.com/best-sites-download-free-stl-files-3d-models-and-3d-printable-files-3d-printing/

That site has a list of the best options available. The author is engaged at www.thingiverse.com

Here is my Ender-3 collection, you can find my other models and information from there.

https://www.thingiverse.com/OneBadMarine/collections/ender-3

Okay I have found my .stl I want to print. What do I do now?

We need to use a slicer to modify the .stl into gcode for the printer to be able to make it.

Ok, another strange named file. What is it? Gcode is a series of instruction that instructs the printer what to do. There are M codes, or modal commands, and g code or linear travel instructions. But thankfully for the most part the slicing software takes care of that for us.

Slicer, what is that? It gets its nickname from slicing the part into layers, so that the printer knows what to do in each layer to build your new model you want.

See **Slicing software** to learn what slicers are available and basics on how to use them.

1.7. Slicing software

5. Slicing software to learn what slicers are available and basics on how to use them.

What is Slicing software? It is a tool to translate .stl files into Gcode files that we can print with. Using a set of directions or rules that we give it in our profiles. A profile can be a static set of instructions given the slicer, or a basic set of instructions that the user augments with additional instructions based on the part shape or special requirements to print.

So what slicers are out there. We have **Simplify3d,** a paid product that is often preferred by advanced users. **Cura**, a product of Ultimaker brand printers. **Slic3r** an open source based project. **Repertier**, a slicer that can be used with Cura in certain packages. And many more.

So for the how to set up and how to add others profiles, I will focus on Cura as it is what I use.

To start, skip the shipped version of the software sent with the printer, it is likely several versions or updates out of date. So head to https://ultimaker.com/en/products/ultimaker-cura-software

, or the Slicer of your choice's home page to find the last full release that is not a Beta testing version.

My images will be from Cura 3.5.1

Setting up the slicer

The first you must do is set up a machine profile in the slicer to define your machine to the software.
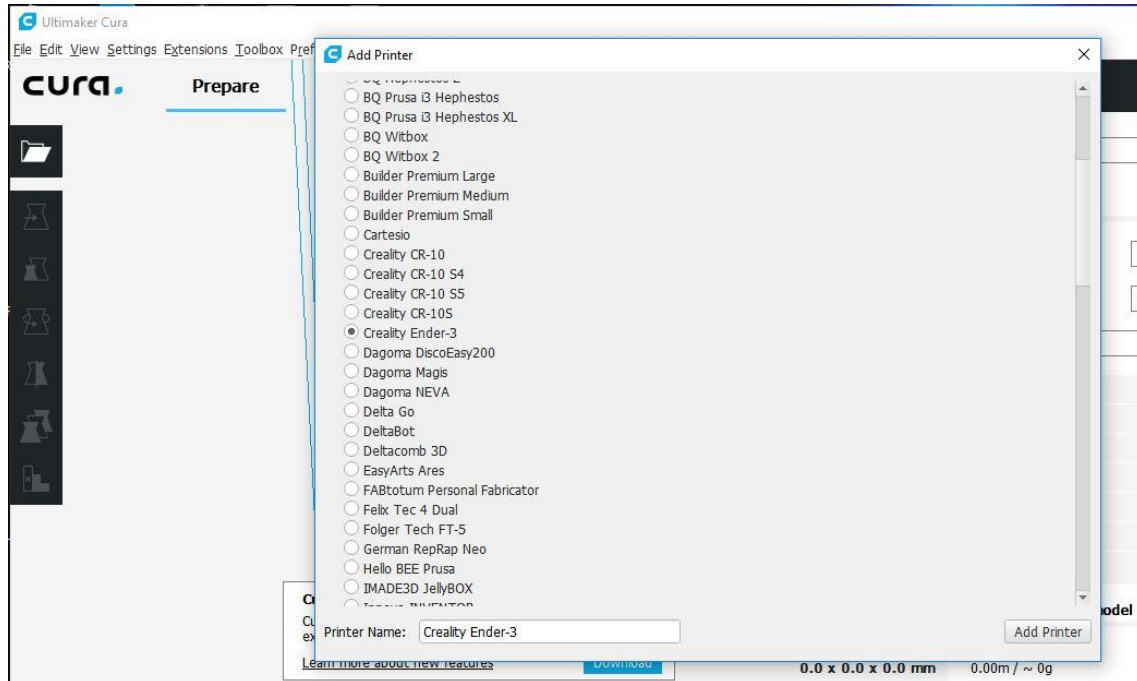
Most mainstream printers will have a selectable pre-set profile in the software. If not you will have to give it the relevant information to define the printer.
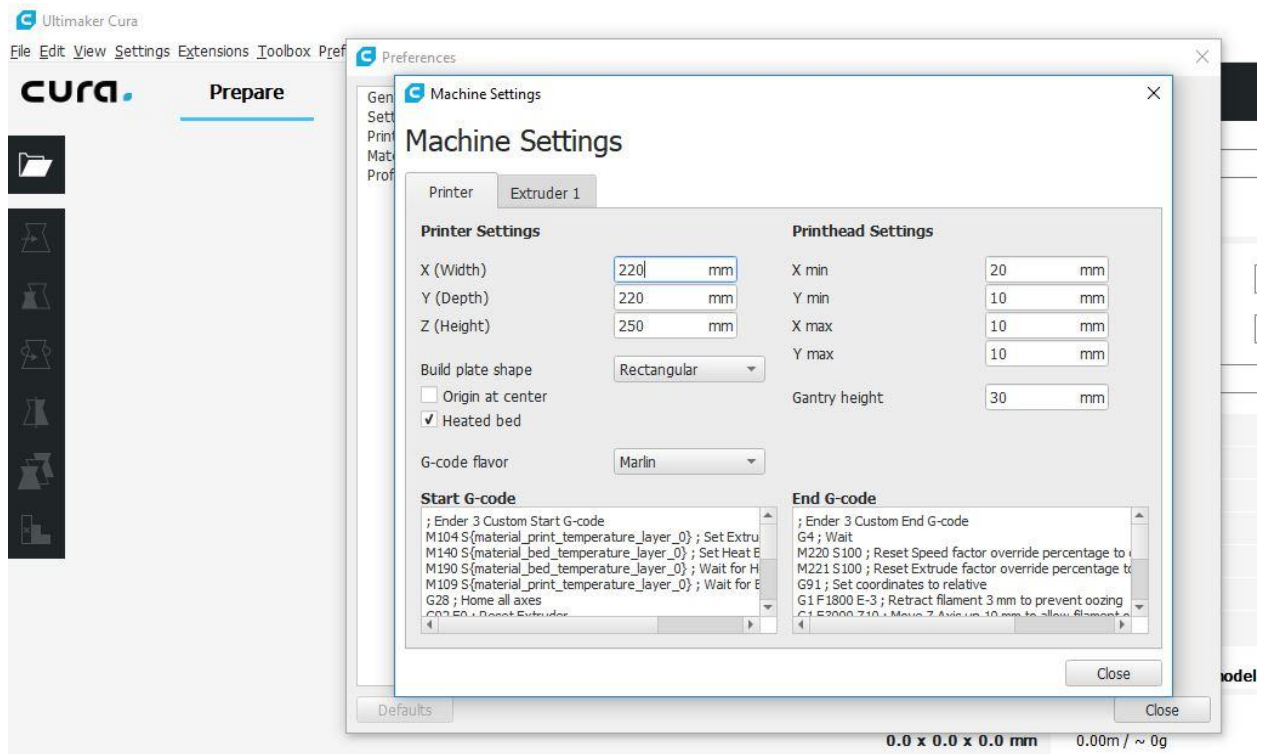
That would be build volume, what firmware used, and the location of the origin in relation to the bed surface. For Ender3 as an example to use full build volume (Requiring a bootloader

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and changing bed safety parameters) X 235mm Y 235mm Z 250mm with extruder offset of X0 Y2.5.

We have now established the printer. There are stock profiles based on an material brand and type within most of the slicers. So for example you could choose Hatchbox PLA and it will give you a base profile with the settings that were suggested by the mfg to print their product. Or you can forgo that and set the temperatures and other settings using the custom option and select what you determine would be the best for the print you are slicing.

You can also borrow from others experience by finding other users profiles in groups or places where other users gather and share information. For example if you were to go to any of the Creality user groups I participate in. In Facebook groups there is a section called Files. You can see the profile name, slicer type by the file extension, and who up loaded it. You can then download the file, unzip the profile into a new folder, and set up to use it in your slicer. You will go to the profile editing section of the slicer and they will have some sort of import or add profile option to load the profile for your use.

Slicing terms and functions the basics

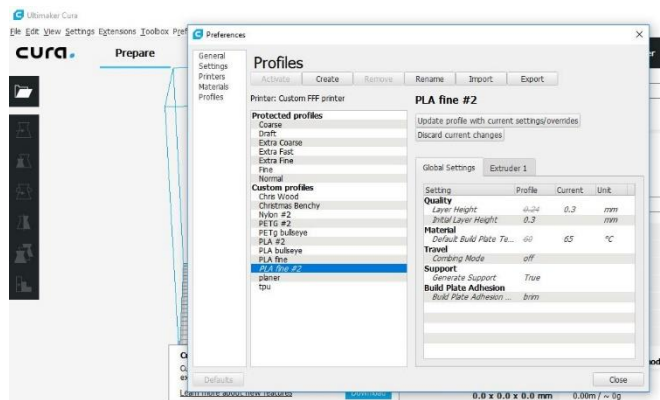Here are some of the basic terms for what you may need to select or provide values for to slice a part. I will list the sections as Cura defines them and what values to input.

Quality; you will need to set the layer height. This is the amount the printer will lay down in a given layer of the print. This will be from .04 to .3mm with an stock .4mm nozzle. Also the first layer height, this may differ from the layer height as you do not want to get too close to bed and cause a nozzle jam or potentially hit the bed with nozzle if bed is not perfectly flat. Most users will run first layer at .2 or .3mm height. Note for other size nozzles you should not exceed 75% of the nozzle diameter as the maximum layer height.

Shell; This pertains to the thickness of the outer layer of the part. It may be defined by setting a numeric value based on nozzle size, or as layers also referencing nozzle width as a count of how many layers wide you want the walls. Example 1 layer or .4mm based on a .4 nozzle width, or 1.2mm and 3 shell or walls for a part that needs more surface strength.

Infill; this is the way you can support the inside of part without making it a solid piece of plastic. Infill can be from 1% to 100%. 20 to 40% is common range of infill for nonstructural parts. Note that later in the part this controls how much support will be given to the top layers of the part. If its too sparse the infill pattern may show in the part finish

Material; This section has four very important features defined. The nozzle temperature you will be printing at, with sub options for first layer and top layer. Build plate or bed temperature for part adhesion or to prevent warping. Flow which is a way you can change the extruded amount if a filament is over or under extruding. And first layer flow which can be used in conjunction with layer height to facilitate bed adhesion of first layer. And finally retraction. Retraction is a mode that when the nozzle is moving but not wanting to extrude, it pulls the filament back against the molten zone, trying to keep it from leaking while moving.

Speed; This controls printing speeds for different areas of the print. With sub options for first layer, outer wall inner wall and infill print speeds.

Travel; has a few options to avoid crossing certain areas while re positioning the nozzle during printing.

Cooling; setting when or if you want the part cooling fan to run, and what percentage of its capacity to run at if selected.

Support; This prints waste material that will not bond to the primary model, when there are areas that start printing above the initial be height and need support till that section bonds with the kept part. It has multiple choices as to where support will be added. 15% is a good starting point for support.

Build plate adhesion; There are a few choices in this category. Skirt, is a priming function, so that if model needs no extra adhesion, the nozzle is still primed when printing commences on the part. Second is Brim, this adds multiple passed adjacent to and connecting to the part, to add stability, or help edge to not lift up from the bed. And Rafts, this uses significantly more filament, but can manufacture a flatter surface on which the part is built, as it evens out bed irregularities before printing the part using the raft as its build platform.

Options for transferring gcode from computer to printer

1. Save it directly to the SD card.
2. Connect via the usb port directly to printer using software
3. Via an raspberryPi

1.8. E steps and flow rate tuning

E step calculation

What is an E step? This is the description of how many times the stepper motor on the extruder must advance for 100mm of filament to be advanced. There is two methods that can be used. First method is to remove the Bowden tube from the extruder. We will call this the free air method. The second would be to do the test thru the heated extruder. The through the extruder is done by marking the filament at 100 and 120 mm from the inlet to the extruder. Then use the controller or gcode to advance 100mm of filament. Once done, you measure the distance from the extruder to the 20mm mark to determine actual length advanced. You then use the actual filament extruded in a formula, along with the current e step to calculate your new E step value. Example using 87 mm advanced (100 commanded measured 33mm from the 120mm mark, giving 87 actual distance traveled) and 98 for current e step; Formula $100/87 = 1.1494 \times 98 = 112.64$ so rounded off that's a new e step of 113 steps.

Using the free air method, we will remove the Bowden tube and coupler from the extruder. Run the filament just out of the extruder by hand and use flush cuts to cut it at face of extruder. Now use the control panel to advance 100mm with hot end at temperature, as extruder will not function when nozzle off. Or use this gcode put into a text editor and saved as a gcode file extension for use in the printer. <mark>Note if you use abl use your start g28/g29 in place of whats provided here.</mark>

; 100mm gcode advancement program

==G28 X0 Y0 Z0 ; HOME ALL AXIS==

G90 ; ABSOLUTE POSITIONING

G92 E0 ; SET EXTRUDER TO ZERO VALUE

M92 E93 ; ***SET NEW E STEP *** (93 is factory value) (set new target value here once you ;have calculated your new estep, to run a test of the new value)

M190 S60 ;

M104 S215 ;

M109 ;

M82 ;

GO1 E100 F200; ADVANCE 100MM OF FILAMENT (***set to F50 if using the thru the hot end method****)

M140 S0 ;

M104 S0 ;

G90 E0; Return to absolute positioning

Continued next page

 After extrusion stops, cut the filament in same location. Take the cut piece and measure its length. Use 100/measured length x the current e step to calculate your new e step. Example; we sent 100mm with an e step of 93mm the stock ender 3 value. Our cut length of material was 86mm. So 100 / 86 is 1.1628 x93 equals a new e step of 108.13 or 108.

Ideology of each method. Free air is giving a direct linear advance without the restriction of the hot end flow path. The slicer is designed to use linear value along with measured diameter to calculate extruded volume in a part tool path. This method does not require you to calculate e steps again if changing filament type. It is one and done, only to be re visited if changing extruder or extruder drive gear. With this method any filament used will then be tuned with the flow rate to optimal extrusion using a single wall test cube. Print the cube at .40 single wall, then measure and record 2 values from all 4 sides. Add them together and divide by eight. Divide .40 by the resultant, and multipy that by 100 to give your new flow rate or extrusion multiplier. Example test cube measurements avg to be .428 so we take .4/.428 which equals .934579 x 100 = 93.458 or 93% flow rate as your new value. Note: if you had already been using a flow rate modifier, you would be at that % of the rate you were using. Example was at 97% and the calculation comes to 92%. That's 92% of 97% or 89% 97 x.92 is 89

In summary, the author prefers this method, as I never have to chase my e step, I can mark a filament of any type with its flow % on the spools label, and just change it in slicer. Being able to move through many materials at will.

Ideology of threw the nozzle method. When done with a given filament, the flow rate may be left at 100% as you have tuned the e step to the current condition of the hot end and the specific filament that you are running. There is no need for a flow test to be done once the e step is set, unless conditions change.

1.9. Bed center establish

8. How do I get my nozzle centered on the bed

First open up the machine settings for the slicer. You want X 235 Y 235 Z 250.

Then you need to also tell slicer how far from the bed corner the mechanical home is.

For a standard Ender-3 this is X 0 Y 2.5, to be entered as extruder offset.

To realize the back extra 15mm and the right 15mm that are past the machine default of X 220 Y 220 you must install a bootloader and change the machine hard travel limits to match the 235 235 over all capacity

1.10. List of mods that are in other parts of document that are able to be performed at assembly

1. Bed stabilization mod. This requires four 4 mm x .7mm pitch nuts
2. Stepper dampeners

<mark>Suggested Mods that can be done at any point.</mark>
1. Bed screw stabilization in the modification section, you will need four 4mm nuts to execute
2. Change out springs for the CR 10 springs https://www.amazon.com/uxcell-Light-Compression-Spring-Yellow/dp/B013G5I4US/ref=pd_sbs_328_2?_encoding=UTF8&pd_rd_i=B013G5I4US&pd_rd_r=77568fe0-e95a-11e8-8731-197ef284cbe4&pd_rd_w=ZTXIH&pd_rd_wg=60mG3&pf_rd_i=desktop-dp-sims&pf_rd_m=ATVPDKIKX0DER&pf_rd_p=7d5d9c3c-5e01-44ac-97fd-261afd40b865&pf_rd_r=20HBVE4F71MJGWQZZ6P6&pf_rd_s=desktop-dp-sims&pf_rd_t=40701&psc=1&refRID=20HBVE4F71MJGWQZZ6P6
3. Extruder replacement https://www.amazon.com/Official-Creality-3D-Extruder-Aluminum/dp/B07J44QW8B/ref=sr_1_1?s=industrial&ie=UTF8&qid=1542343711&sr=1-1&keywords=creality+3d+extruder&dpID=41Kz8GVrSHL&preST=_SX342_QL70_&dpSrc=srch
4. Stepper dampeners ; search amazon there are 2 needed to quiet the primary drive steppers

1.11. Rocking base fix

How to get your printer to not rock on two corners if frame was twisted.

Loosen the four bolts two on each side on the lower base extrusions. Grab the top rail and move it fore and aft. The feet should be sitting flat on the table now. Slide each side just off the table and re tighten the bolts.

1.12. Extruder trouble shooting

Items that may cause intermittent extrusion fluctuations

1. Crack in the release lever, sometimes cannot be seen from the top side.

Eccentric hole in drive gear. Causes patterns to show in the first layer or top layer of parts.

2. The drive gear slipping on the drive shaft. ==Fix== ; make sure one of the two grub screws is on the drive flat. A little blue Loctite can keep them from vibrating loose.
3. The pivot screw for the release arm being over tightened, causing the spring tension not to transfer to the idler bearing
4. Spring pressure is too weak
5. Filament has worn the release arm causing friction and drag on the filament

6. The drive gear has excessive wear on the teeth. Move gear to a different height or replace.
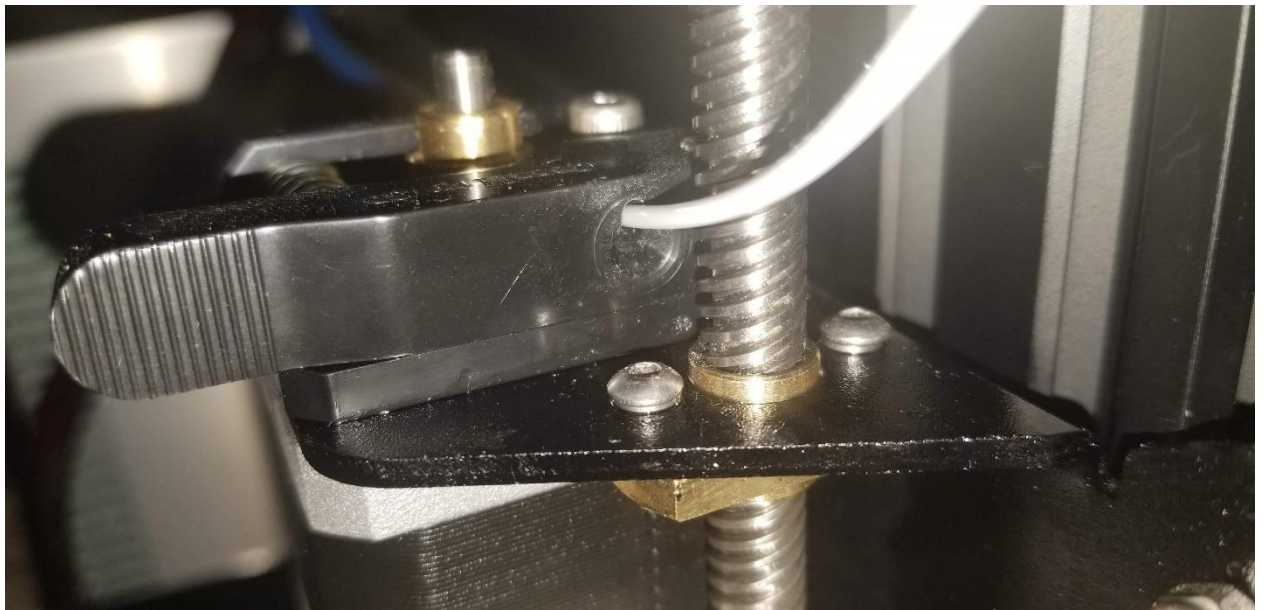
2.　　Luke's check list to a stable/fine-tuned machine

2.1.1.　Z binding shim

Shaft Alignment/Binding correction

Symptoms; Prints are too short/compressed in height, varying thickness of layers throughout the part, occasionally Z axis motor clicking/skipping.
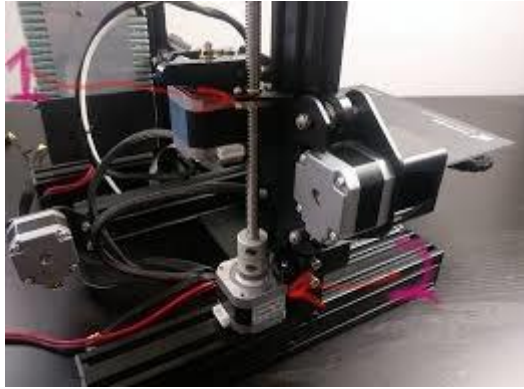
Procedure. You are now going to align the Z stepper motor to the Z drive screw. Support X axis just off bed with 50mm support. Remove the Z rod from the coupler, using the top two grub screws. Remove the 2 bolts holding the stepper motor to the frame. Now insert the shaft into the stepper and measure the gap from bracket to the extrusion. A shim of that thickness between stepper motor and frame is needed. List of shims and printable stepper holders below.

If you currently are not able to print a solution, a nut put on both bolts in between the stepper and the extrusion can temporarily reduce binding. Then you can print a shim to fix properly.

Find the right shim thickness you need on www.thingiverse.com or here's a couple I have found.

www.thingiverse.com/thing:2959991
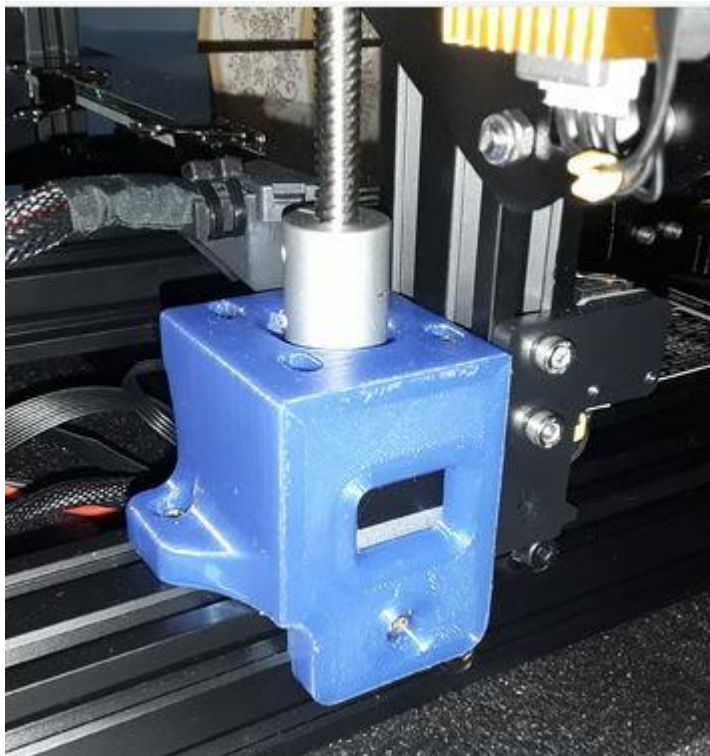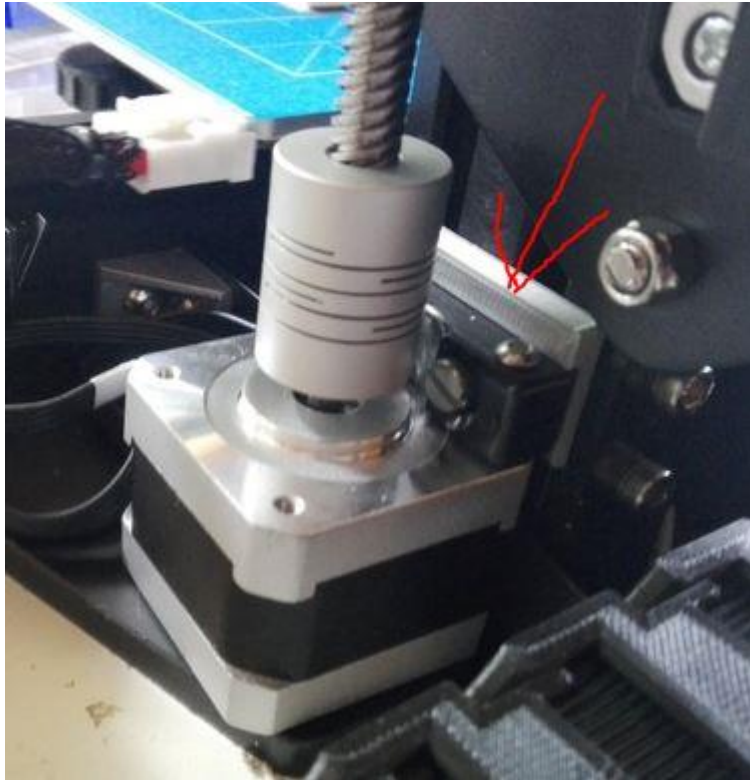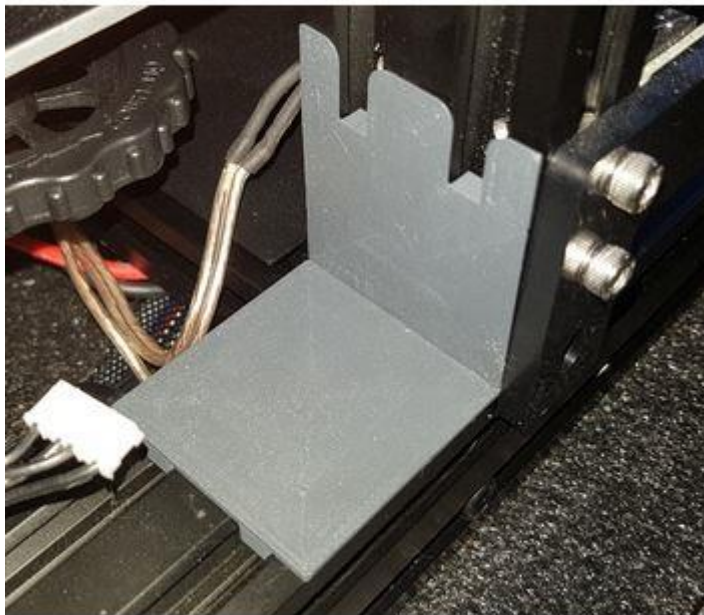
https://www.thingiverse.com/thing:2526607

https://www.thingiverse.com/thing:2925230

https://www.thingiverse.com/thing:3115362

Alternate methods

Option 1

<mark>If your bracket is bent so much that the shim does not fully correct this issue</mark>. You can thru drill the bushing and bracket with an 3mm or 1/8"drill bit. Replace original screws with 3mm x15 screws and nyloc nuts, or doubled nuts jammed together. Take till tight, then back off 1 turn. The 2 nut jam will be hard to accomplish, but not all have access to nyloc 3mm nuts at home depot, so this option is included.

Option two;

Remove the x gantry , strip all parts from bracket holding the z nut. Put bracket in vice bending to 90` using a crescent wrench.

2.1.2. X gantry rework

Re-alignment of the X gantry assembly of single stepper drive Ender-3 and CR-10 models (other MFG. using same system) with an following 3 wheel trolley. Creating stable Z repeatability and fixing x lagging or hanging up

So an explanation of the methodology of the adjustment you are about to perform. Many teaching guides have you use the cross extrusion to align the faces of the vertical extrusions. This would be an excellent practice, if, the wheel trolleys were then sitting perfectly square to the vertical extrusions. But we are in an imperfect world. We want the two rolling trolleys to travel together with no lag of the right side and assist in always returning to a consistent position for the tramming of the bed or leveling. My observation is that using the previously mentioned method may be having the wheels try to run out of the v groove because the trolleys are twisted and may exaggerate any inconsistency in "V" groove geometry. Either way, this new method offered has proven reliable for the author and many people who struggled with bed level inconsistency.

You will see references to eccentric nuts. This is one with the wheel and bolt thru it removed in the accompanying photo. They will always be between a wheel and a bracket/frame, not on the end of a bolt. Those nuts would be the nut holding the whole assembly together. By rotating the eccentric nut, you are moving the attached wheel either closer or further from the extrusion it rides on. One item to note, if you rotate the nut clockwise as facing the retention nut, it will try to loosen the retention nut. And there is no consistency from the factory on which way they started them. So anti clockwise is better, monitor the retention nut and the assembly tightness as you make these adjustments. The wheels should never be so tight that if a trolley of carriage is held in place, that a wheel could not be spun with a bit of force with 2 fingers

Continued next page

Directions

Remove any filament from the printer, and then remove mains power and un plug the extruder, X stepper motor, and x end stop connections from the X gantry.

29. Lower or remove z end stop.
30. Remove the top rail extrusion.
31. Support the x gantry and remove the z lead screw.
32. Take X gantry and set on the table.
33. Loosen the 4 screws that attach to the bottom of the two vertical extrusions. They should be able to be rotated with medium force within the range the slop in the screws allow.
34. Remove the 2 screws holding on the three-wheel trolley.
35. Place trolley on the right-hand extrusion.
36. The two screws securing the horizontal extrusion to the z drive bracket. Loosen them, then re-tighten to just past snug.

37. Put the drive side of the gantry on to the vertical extrusion.
38. While supporting it from hitting the table (Find a household object that is more than 40 mm tall to go between extrusion and the bed.), adjust the eccentric nut shown in photo. Back the nut off until the crossarm can be moved easily front to back with the slop in the guide wheels. Then slowly tighten it, in small steps while moving fore and aft till the play in the wheels stops. No further, as this will cause problems later. Leave supported above the bed.

39.   Put the right-side trolley on to the horizontal extrusion. Adjust the eccentric wheel until the trolley is loose when rotated side to side. Then slowly tighten in small steps, until the play goes away.

40.   Now position the right-side trolley in position like you are going to connect the two halves of the gantry together at the position you left the gantry supported at.

41. Then using the rotation of the vertical extrusions rotate both left and right extrusions until the mating surfaces of the two parts are parallel and just lightly touching.
42. Mate the two together with the two m4 x16 screws.
43. We will now temporarily put the top rail in place, with the machined counter sink side on top.
44. Tighten the bolts on top rail extrusion up snug.

45. Prepare for this step by having the z rod at hand. Bring the x gantry up near the top rail. Insert the z rod by screwing it through the nut until it is in the coupler of z stepper. Lightly tighten the top grub/set screw of the aluminum coupler.

46. Now that Z rod is holding the weight, measure from the X gantry extrusion to the top rail on the far left, and again on far right. If there is more than 1 mm of difference in

the measurements,   adjust to correct.

47. You had left the 2 screws holding the cross arm extrusion not fully tight, so with a bit of pressure, you should be able to lift up or push down to level arm. (Note if it will not stabilize in level position because arm keeps dropping, take top rail off, undo the Z rod and remove, then pull assembly tightening the two bolts nearest the extruder motor again, so that it still can be manipulated for adjustment. Then repeat this step)
48. Once leveled, remove the top rail extrusion.
49. Now while supporting the x gantry, loosened grub screw on z coupler, remove Z rod and carefully lift the X gantry off the vertical extrusions.
50. Final tighten the 2 screws nearest the extruder, very firmly now, but take care to not strip the threads or round out the screw heads. (DO NOT use the ball sockets of the Allen key for this tightening).
51. Place the X gantry back onto the vertical extrusions and support it with work head off the bed surface.
52. Install the top rail extrusion and take to firmly tightened.
53. Tighten thee 4 screws under the vertical extrusions.
54. Install Z lead screw.
55. Re connect all wiring
56. Remove that support used earlier.

57. Tighten all bed screws down till tight moving them in pairs, front 2 then rear 2. Then back off 4 turns, again working in pairs.
58. Now move the nozzle manually to the front left corner of the bed, using the Z screw by hand lower and touch off to a piece of paper.
59. Take the Z end stop switch and slide it up until you hear the switch click. Tighten the 2 screws.
60. Auto home all axis and re tram the the bed.

<mark>Congratulations your x gantry is now optimally aligned</mark>

2.1.3.   Bed stabilization mod

Bed modification to stabilize adjustment screws

The goal

Stabilizing the screws that cause bed level to shift often, also to secure the screw's, so they do not spin when attempting to tighten adjustment knobs. Also stopping them from being able to lean or tip from being perpendicular to the bed plane.

Process: Take the knobs off, lift bed up and remove the springs. Take care to not stress the heater wires as you flip over the bed to work on it.

 Add four 4mm jam nuts to lock the screws to the bedsurface.

You will need to stop screw from rotating with a pliers as you tighten nut against back of bed surface.

Holding bed level test fit the bed into the Y mounting plate making sure screws freely move through that plate. If not, slightly enlarge holes, or loosen and shift screws so they do not hang up when moving up and down.
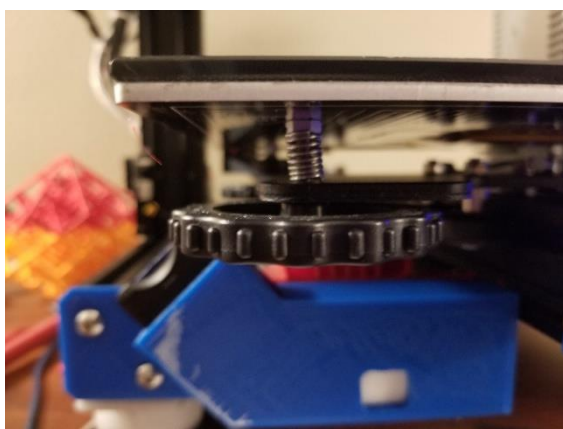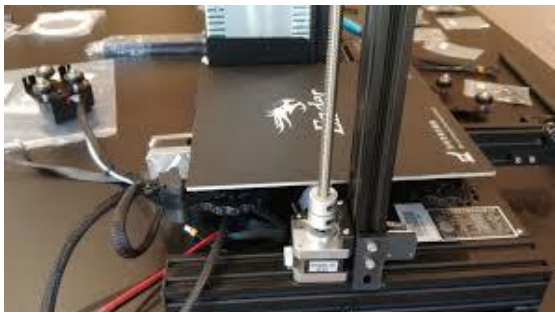
Re assemble bed.

2.1.4. Set bed height and adjustment.

We are going to adjust the bed spring tension. Set the z end stop height, and paper level the bed. Or use a gcode assisted leveling. What we are doing is actually bed tramming, which aligns the x gantry arm and the bed to each other.

1. Loosen and lower or remove the Z end stop. Shown in the photo at bottom of left vertical extrusion.
2. Working the knobs in pairs, front and back, tighten the bed down until the springs are fully compressed.
3. Back of the knobs 3 to 4 turns all 4 corners. Again, working in pairs. As pictured
4. Disable the stepper motors
5. Manually move the hot end up above the bed in front left corner. Using the z lead screw, and manually moving bed and x trolley.
6. Using z lead screw, slowly lower the the x gantry until a piece of paper moving back and forth under nozzle folds as you push the paper in.
7. Put Z end stop on rail,
8. Run it up until you hear the switch "click"
9. Tighten the Z end stop at this position.
10. If the little plastic nub is in the way, remove it using the provided flush cut pliers.
11. Activate the Home all on the machine controller
12. Alternate method Use the thingiverse file https://www.thingiverse.com/thing:2987803 this will take the hot end above bed coming down to zero at each corner lifting up and coming down, waiting until your ready to push the control button to advance. This is done nozzle and bed heated. And once you go around bed twice, it will print a single layer .2mm thick test pattern of discs at all four corners and the center. Along with a skirt that can be measured. You can adjust each corner based on measured disc thickness from target size. Each 1/16 turn of the bed knobs is .04mm , this can fine tune the height.
13. Disable the steppers
14. Heat nozzle to 200` and bed to 60`.
15. Using the paper, move the hot end to each corner to set the bed to the paper move till it folds method. Note it may be higher at next corner you are headed to. Keep paper under nozzle, if you feel it getting tight as you move, lower the bed as needed to be able to move the nozzle to the corner. Do this to all four corners
16. Now do one more round of fine tuning, using the paper touch method as the other corners were affected by the adjustments made after you moved on from them.
17. Turn off hot end and bed by selecting cooldown from the menu.
18. You can slice a 5 point test to try, or a live level gcode file to give you a measurable first layer to final adjust the bed height. The bed knobs move the bed .04mm per 1/16 turn of leveling knobs.

19. Thingiverse pattern/gcode links Ender-3/ CR-20

https://www.thingiverse.com/thing:3118088

https://www.thingiverse.com/thing:3069292

https://www.thingiverse.com/thing:2948908

https://www.thingiverse.com/thing:3177424

19. Thingiverse pattern/gcode CR-10

https://www.thingiverse.com/thing:2898163

https://www.thingiverse.com/thing:2748074

https://www.thingiverse.com/thing:2188146

https://www.thingiverse.com/thing:2187071

https://www.thingiverse.com/thing:2549082

2.1.5.   Hot end fix

13**. Original Creality hot end ptfe fix**

www.thingiverse.com/thing:3203831

Why do I want to do this fix to my hot end?

Answer; it takes the bownden fitting duties for holding the ptfe to the back of nozzle away from the grabber teeth, and uses the fitting body to trap a spacer creating a consistent capture of the cut length of tubing to the nozzle and no void that often happens with factory arrangement can occur.

This fix adds a spacer inside the top of hot end that allows a cut length of tubing to be lightly compressed against the nozzle. also taking the extra work of maintaining that seal away from the teeth in the bowden coupler.

There are verions currently for the following model hot ends, Ender-3, CR10, CR10S Pro

(Pro----note that i am preparing an addendem as with the screw in throat you will need to adjust to pre determined measurements for tube to work).

If your model hot end is not listed contact me to see if we can fit it up as well.

!!!! If for some reason the parts do not work. Contact me so we can determine if you have out of specification parts. !!!!
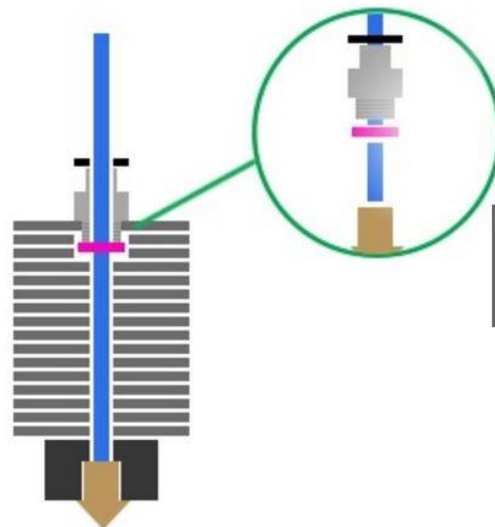
Notes:

Files set to print at 60mm/s, 100% infill no supports. .12mm layer height.

How to correct the spacer if the hole is printing too small for filament to pass thru.

Easiest way is to reduce your flow rate, either in the slicer, or you may over ride flow during the print. I would suggest a 5% decrease in flow, each attempt till you get desired result. The spacer is a 4 minute print solo. So don't be afraid to print it a time or two so you have a well fitting part.

Video on why and installation

https://youtu.be/ANUhIF1YrRU

Post-Printing

Step 1 Detail parts

1. Make sure that the insert washer is able to pass a piece of filament loosely thru the center hole.

2. Ensure it easily fits inside the cooling block threaded countersink, so it is not stuck later during maintenance activities.

3. Check that the ptfe fits thru the cutting guide/guage.

4. Clear hot end and reset nozzle

5. Prepare the hot end
6. Heat up the hot end
7. Remove filament
8. Remove the bowden tube and its fitting
9. Remove the nozzle
10. Use ptfe to clear any plastic in throat by passing the ptfe top down thru the heat block several times
11. Make sure no plastic on mating surface/back of the nozzle and re install
12. Take temperature to 20` over operating temp and final tighten nozzle supporting heat block while tightening
13. Cut ptfe and install all parts
14. Use the cut guide/gauge to cut your ptfe piece for inside the hot end.
15. Tubing can come from the original tube, or upgrade by using capricorn xs for this hot zone piece

16. Have a piece of filament cut to about 100mm for testing fitment and a guiding assembly
17. Put the cut piece of tubing into the heated hot end
18. Put the spacer washer into the top of the cooling block
19. Hand screw the bowden fitting in until it just touches spacer washer
20. Put filament thru washer and slowly move it up and down while tightening the bowden coupler down on the spacer till its tight enough it wont easily back off in use.
21. There will be a small space between the shoulder of the fitting and cooling block. This is normal, and ensures the spacer is being compressed and compressing ptfe lightly into nozzle inside the hot end.
22. Push your supply ptfe into the fitting till it stops, pull up on lock collar and zip tie or put clip on.
23. Load filament

Congratulations you are now done.

Enjoy your new less back pressure flow, as the small void left by the push pull nature of the design of the original flow path have been eliminated. and your bowden fitting will see less forces trying to push the tube back.

How I Designed This

Fusion 360

Modeled using parametric techniques

Maintenance and FAQ.

Does this effect routine maintenance of nozzle.

No, as the tube should remain in place when removing and replacing a nozzle.

How do I get the cut ptfe out for changing it.

Remove Bowden coupler, use a small Allen key to fish out the spacer, remove nozzle and push through while hot end heated with an 3mm Allen key wrench.

My spacer was a bit big and its stuck, not able to remove from top end.

Heat up the hot end, remove the nozzle, use 3mm Allen key to push ptfe and washer from the bottom end, out the top.

How much skill does it take to do this mod?

If you can handle removing a nozzle and Bowden fitting, routine maintenance, you should be ok to use this mod.

Does this alter my printer permanently? No, with the understanding that if you cut the primary bowden tube, it could be short on travel if you stop using mod and were to try and use tubing you cut.

2.1.6.   E step calculation

What is an E step? This is the description of how many times the stepper motor on the extruder must advance for 100mm of filament to be advanced. There is two methods that can be used. First method is to remove the Bowden tube from the extruder. We will call this the free air method. The second would be to do the test thru the heated extruder. The through the extruder is done by marking the filament at 100 and 120 mm from the inlet to the extruder. Then use the controller or gcode to advance 100mm of filament. Once done, you measure the distance from the extruder to the 20mm mark to determine actual length advanced. You then use the actual filament extruded in a formula, along with the current e step to calculate your new E step value. Example using 87 mm advanced (100 commanded measured 33mm from the 120mm mark, giving 87 actual distance traveled) and 98 for current e step; Formula 100/87 = 1.1494 x 98 = 112.64   so rounded off that's a new e step of 113 steps.

Using the free air method, we will remove the Bowden tube and coupler from the extruder. Run the filament just out of the extruder by hand and use flush cuts to cut it at face of extruder. Now use the control panel to advance 100mm with hot end at temperature, as extruder will not function when nozzle off. Or use this gcode put into a text editor and saved as a .gcode file extension for use in the printer. Note if you use abl use your start g28/g29 in place of whats provided here.

> ; 100mm gcode advancement program

G28 X0 Y0 Z0 ; HOME ALL AXIS

G90 ; ABSOLUTE POSITIONING

G92 E0 ; SET EXTRUDER TO ZERO VALUE

M92 E93 ; ***SET NEW E STEP *** (93 is factory value) (set new target value here once you ;have calculated your new estep, to run a test of the new value)

M190 S60 ;

M104 S215 ;

M109 ;

M82 ;

GO1 E100 F200; ADVANCE 100MM OF FILAMENT (***set to F50 if using the thru the hot end method****)

M140 S0 ;

M104 S0 ;

G90 E0; Return to absolute positioning

After extrusion stops, cut the filament in same location. Take the cut piece and measure its length. Use 100/measured length x the current e step to calculate your new e step. Example; we sent 100mm with an e step of 93mm the stock ender 3 value. Our cut length of material was 86mm. So 100 / 86 is 1.1628 x93 equals a new e step of 108.13 or 108.

Ideology of each method. Free air is giving a direct linear advance without the restriction of the hot end flow path. The slicer is designed to use linear value along with measured diameter to calculate extruded volume in a part tool path. This method does not require you to calculate e steps again if changing filament type. It is one and done, only to be re visited if changing extruder or extruder drive gear.

Ideology of threw the nozzle method. When done with a given filament, the flow rate may be left at 100% as you have tuned the e step to the current condition of the hot end and the specific filament that you are running. There is no need for a flow test to be done once the e step is set, unless conditions change.

2.1.6.1.   Flow

With this method any filament used will then be tuned with the flow rate to optimal extrusion using a single wall test cube. Print the cube at .40 single wall, then measure and record 2 values from all 4 sides. Add them together and divide by eight. Divide .40 by the resultant, and multipy that by 100 to give your new flow rate or extrusion multiplier. Example test cube measurements avg to be .428 so we take .4/.428 which equals .934579 x 100 = 93.458 or 93% flow rate as your new value. Note: if you had already been using a flow rate modifier, you would be at that % of the rate you were using. Example was at 97% and the calculation comes to 92%. That's 92% of 97% or 89% 97 x.92 is 89

In summary, the author prefers this method, as I never have to chase my e step, I can mark a filament of any type with its flow % on the spools label, and just change it in slicer. Being able to move through many materials at will.

2.1.7. Y axis trolley eccentric wheel adjustment

Y axis eccentric nut adjustment with pictures of what eccentric nuts look like.

Issue

Bed rollers not properly tensioned to v groove

Symptoms;

Too Loose;

 Bed has excessive rock or wobble when gently rocking across X axis, bed leveling does not repeat,

layer lines have waves in them.

Too Tight;

Stepper straining, a pronounced flat spot develops on wheels when left un-used for a while. Type 1 bed skewed away from square in Y axis.

Example of eccentric nut to understand how they function.

This is the eccentric wheel in the fully loose position where through bolt is furthest away from the fixed idler wheels (left side in photo)

Continued next page

Fix;

Condition bed is Too Loose: Type 2 (later models)

 Tip machine up or lay on side. Use eccentric nuts (Shown exposed in photos below) on the one side to adjust. Loosen both of the eccentric nut wheels. Rotate first nut until it just stops excessive movement. Second eccentric nut tightening till there is some resistance to turning rubber wheel while holding carriage in place. Once adjusted properly a moderate pressure applied to the bed corner should only see 1 to 2mm of deflection.

Condition bed is Too Loose; Type 1(Early production models) First design offset wheel pattern

Note the hand is tightening the compression nut, Not the Eccentric nut.

Tip machine up or lay on side. Use eccentric nuts to adjust. Loosen both eccentric wheels 3 and 4. Rotate nut 3, until it just stops excessive movement. Second rotate nut 4, tighten till there is some resistance to turning rubber wheel while holding carriage in place. !! Warning over tightening this outside wheel #4 can and will cause bed to be skewed to the y axis.!! Do not over tighten.!!
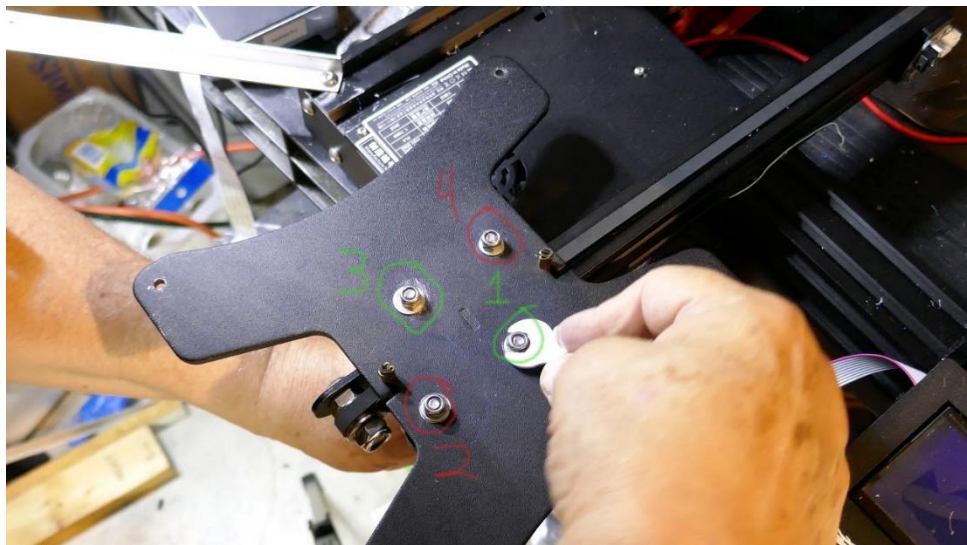
3.   Hot end

3.1. Nozzle clogs or filament drag issues

Symptoms;

Clog or full stoppage, inconsistent extrusion, blockage, retraction no stopping stringing. Infill not complete. Inconsistent outer wall surface.

Stock Ender 3 hot end with insulation and Kapton tape wrap.

Reason this occurred.

Why am I getting nozzle clog or restricted filament advancement? The most common cause is that the PTFE tube pushed back away from nozzle inside the hot end. As illustrated in this cut away drawing
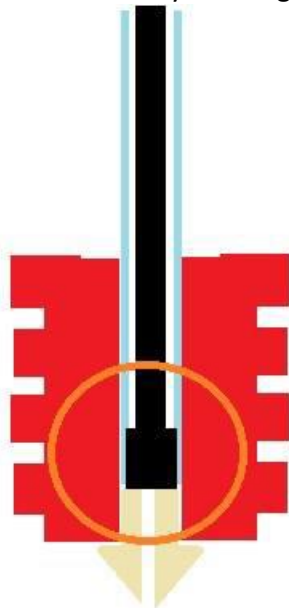
Figure 1 The PTFE pulled away about 2.5mm from nozzle in this discovery picture.

You now have a void space that once heat creep sets in or it gets to full operating temperature, melting the plastic into void. This can cause drag, the filament can harden over time restricting the path to the nozzle creating back pressure, often causing stepper skipping, or also variations in flow. Once there is a gap the retraction, it can act on the melted filament to hydraulically push it further away or back into the Bowden connector. There are very specific tasks on re-assembly, if you do not read to the end, and just re-assemble, you will likely see this happen again. Can take minutes or days to re manifest.

Solution;

First disassemble the hot end.

!!!!This is a **Hazardous Task**, as you most likely will need to work with the hot end at temperature for parts of disassembly and cleaning. !!!!

Tools needed, pliers or crescent wrench to support heat block, nozzle wrench or socket that fits nozzle. Additional tools that can help, 2 pairs of pliers, heat gun, nozzle cleaner from the Ender 3 tool kit, tooth picks, anything that you can scrape, heat or otherwise clean up filament with.

First remove both the part and hot end fans, and pull them back and out of the way.

Continued next page
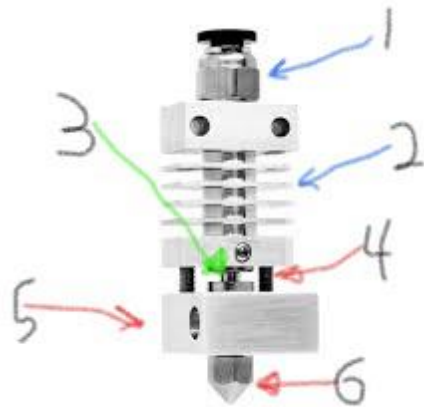
1. Bowden coupler
2. Cooling body
3. Throat
4. Assembly screws
5. Heat block
6. Nozzle

To disassemble. While cold, insert the two screws between the heat block and cooling body. If you have removed them prior re- install them.

(Note opinions vary on whether to remove these in normal use, Author prefers to remove them as in my opinion it moves un-needed heat to cooling body causing heat creep.) !!!The removal of the installation screws can cause serious issues, especially if you have a defective or weak throat piece, you have been warned that it can cause loss of use while diagnosing or repairing if these conditions exist!!!!

Heat up hot end, pull any remaining filament out from the Bowden tube.

Then support heat block, removing nozzle. You can choose to let heat block melt/drip away some of the filament. Warning this can cause hazardous fumes. Once nozzle is removed, remove grub screw holding the throat end while holding on to the heat block with pliers.

Now clean all plastics out of throat, inside cooling body and the nozzle.

Assembly process

Because of filament residue in threads, this is best accomplished with nozzle temperature set to 180`C to 250`C depending on what polymer of filament you use.

Screw nozzle into heat block until it bottoms out against its shoulder.
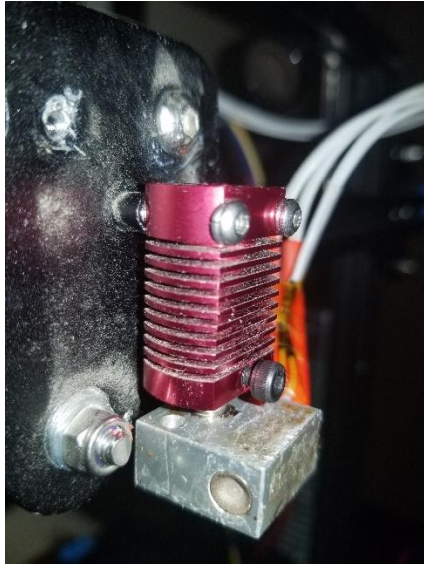
Tighten the nozzle while supporting the heater block

Using the two assembly screws push throat into cooling body.

Ensuring that the heat block is parallel to the bed.

Continued next page

If you have a matching 3mm x 8mm long socket headed cap screw, i recommend that you replace the grub screw entirely. Check clearance of all shrouds and covers prior to full re assembly to check for interference.

> Remove the installation screws and set aside for later hot end maintenance work.

Heat up hot end to 10 degrees above the hottest working temperature you work at. For author that is 255c.
While supporting heat block tighten nozzle firmly now.
In preparation for Bowden tube installation, pre mark your ptfe with a marker or piece of tape at 51mm from end for a depth check after tightening. Back off the Bowden coupler ¾ to 1&3/4 turn. Then push PTFE tubing firmly seated to a stop inside the hot end against the back of nozzle. Now while continuing to push in, pull back on Bowden locking collar and lock in place with zip tie, or a printed clip.
 Now tighten Bowden coupler. This has ensured it is seated against the nozzle.
Feed filament until it oozes some outset control to cool down.
Re assemble the fans and shrouds .
You should now be on to printing without mechanically induced clogs.

3.2. Nozzle leaking

Nozzle leaking filament
Symptoms;
Burnt filament deposited in prints. Blobs of filament on top of heat block making it encapsulated. Thick or thin wisps of filament that did not originate from nozzle tip. Heat block covered in filament.
Fix
Pre heat hot end to 20` hotter than your planned working temperature.
Use a wrench or pliers to stabilize hot end.
Firmly tighten nozzle using supplied wrench or an socket that fits nozzle on a nut driving handle or ratchet. Note if the nozzle bottoms out against the heat block before the assembly tightens, you must dis assemble the throat , heatblock and nozzle. Re assemble by running the nozzle to stop while heat block at temp. Back it off 1.5 turns, run the throat in till touching nozzle, install throat into cooiling body. Tightne grub screw. Heat to 20` over working temperature, support heat block and tighten nozzle. Run bowden fitting in till tight, back off ¾ turn, insert ptfe till pushed against nozzle. While holding it in , pull plastic collar up, and clip or zip tie it to lock. Now release pressure and tighten the final ¾ turn, lightly compressing the ptfe against the nozzle to try and prevent the "void". See also the hot end fix as altenative to this method.

3.2.1.   How can my brand-new printer have a clog or jam?

The stock PTFE couplers are often of poor quality. They allow the ptfe to back away from the nozzle creating a void.
The mfg does not give a method to add more than hand pressure to installing ptfe.
The material in void does not flow through, over time hardening and eventually causing drag on the remaining path for the filament to travel.
See the nozzle clog section for repair process as fix for all these issues.

3.2.2.   I ran my nozzle into bed, could I have damaged the nozzle?

Yes. There have been several reported in forums that were damaged, also creating an issue diagnosing extrusion problems as an oval, or rolled lip on a nozzle does some very erratic things while extruding. You may have also bent the throat which will be evident if heat block is skewed.

4.   Extruder

4.1. Extruder trouble shooting

15. Extruder troubleshooting

Items that may cause intermittent extrusion fluctuations

1. Crack in the release lever, sometimes cannot be seen from the top side.


2. Eccentric hole in drive gear. Causes patterns to show in the first layer or top layer of parts.

3. The drive gear slipping on the drive shaft. Fix ; make sure one of the two grub screws is on the drive flat. A little blue Loctite can keep them from vibrating loose.

4. The pivot screw for the release arm being over tightened, causing the spring tension not to transfer to the idler bearing
5. Spring pressure is too weak
6. Filament has worn the release arm causing friction and drag on the filament
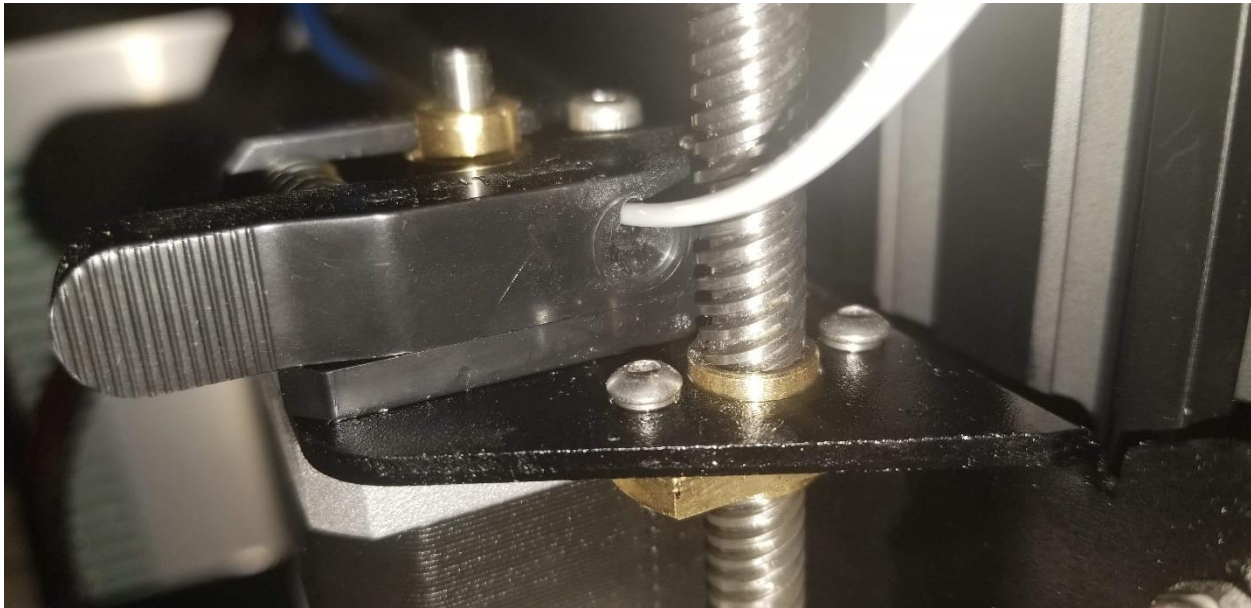
7. The drive gear has excessive wear on the teeth. Move to a different height or replace.

4.2. Extruder issues

4.2.1. Filament is being fed backwards

Issue
Filament is being fed backwards out of the extruder.
Commonly this is on a new build. The X and E stepper cables are reversed. Rumors of occasional label swap, also reports of cables landed to the wrong mosfet on control board by factory.
Fix
Reverse the stepper cables,
With others contact Creality support to get wiring diagram and put wires back in proper order.

4.2.2. What are the best replacement couplers for the Bowden tube?

 (this was volunteered by another, cannot vouch for validity of claims)
The M6 threaded one (PC4-M6) if you want to replace the hot end one as well, that is a PC4-M10x0.9-4.1 (the tube goes through) If you aim for the stars, go with Festo couplers/fittings but that's might be over the top.

4.2.3. How do I calculate e steps for my extruder? Also flow rate?

E step calculation

What is an E step? This is the description of how many times the stepper motor on the extruder must advance for 100mm of filament to be advanced. There is two methods that can be used. First method is to remove the Bowden tube from the extruder. We will call this the free air method. The second would be to do the test thru the heated extruder. The through the extruder is done by marking the filament at 100 and 120 mm from the inlet to the extruder. Then use the controller or gcode to advance 100mm of filament. Once done, you measure the distance from the extruder to the 20mm mark to determine actual length advanced. You then use the actual filament extruded in a formula, along with the current e step to calculate your new E step value. Example using 87 mm advanced (100 commanded measured 33mm from the 120mm mark, giving 87 actual distance traveled) and 98 for current e step; Formula 100/87 = 1.1494 x 98 = 112.64   so rounded off that's a new e step of 113 steps.

Using the free air method, we will remove the Bowden tube and coupler from the extruder. Run the filament just out of the extruder by hand and use flush cuts to cut it at face of extruder. Now use the control panel to advance 100mm with hot end at temperature, as extruder will not function when nozzle off. Or use this gcode put into a text editor and saved as a .gcode file extension for use in the printer. Note if you use abl use your start g28/g29 in place of whats provided here.

    ; 100mm gcode advancement program

G28 X0 Y0 Z0 ; HOME ALL AXIS

G90 ; ABSOLUTE POSITIONING

G92 E0 ; SET EXTRUDER TO ZERO VALUE

M92 E93 ; ***SET NEW E STEP *** (93 is factory value) (set new target value here once you ;have calculated your new estep, to run a test of the new value)

M190 S60 ;

M104 S215 ;

M109 ;

M82 ;

GO1 E100 F200; ADVANCE 100MM OF FILAMENT (***set to F50 if using the thru the hot end method****)

M140 S0 ;

M104 S0 ;

G90 E0; Return to absolute positioning

Continued next page

After extrusion stops, cut the filament in same location. Take the cut piece and measure its length. Use 100/measured length x the current e step to calculate your new e step. Example; we sent 100mm with an e step of 93mm the stock ender 3 value. Our cut length of material was 86mm. So 100 / 86 is 1.1628 x93 equals a new e step of 108.13 or 108.

Ideology of each method. Free air is giving a direct linear advance without the restriction of the hot end flow path. The slicer is designed to use linear value along with measured diameter to calculate extruded volume in a part tool path. This method does not require you to calculate e steps again if changing filament type. It is one and done, only to be re visited if changing extruder or extruder drive gear. With this method any filament used will then be tuned with the flow rate to optimal extrusion using a single wall test cube. Print the cube at .40 single wall, then measure and record 2 values from all 4 sides. Add them together and divide by eight. Divide .40 by the resultant, and multipy that by 100 to give your new flow rate or extrusion multiplier. Example test cube measurements avg to be .428 so we take .4/.428 which equals .934579 x 100 = 93.458 or 93% flow rate as your new value. Note: if you had already been using a flow rate modifier, you would be at that % of the rate you were using. Example was at 97% and the calculation comes to 92%. That's 92% of 97% or 89% 97 x.92 is 89

In summary, the author prefers this method, as I never have to chase my e step, I can mark a filament of any type with its flow % on the spools label, and just change it in slicer. Being able to move through many materials at will.

Ideology of threw the nozzle method. When done with a given filament, the flow rate may be left at 100% as you have tuned the e step to the current condition of the hot end and the specific filament that you are running. There is no need for a flow test to be done once the e step is set, unless conditions change.

5.   Heated bed

5.1. Leveling the be

ENDER 3
Bed modification to stabilize adjustment screws
Followed by bed leveling , with two options

A tech tip for bed adjustments.

The goal
Stabilizing the screws that cause bed level to shift often, also to secure the screws so they do not spin when attempting to tighten adjustment knobs.
Process: Take the knobs off, lift bed up and remove the springs. Take care to not stress the heater wires as you flip over the bed to work on it.
Add four 4mm jam nuts to lock the screws to the bed surface.
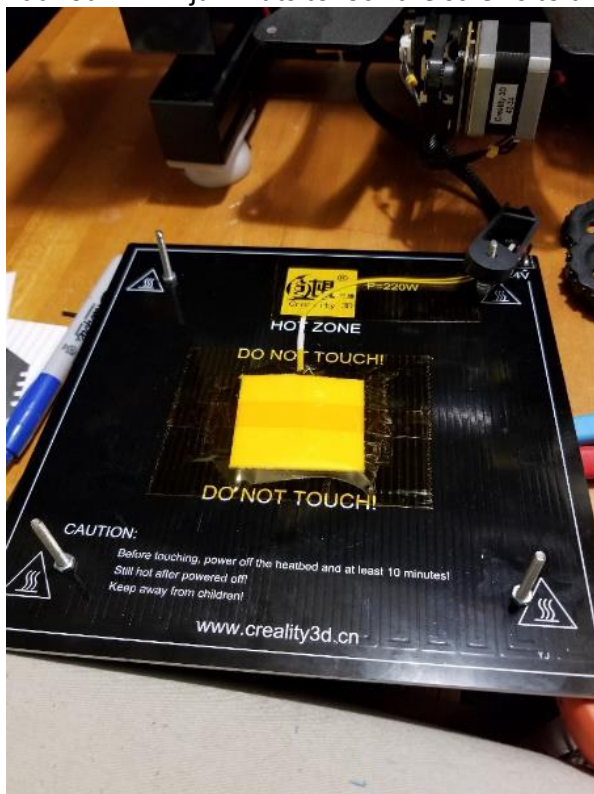
You will need to stop screw from rotating with a pliers as you tighten nut against back of bed surface.

Holding bed level test fit the bed into the Y mounting plate making sure screws freely move through that plate. If not, slightly enlarge holes, or loosen and shift screws so they do not hang up when moving up and down.

Now put springs on, tightening springs till about 70% compressed.
Turn on printer and home all axis. Turn machine off or disable steppers.
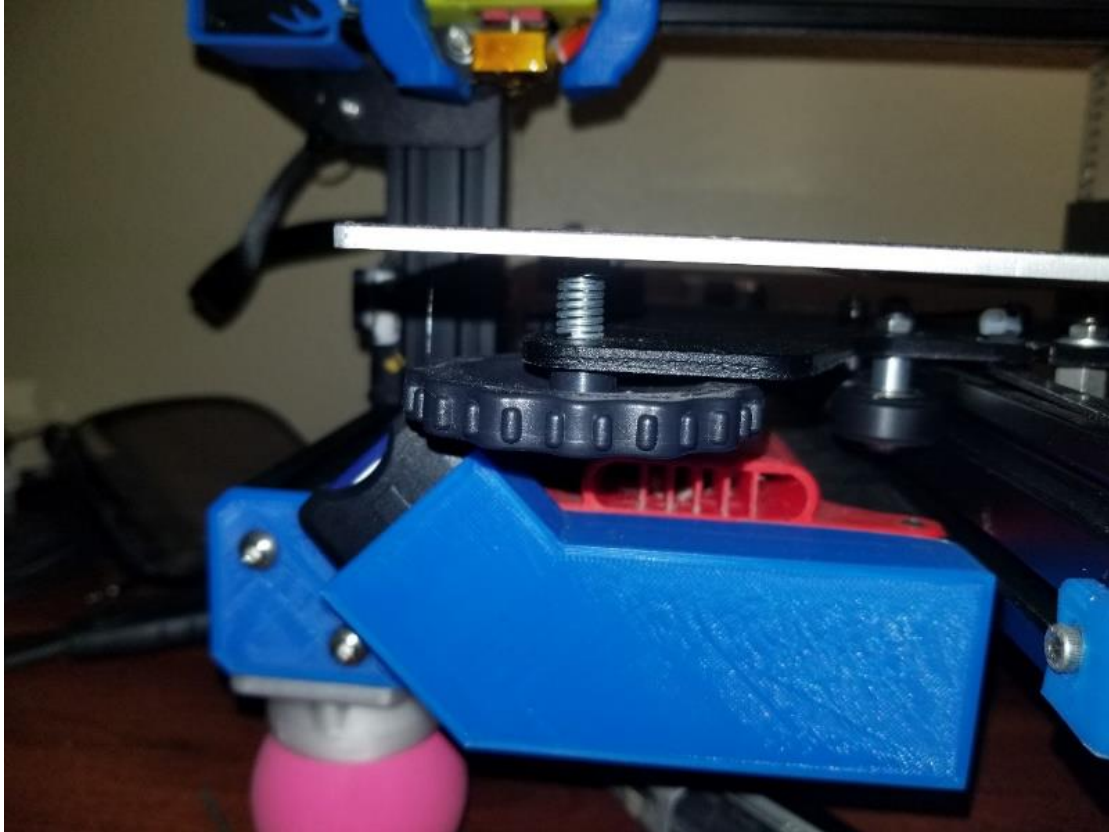
Now loosen both screws on the Z end stop lowering it so it is not hit while you move the x cairrage over the front right corner, using the nozzle wrench as a guage set nozzle height its thickness above bed. Now take the z liit switch and slowly move up until you hear the microswitch click, and tighten the stop bracket down.

Your now ready to move on to tram or "level" the bed to the nozzle and X axis.

Bed leveling procedures

Option 1;

Conventional manual level, must complete process   above before proceeding!

Tram the bed after homing all axis and disabling stepper motors. Pre heat bed and nozzle to your normal working temperatures. 200` c and 60`c avg. Then move to each of the four corners using the paper till it drags method to bring bed up to the. You should move to each of the 4 corners in rotation making two or three trips around until you are confident the 4 corners are equal. The author finds that using notebook paper if you tighten while sliding paper in and out under nozzle, when the paper folds on the push, that will be near .25mm from the bed. Once this is done you can measure your skirt on your first print to make adjustment to Z height. The thread pitch for the 4mm screws is

.7mm per revolution. This nets movement of .0875 per 1/8 turn, .175 per ¼ turn, .35 per half turn…..and so on. If you have reached the set value in your slicer for first layer height. And your filament is not sticking to the bed. Leave Z height here. Use the first layer flow to add "squish" until you are happy with the adhesion to the bed. 104 to 112% would be a normal range for that value.

Option 2; G code assisted level with a confirmation test print as continuation of the program.
Go to Thingiverse and download the files for
https://www.thingiverse.com/thing:2987803.
You need to perform must complete process   above before proceeding!
The g code will pre heat nozzle and bed. Then move over front left corner and park. Using paper, adjust up till the paper gets to the point where it drags on pulling, and folds when pushed forward. Push knob to move to next step. Note, if you work both front adjustment wheels together, it will help keep the opposite side from restricting the move up. Hit button on printer. It will go up in z and move over to come down on right side. Have paper under as it comes down. Adjust up if paper is loose, down if trapped. This same sequence will happen on back 2 corners. Then it will make another or second round of the 4 corners to fine tune the level. After the last manual level, it prints a skirt and 5 round circles. They should all measure. 3mm if the leveling went well. If the center disc is off from the outsides, minor corrections can be made for a difference of up to .1mm, much more and you may need to look at a replacement bed surface. Note the adjustment screws have a thread pitch of .5 mm. That means .125mm per 1/4 turn of the adjustment knob. You can fine tune without running full program if you're printed pads are too thin or thick. The author prefers to see the skirt at .27 to .33 with a set value of .3mm for first layer in the slicing software.

5.2. Heated bed issues

5.3. Warped bed

Issue
Bed is warped on delivery, is this normal?
Fix.
On machines with an overall flatness of >.15mm, after tramming bed, with the height difference split, it is capable of usable prints for most users with manual leveling techniques
With a Flatness of .15 to >.27mm, using mesh bed leveling, or an aftermarket probe and software correction. These can still be used.
<.27mm or greater and for any bed where the 3d operator is not able or willing to adjust for an out of flat bed.
Mirror or Glass cut to 235 by 235 can be cut and clamped to bed for a flatter surface. In some cases, capton tape may be needed to be applied to the bed to keep these add on surfaces supported and flat.
There is a myriad of other magnetic and other types of bed materials available, I encourage you to research what you think will work for you on your own. As this is a

very personal choice. And to Authors knowledge no surface covers every polymer available.

Question

Is anyone using Cura? Are there any good profiles?

Answer;

Seek out Facebook groups, or Internet 3d printing forums, and search their files or file archive sections for a profile that may suit the style of printing you are performing. For example, a Miniatures profile, or a file tuned for an specialty filament like Nylon or Abs, or? It's up to you, your materials used and your imagination.

The authors profiles are listed on the 5 groups I participate in, look for Luke Hatfield

6.   X axis

6.1. X axis tuning

X axis tuning

Symptoms;

No repeatability in bed level or first layer adhesion.

Occasionally varied layer heights if arm is catching and then releasing.

There are three possible mechanical causes for this if bed stabilization has been modified per tutorial here.

Issue One;

Improperly adjusted Y axis bed carriage/trolley wheel bearing rollers.

Fix

With the bed tensioner removed, the bed should move fore and aft freely, and no wobble if gently rocking side to side across the carriage.

To adjust, loosen the two eccentric nuts until carriage is loose. Slowly adjust one till the play just goes away, now adjust second till it snugs up and you can just cause it to slip pulling on the wheel radially with your fingers with carriage held in place.

25195-01

Issue Two;

Symptom;

X axis drag of arm, due to not fully tightening the cross-extrusion bolts between x motor bracket and the cross extrusion. Or cross extrusion was not parallel at time of asssembly

Fix
Loosen the X gantry extrusion bolts on the extruder frame
Set extrusion parallel to lower frame by measuring from x extrusion to top of frame
Re-tighten the bolts.

Issue Three;
Symptom;
X Axis has right side catching or lagging/ canting as Z height moves causing bed leveling
to not repeat and layer thickness/height issues.
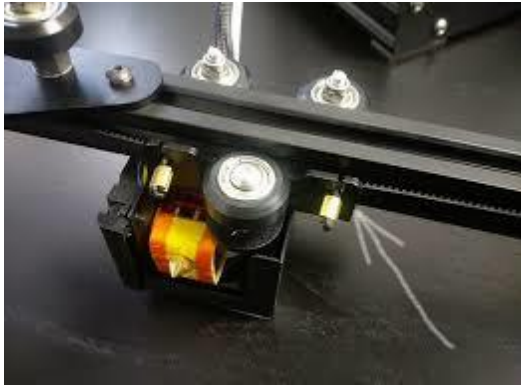
Adjustment procedure;
How to make X axis wheel adjustments to right guide bracket

Step One
Remove the belt by loosening tensioner

Step Two
Then pulling belt out of retainer groove

Step Three

Unbolt the right-side bearing plate from cross arm.
(shown off printer for clarity)

Step Four
Adjust the eccentric wheel until the play just goes away.

25195-01

As you move it up and down right vertical extrusion you should be able to lightly spin each wheel with your fingers, while holding plate in place, but feel drag of it trying to move assembly.

Photo step 4
Re attach and assemble in reverse order. See also X belt tensioning.
If problem is still there, check straightness of the two vertical extrusions. Also check if top and side extrusions are square. Also see Z axis bind if this doesn't resolve your issue.

6.2. X axis issues

X axis Belt under tensioned

Symptom;

Ghosting in X axis vertical face of prints.

Oval circles.

Corner over run

Option One.

Loosen the two smaller screws, push sideway with hand against idler arm, while tightening first screw. Tighten both screws now. This should be enough tension to properly operate. A plucking of belt should give a slight twang. Check that belt is running in into the extrusion without rubbing on it. You may need to shim towards right end between bracket and extrusion to square idler bearing to the extrusion.

Option Two, (Perform Option One first so you can print option two) print

https://www.thingiverse.com/thing:2986144

7.   Y axis

7.1. Y axis tuning

7.2. Y axis belt tension

Y axis belt tension

Symptoms;
Evidence of ringing in vertical walls
Ghosting
oblong holes oval in Y plane
Option One

To tension Y axis you must loosen the four t-nut screws on either side of the y axis extrusion. Pull or very lightly leverage tension on belt tightening one screw each side. Move bed in and out. If belt not running true, you must adjust one of the two side plates to get the belt running true in the middle of the extrusion.
Option Two (Perform Option One First)
Print thingiverse.com file https://www.thingiverse.com/thing:2986144
And use tension ring to tighten belt until it is under moderate tension.
If belt not running true, shim between face of extrusion and the tensioner on the side the belt is tracking towards.

7.3. Y axis eccentric nut adjustment

Y axis eccentric nut adjustment with pictures of what eccentric nuts look like.
Issue
Bed rollers not properly tensioned to v groove
Symptoms;
Too Loose;
Bed has excessive rock or wobble when gently rocking across X axis, bed leveling does not repeat,
layer lines have waves in them.
Too Tight;
stepper straining, a pronounced flat spot develops on wheels when left un used for a while. Type 1 bed skewed away from square in Y axis.
Fix;
Condition bed is Too Loose: Type 2
Tip machine up or lay on side. Use eccentric nuts (Shown exposed in photos below) on the one side to adjust. Rotate first nut until it just stops excessive movement. Second eccentric nut tightening till there is some resistance to turning rubber wheel while holding carriage in place.
Condition bed is Too Loose; Type 1
Tip machine up or lay on side. Use eccentric nuts to adjust. Rotate first nut 1 or 3, until it just stops excessive movement. Second eccentric nut, 2 or 4, tighten till there is some resistance to turning rubber wheel while holding carriage in place. !! Warning over tightening this outside wheel can and will cause bed to be skewed to the y axis.!! Do not over tighten.!!
Too Tight;
Rotate both eccentrics till bed is loose to v grooves. Then use "Too loose" procedure to set the eccentric
wheels".

Type1
First design offset wheel pattern.
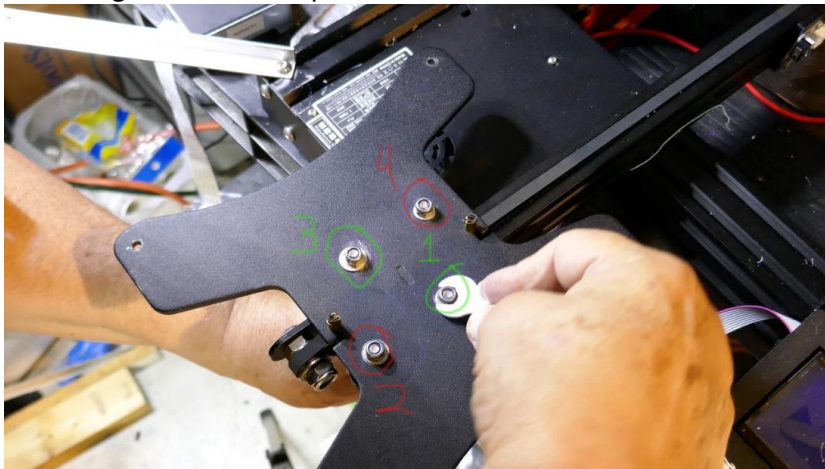
Note the hand is tightening the compression nut,

Type 2 later production" fixed offset issue"

This is eccentric nut (with wheel removed for clarity) in the fully tight position

This is the eccentric wheel in the fully loose position where through bolt is furthest away from the fixed idler wheels (left side in photo).

# 8.	Z axis

8.1. Z axis binding issues

Z Shaft Alignment/Binding correction

Symptoms; Prints are too short/compressed in height, varying thickness of layers throughout the part, occasionally Z axis motor clicking/skipping.
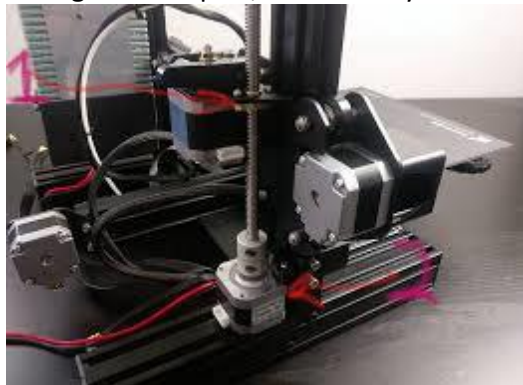
Procedure. You are now going to align the Z stepper motor to the Z drive screw. Support X axis just off bed. Remove the Z rod from the coupler, using the top two grub screws. Remover the 2 bolts holding the stepper motor to the frame. Now insert the shaft into the stepper and measure the gap from bracket to the extrusion. A shim of that thickness between stepper motor and frame is needed. List of shims and printable stepper holders below.

If you currently are not able to print a solution, a nut put on both bolts in between the stepper and the extrusion can temporarily reduce binding. Then you can print a shim to fix properly.

Find the right shim thickness you need on www.thingiverse.com or here's a couple I have found.

https://www.thingiverse.com/thing:3124959,
https://www.thingiverse.com/thing:2526607,
https://www.thingiverse.com/thing:2925230,
https://www.thingiverse.com/thing:2907882
https://www.thingiverse.com/thing:3115362

Alternate methods
Option 1

If your bracket is bent so much that the shim does not fully correct this issue. You can thru drill the bushing and bracket at 3mm, using longer 3mm screws and nyloc nuts, or doubled nuts jammed together. Take till tight, then back off 1 turn. The 2 nut jam will be hard to accomplish, but not all have access to nyloc 3mm nuts at home depot, so this option is included.

Option two;

Remove the x gantry , strip all parts from bracket holding the z nut. Put bracket in vice bending to 90` using a crescent wrench.

9.   X, Y and Z axis

9.1. Dust on roller wheels

Issue;
Dust on rails or roller wheels
Symptoms;
Dust or debris seen on wheels or rails
Fix
Option One
Do nothing but clean the offending dust off of printer. There is static electricty created as wheels roll on the aluminum rails, which attracts dust.
Option Two
Check that wheels are adjusted properly on X and Y carriages. If Wheel damage is verified, replace rollers and see Y bed cairrage wheel adjustment procedure for proper adjustment guide.
This is authors Y carriage just before performing maintenance (adding dampeners) 2 months accumulation, no wheel wear noted.

9.2. X, Y and Z axis issues

9.2.1. Why is axis X,Y,Z not homing with a home all?

- The wire to the axis end stop is unplugged
- The stepper motor is un plugged
- On build X and E stepper reversed causing X to not be powered

9.2.2. I have this weird pattern in the X or Y axis, what is causing it?

Failed bearing, see picture of my personal bearing failure recently.

10.   Suggested upgrades purchased or printed

10.1. Stepper dampeners

Stepper dampener installation series X Y E

Stepper dampeners; these are used to significantly reduce the electronic stepper noise that is resonated through the aluminum extrusions. This guide will show how to install on X Y and E axis. The E axis has the least effect on overall noise.

Note, for my installation I had to cut some screws down, as they were bottoming out before tightening dampeners to the steppers. In the end, there were enough of the shorter screws, that are displaced by going from 4 screws to 2, in all 3 axis to possibly 1not do this, but I did them one at a time, so realized it after the fact. Just know you may need to adjust, purchase, or modify some screws.

Step one

Y axis

Step 1

To release tension on Y axis belt tensioner. Loosen the t nut screws that hold the 2 side support brackets to the extrusion.

Step 2

Take belt off the stepper drive pulley. Remove pully off the stepper shaft using the 2 grub screws. Unbolt the 4 bolts of the stepper motor from the bracket.

Step 3

Now mark the amount of material to remove from the Y frame.

Alternate use a printed adjustable Y axis end stop mount. This reduces available bed surface in Y by a few mm. https://www.thingiverse.com/thing:298746

Step 4

Cut out the excess material from the Y plate.

Extra style points for using a 3d printed sawzall blade handle to perform the cuts.

Use 2 screws to attach dampener to the stepper motor (note: you may need to use shorter screws if the stock ones bottom out or use Dremel to cut them down). Use 2 factory screws to mount dampener bracket to the stepper bracket. Then align pully to the extrusion. You can re attach the tensioner loosely on other end to allow you to run carriage in and out and check that belt is running in the proper position.

Step 5

Perform final tensioning of the Y belt. Taking care to make sure the belt does not try to run off the side of pulley. You can use the side plate on the side that belt is moving towards and add tension till it runs true.

X axis stepper dampener installation

Step 1

Loosen the 2 screws that hold the plate of the X roller bearing support to take tension off the belt.

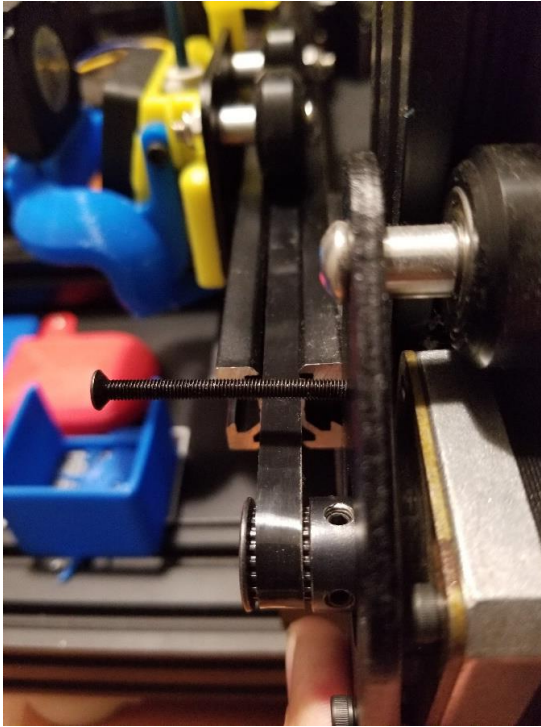Then remove one side of belt catch on the x axis trolley

Step 2

Now you are ready to remove the 4 screws holding the dust cover with x end stop off. Have ahold of stepper as these through bolt holding it to the frame. You must remove the QR code sticker to access screw heads.

Step 3

Now loosen and remove the drive cog from the stepper and mount the stepper dampener with the 2 screws to the stepper. Ensure the cover screws and the stepper screws leave the stepper plug pointing away from printer when installed.
The author chose to use a temporary screw to hold the stepper in place while aligning the drive cog and belt to the center of the extrusion, and tightening the 2 set screws.
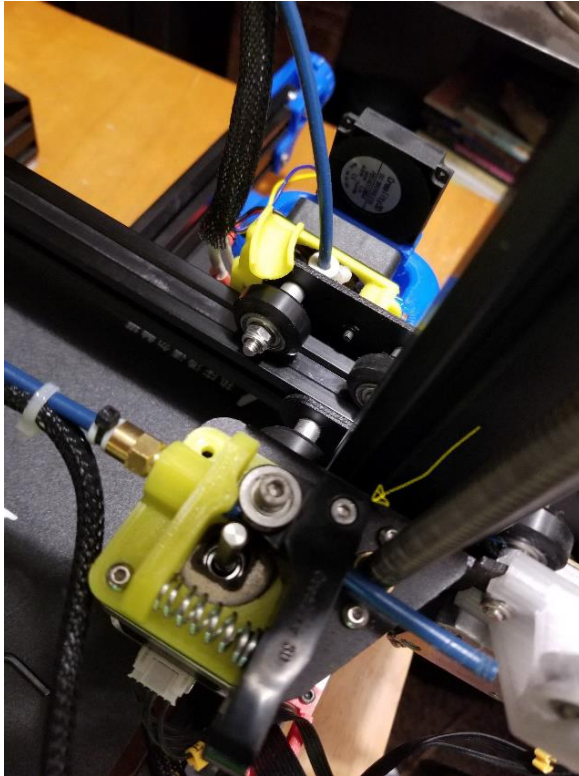
Step 4
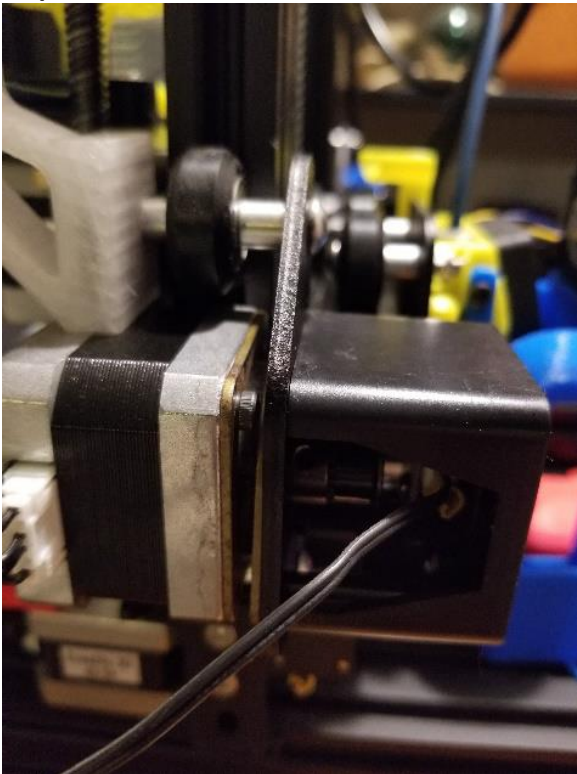
Now remove temp screw and install 2 of the original 4 screws through the plastic end stop housing and into the x stepper dampener. (end stop cable goes in from below, was testing install before I re-routed it)

Step 5

Re-install the belt to carriage and use tensioner pully to re-tension the x axis belt.

E axis

First remove any filament from printer.

Now remove the screw that holds the idler bearing arm to the stepper

Caution, you are releasing the pressure on a compressed spring. Safety glasses would be prudent. You can put a rag over it so it doesn't fly, or use pliers to remove prior to the arm removal.

Now undo last 3 bolts holding extruder drive frame and stepper on the bracket.
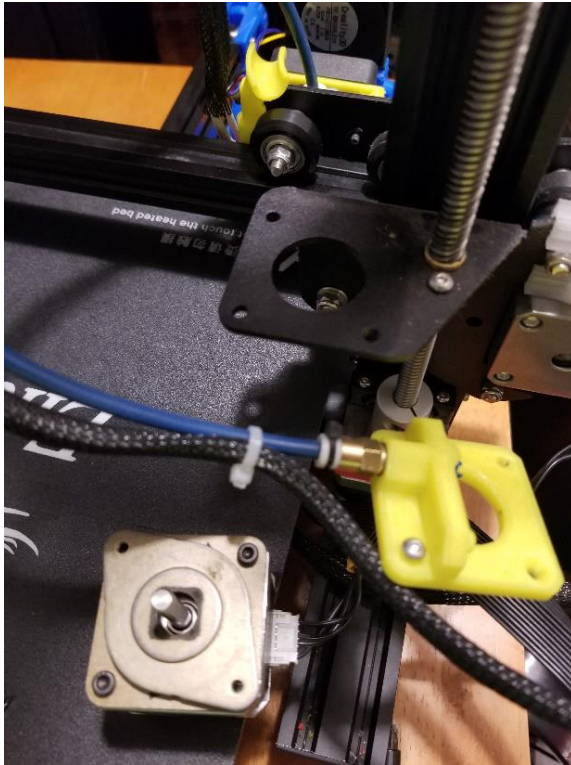
Then bolt the dampener to the stepper motor. Orient so that stepper plug is pointed to back of printer, and the dampener mount plate will be under the pivot arm bolt location shown previously

Install the screw diagonal across from pivot arm to affix the extruder drive body to the stepper.

Then install pivot screw. While compressing spring with arm. Alternately install arm, then use pliers to put spring in place.

Install drive gear. You are now done.
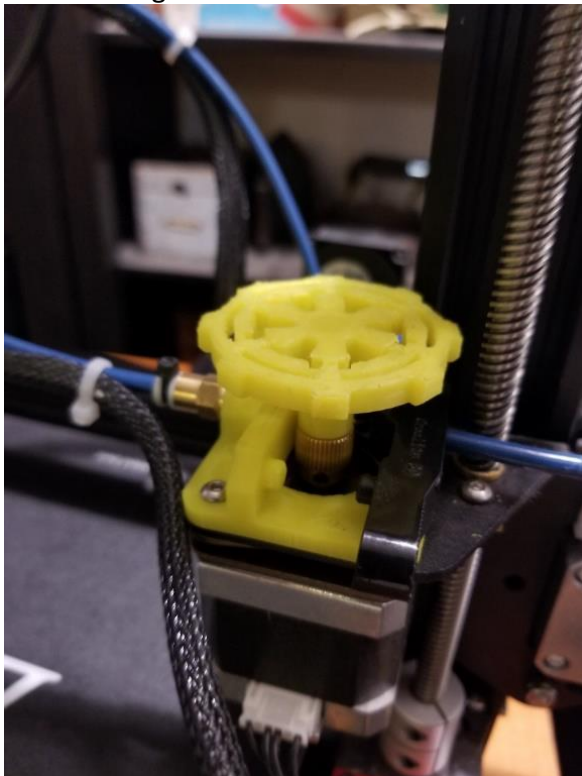
End of project check list

1. All end stops mounted and plugged in
2. All stepper motors wires are installed
3. All motion systems can reach, and touch end stops
4. All wires are back in restraints or looms
5. Test each axis before a home all
6. Enjoy your now significantly quieter printer.

10.2. Case fan

Issue
Case fan not running
Symptom;
Case fan observed to not be running when printer turned on.
Fix
The fan is only set by Creality to run when the software turns on the part cooling fan.
Option One
Do nothing as this was the factory design.
Option Two
Modification;
Unhook wires or fan from control board. Extend wires to run to the 24v terminals of the power supply,
adding a fuse to protect against shorting.

10.3. Printable upgrades

11. Software

11.1. Marlin firmware

11.1.1. Why should I update Firmware?

Option 1
As shipped the Marlin version that Creality purchased shipped with High temperature run away disabled. That is a fire hazard. Purchase boot loader to be able to flash firmware with a safe Marlin version.
Option 2
Skip update, do not print un-attended.

11.1.2.   My printer won't store the settings (e-steps) in the eeprom.

What could be the problem?

You must have a bootloader to flash eeprom on an Ender 3. As shipped there is No bootloader or way to set the eeprom through the serial port that is on the printer.

11.2. G code

11.2.1.   Start and End G code scripts

Their purpose. The start code rapidly purges filament as a nozzle cleaning exercise, to prevent build up and clogging. The end code purpose is getting the nozzle off the part and presenting the bed forward for print removal.
;Start gcode
M107 ;turn off fan
G28 X0 Y0 Z0 ; home X, Y and Z axis end-stops
G0 X0 Y0 F9000 ; Go to front
G0 Z0.15 ; Drop to bed
G92 E0 ; zero the extruded length
G1 X40 E45 F300 ; Extrude 25mm of filament in a 4cm line
G92 E0 ; zero the extruded length
G1 E-1 F500 ; Retract a little
G04 S10 ;Dwell 8 seconds
G1 X80 F4000 ; Quickly wipe away from the filament line
G1 Z0.3 ; Raise and begin printing.
;End gcode
G91;
G1 F1800 E-3; retract filament
G1 F3000 Z10; move z 10mm above print finish height
G90;
G28 X0 ; home x
G1 F3000 Y200; bring bed forward
M104 S0 ; turn off extruder
M140 S0 ; turn off bed
M84 ; disable motors
M4 60000; dwell to cool hot end
M106 S0 ; turn off cooling fan

11.2.2.   Estep 100mm advance gcode

What is an E step? This is the description of how many times the stepper motor on the extruder must advance for 100mm of filament to be advanced. There is two methods that can be used. First method is to remove the Bowden tube from the extruder. We will call this the free air method. The second would be to do the test thru the heated extruder. The through the extruder is done by marking the filament at 100 and 120 mm from the inlet to the extruder. Then use the controller or gcode to advance 100mm of filament. Once done, you measure the distance from the extruder to the 20mm mark to determine actual length advanced. You then use the actual filament extruded in a formula, along with the current e step to calculate your new E step value. Example using 87 mm advanced (100 commanded measured 33mm from the 120mm mark, giving 87 actual distance traveled) and 98 for current e step; Formula 100/87 = 1.1494 x 98 = 112.64   so rounded off that's a new e step of 113 steps.

Using the free air method, we will remove the Bowden tube and coupler from the extruder. Run the filament just out of the extruder by hand and use flush cuts to cut it at face of extruder. Now use the control panel to advance 100mm with hot end at temperature, as extruder will not function when nozzle off. Or use this gcode put into a text editor and saved as a .gcode file extension for use in the printer. Note if you use abl use your start g28/g29 in place of whats provided here.

     ; 100mm gcode advancement program

G28 X0 Y0 Z0 ; HOME ALL AXIS

G90 ; ABSOLUTE POSITIONING

G92 E0 ; SET EXTRUDER TO ZERO VALUE

M92 E93 ; ***SET NEW E STEP *** (93 is factory value) (set new target value here once you ;have calculated your new estep, to run a test of the new value)

M190 S60 ;

M104 S215 ;

M109 ;

M82 ;

GO1 E100 F200; ADVANCE 100MM OF FILAMENT (***set to F50 if using the thru the hot end method****)

M140 S0 ;

M104 S0 ;

G90 E0; Return to absolute positioning

Continued next page

After extrusion stops, cut the filament in same location. Take the cut piece and measure its length. Use 100/measured length x the current e step to calculate your new e step. Example; we sent 100mm with an e step of 93mm the stock ender 3 value. Our cut length of material was 86mm. So 100 / 86 is 1.1628 x93 equals a new e step of 108.13 or 108.

Ideology of each method. Free air is giving a direct linear advance without the restriction of the hot end flow path. The slicer is designed to use linear value along with measured diameter to calculate extruded volume in a part tool path. This method does not require you to calculate e steps again if changing filament type. It is one and done, only to be re visited if changing extruder or extruder drive gear. With this method any filament used will then be tuned with the flow rate to optimal extrusion using a single wall test cube. Print the cube at .40 single wall, then measure and record 2 values from all 4 sides. Add them together and divide by eight. Divide .40 by the resultant, and multipy that by 100 to give your new flow rate or extrusion multiplier. Example test cube measurements avg to be .428 so we take .4/.428 which equals .934579 x 100 = 93.458 or 93% flow rate as your new value. Note: if you had already been using a flow rate modifier, you would be at that % of the rate you were using. Example was at 97% and the calculation comes to 92%. That's 92% of 97% or 89% 97 x.92 is 89

In summary, the author prefers this method, as I never have to chase my e step, I can mark a filament of any type with its flow % on the spools label, and just change it in slicer. Being able to move through many materials at will.

Ideology of threw the nozzle method. When done with a given filament, the flow rate may be left at 100% as you have tuned the e step to the current condition of the hot end and the specific filament that you are running. There is no need for a flow test to be done once the e step is set, unless conditions change.

11.3. Cura

11.3.1.   Cura settings

11.3.2.   Visually unpleasing diagonal lines

Issue
Visually unpleasing diagonal lines on top or bottom layers of print.
Fix
Change infill pattern and or Shells/ TopBottomPattern/ to Concentric, line, or zig zag

11.3.3.   Cura Combing settings related issue
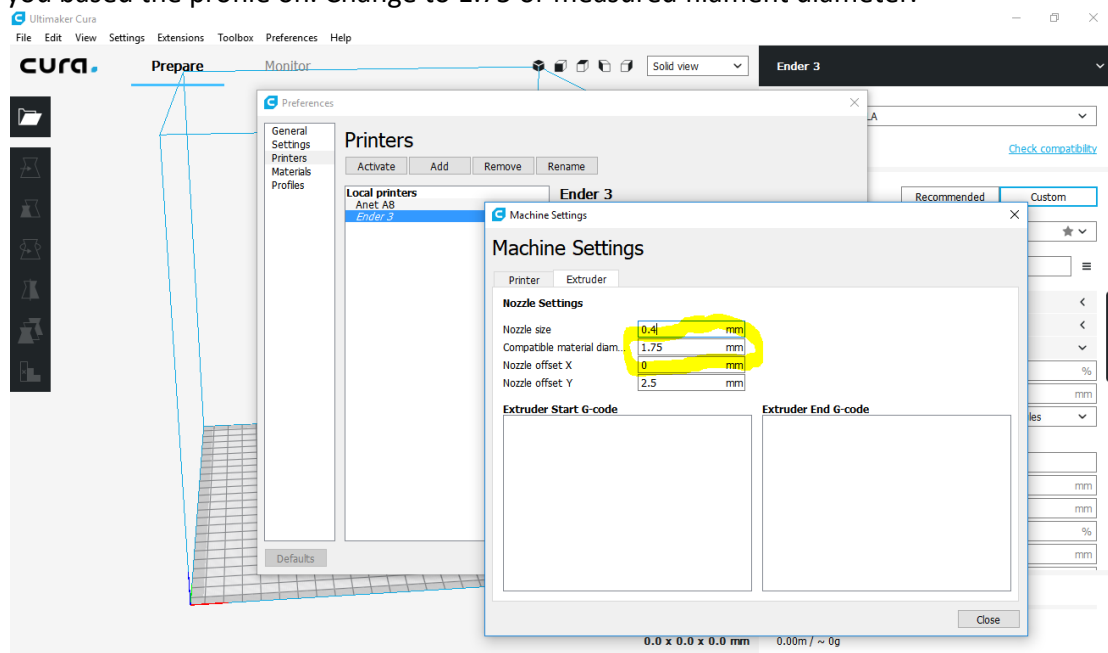
Symptom;
Missing layers and wall defects.

Causes
It can be from combing. Disabling Combing and activating "Retract before outer wall can get rid of the missing layers. Issue initially thought to be a clog with layer separation. Massive under extrusion. See also nozzle clog or filament drag

Symptom;
Looks like extrusion set to .4mm layer with a .4mm nozzle. Filament size / looks like under extrusion or z drag.

Cause
Reason/ fix go to Cura, the filament diameter is set at 2.8 from the initial printer model you based the profile on. Change to 1.75 or measured filament diameter.

11.3.4.   Cura slicer bed origin settings Issue

**Issue slicer bed origin settings **

Symptom
Parts do not align to bed from slicer, not able to use whole build surface. Initial set up of Profile in Cura or another slicer.
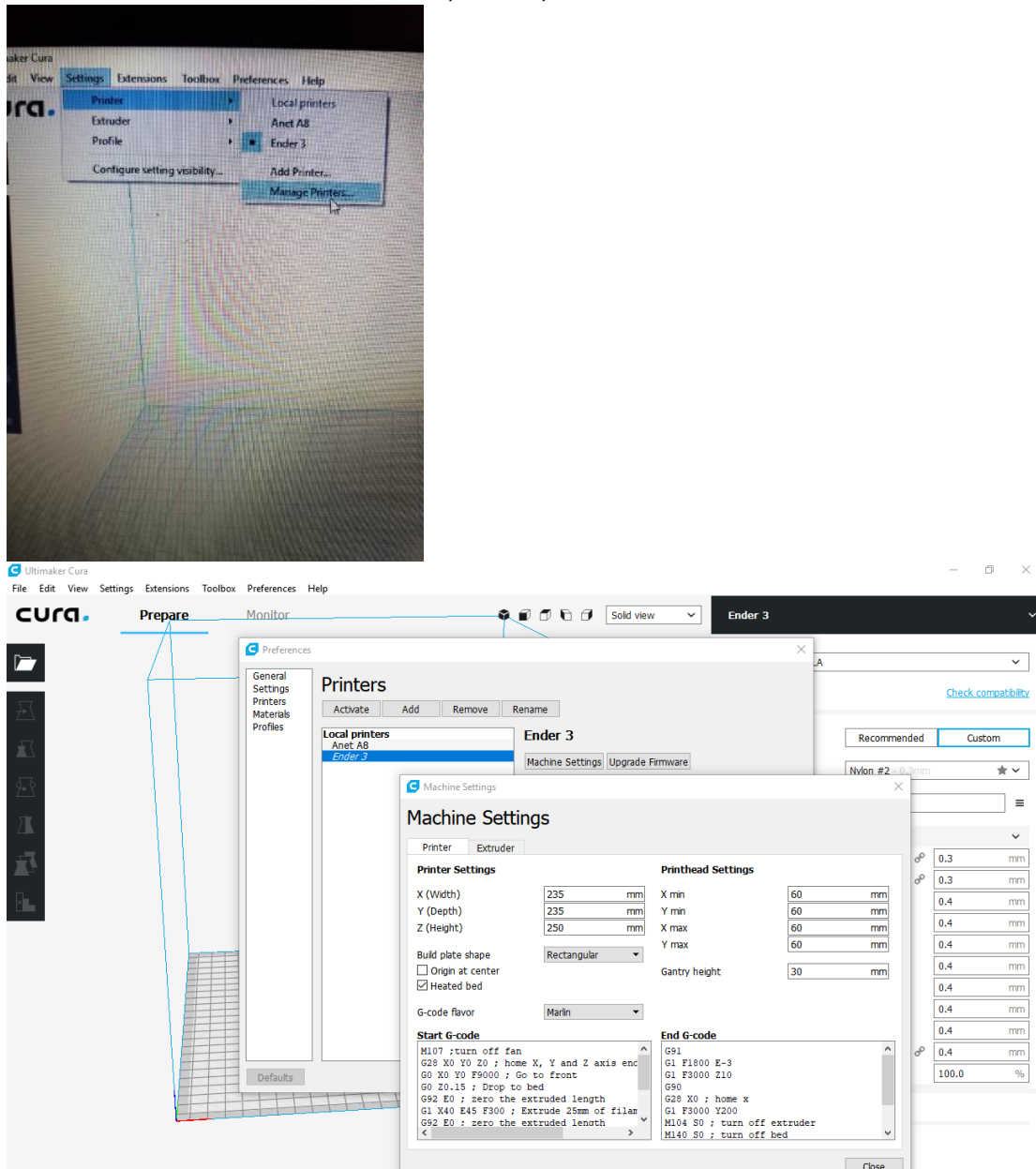There are two places that the Slicer needs information to properly orient your parts to the bed.

First
In the machine settings section (Cura referenced, but all slicers will have something similar)

Set the machine dimensions at X235.0, Y235.0, Z250.0

Continued next page

Second;

Under the extruder settings, in offset you need to set value for the nozzle sitting at lower left corner of the bed. To find your number, home all, then use manual position move with the controller. Or you can try the X0. Y2.5 that the authors stock Ender 3 set up produced.
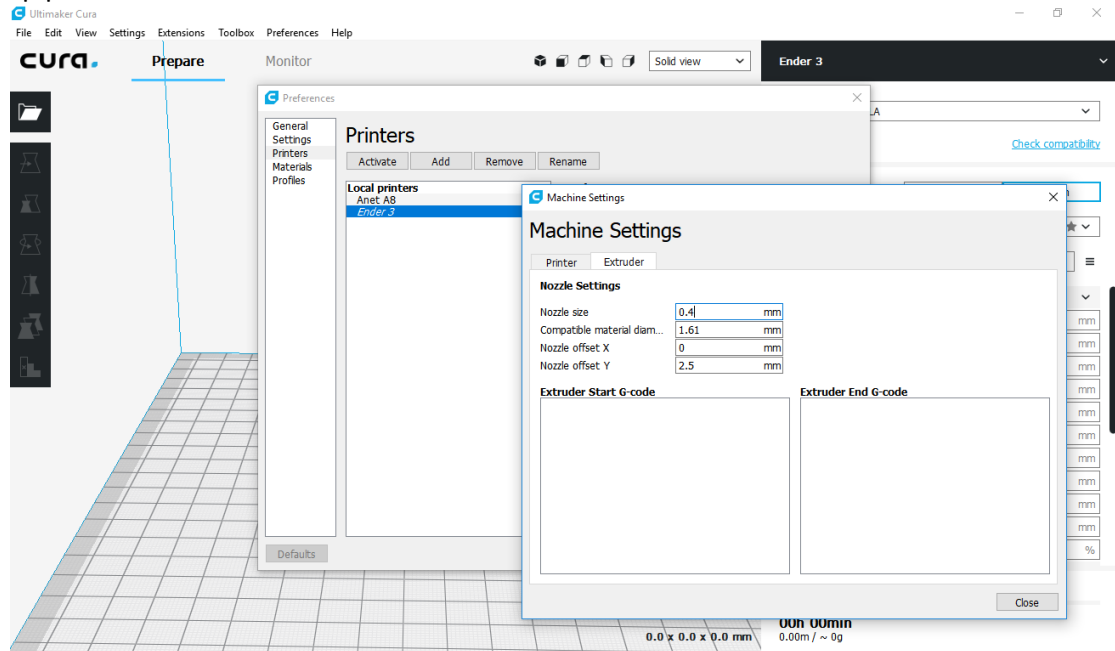
11.3.5. Cura concentric fill issue

Issue
Cura setting defaults to concentric fill

Symptom;
Holes in portions of top infill of test cube or other part.

Fix
Go to Cura/shells/topbottompattern/ select Line or Zig Zag instead of Concentric
Examples;

12.   Print quality trouble shooting

A good guide is found at:

https://www.simplify3d.com/support/print-quality-troubleshooting/

12.1. Under/over extrusion photo examples

To be added next revision placeholder

12.2. First layer / Bed adhesion

Question
Why is first layer so ugly/not sticking?

Answer
I could write a separate book on all the factors that can cause a poor first layer bond to not stick. But I will take a swing at some commonly found issues that people new to the hobby, and some veterans fall victim to.

1. Oils from your hands. This to a polymer is like putting Crisco oil on a frying pan and trying to get something to stick........Use Isopropyl Alcohol, 70 to 94 %. Author prefers 94 % as the water percentage is less to evaporate before printing may commence after cleaning. Some removable surfaces like glass, borosilicate, PEI, glue or hairspray on many of these previous, Build Tack, Kapton tape, and blue painters tape. All these have different methods to clean or prepare for a new print.
2. Bed temperature that is above the glass transition temperature of the filament. These are technical words that boil down to, do not exceed bed temperatures that are generally recommended by the community or manufactures for a given polymer, and expect that being hotter will not necessarily give better results.
3. Nozzle height from bed surface, this is often referred to as needing re-leveled......adjusting height is not leveling, If you are too far from the nozzle to bed, it will have a negative effect on trying extrude material with adhesion.
4. Using a bed material that is not compatible with a given filament, too many variables to list here. See YouTube and google for recommended compatibility.
5. Mechanical issues such as bed is trammed to be level, but the x arm and bed are not on same plane after a positional move, so now it's too high, low, or skewed to get an even first layer for the part.
6. Material is Hygroscopic, another big word. This means it can collect moisture from the air around the filament. This causes steam while extruding that causes uneven flow, bubbling, and often very poor adhesion factor compared to a dry sample of the material.

7. We covered cleaning hand oils, so for those who are a Houdini and do not touch the bed, or who knows use gloves. The bed still needs cleaned of dust and remnants of prior prints each break between parts. Or an application of any agents used to assist in the bonding process.

8. Glues, some glues do very well in assisting adhesion. But others or even good ones, can have a cure time while they off gas water and certain chemicals that before the surface is cured, working against adhesion.

9. Place holder, because I assure you there is more..........

13.   You tube video's

Videos about Ender 3 to watch
Not every one has time, but the author learned much of his 3d printing knowledge from YT videos. Try to be specific in topic you want to study when searching.
7 easy 3D printed upgrades for your Ender 3
https://www.youtube.com/watch?v=fq2IKp3jeaY
7 more easy 3D printed upgrades for your Ender 3
https://www.youtube.com/watch?v=DxopTyCCkOU
Fixing a Filament Flow Problem on CR-10 mini, CR-10 or Ender 3
https://www.youtube.com/watch?v=x35aWmnZ_A0&app=desktop
Fixing a Filament Flow Problem on CR-10 mini, CR-10 or Ender3
https://www.youtube.com/watch?v=x35aWmnZ_A0&app=desktop
updating firmware without a bootloader
https://www.youtube.com/watch?v=oZVTYpHnpIw&feature=youtu.be
building video
https://www.youtube.com/watch?v=VHHxkOULP5Q&feature=youtu.be
Nerys ender 3 misc videos
https://www.youtube.com/watch?v=ffVe-Ir0La0&t=
https://www.youtube.com/watch?v=fn9vo2XiqLY&t=63s
https://www.youtube.com/watch?v=4dTmKPZA0dw&t=14369s
easy live leveling
https://www.youtube.com/watch?feature=youtu.be&v=gkZUAyTxU1Q&app=desktop
un boxing and assembly guide
https://www.youtube.com/watch?feature=youtu.be&v=Fzc_e51vIIA&app=desktop
bootloader and firmware update
https://www.youtube.com/watch?v=fIl5X2ffdyo&feature=youtu.be
bed leveling
https://www.youtube.com/watch?v=RZRY6kunAvs
ABL usage demo

https://www.youtube.com/watch?v=p5iH3y20MQE

Print quality trouble shooting

https://www.simplify3d.com/support/print-quality-troubleshooting/

14. CR10S Pro

14.1. Problems with bed Z height at set up.

14.1.1. Authors suggested set up procedure.

14.1.1.1. The first item to address is the relationship in height between the nozzle and the bottom of the ABL sensor.

14.1.1.2. With the nozzle touching the provided .2mm feeler gauge, and fan cover removed, adjust by loosening the 2 grub screws, the abl to sit on the double ended wrench from the tool kit and a 3x5 notecard folded in half or other paper equaling .5 mm in height. For an overall height off bed of 2.5mm.

14.1.1.3. Now with the wrench removed we are going to adjust the potentiometer screw on the top of the sensor. Turning it till it turns off, then slowly reversing until red light just turns on.

14.1.1.4. Re install the fan shroud

14.1.1.5.   Go to the leveling icon in the menu. Select 5 point leveling, using the menu level all 4 corners of bed using paper or the provided feeler guage

14.1.1.6. Now run the 16 point leveling routine. Once it stops in the middle of bed, use the up or down arrowson left side to touch off the feeler guage. !! Now hit the home button again. This registers the nozzle to the mesh you just established. !!

14.1.1.7. You now will have a mesh that will be used by the g28 command in your start Gcode. It will be available and active till the printer is powered down. Until i find the proper gcode to add into start script to store the value in the Eeprom. If you unlock this, please PM the author so we can share it with the community.

14.1.1.8.