STACKER
INDUSTRIAL GRADE 3D PRINTERS
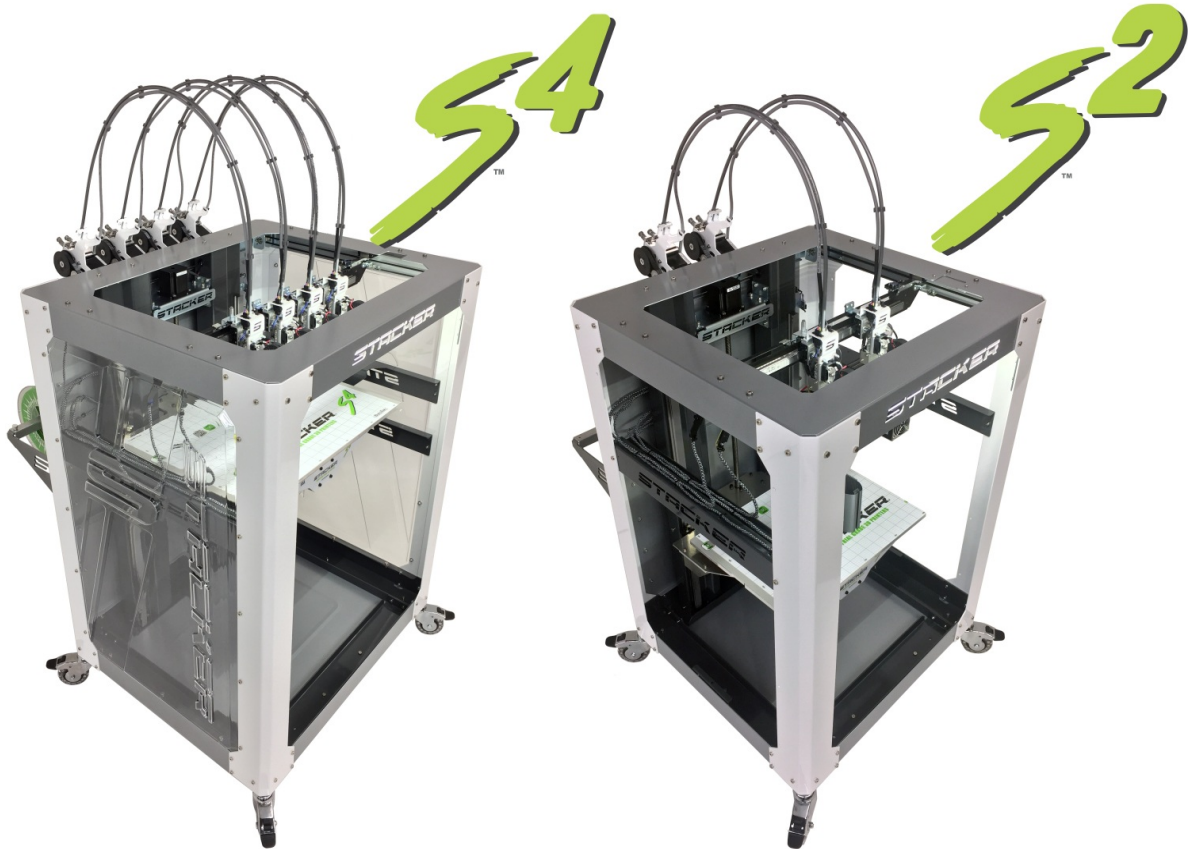
STACKER S4 and STACKER S2
USER GUIDE – PART I

User Guide - STACKER S2/S4 - Part I

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1. Introduction

Welcome to STACKER! Our high performance industrial grade "S" Series 3D printers capable of producing everything from one-off prototypes to multiple part production runs. To get the most out of your Stacker 3D printer, please read the entire User Guide Part I before attempting to operate your printer. Part I of the User Guide should provide all the information necessary to set up and operate your printer. For more advanced operation and calibration, please download Part II of the User Guide from our website.

1.1 Product Registration

It is important to register your printer with Stacker. In order to receive customer service support, warranty service, or join our community forums, you must register your printer. Complete the registration form on our website.
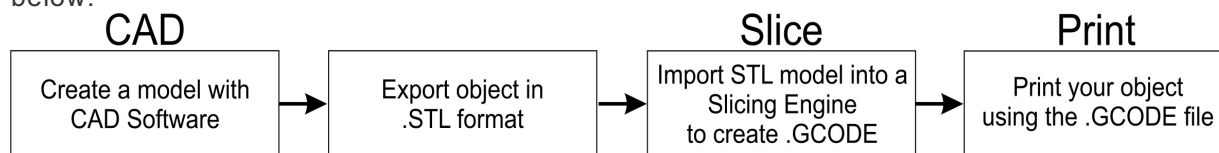
http://stacker3d.com/product-registration/

Your Stacker 3D printer has two serial labels. One is serial label is located inside the controller housing and a second serial label has been attached to the inside of the front right leg.
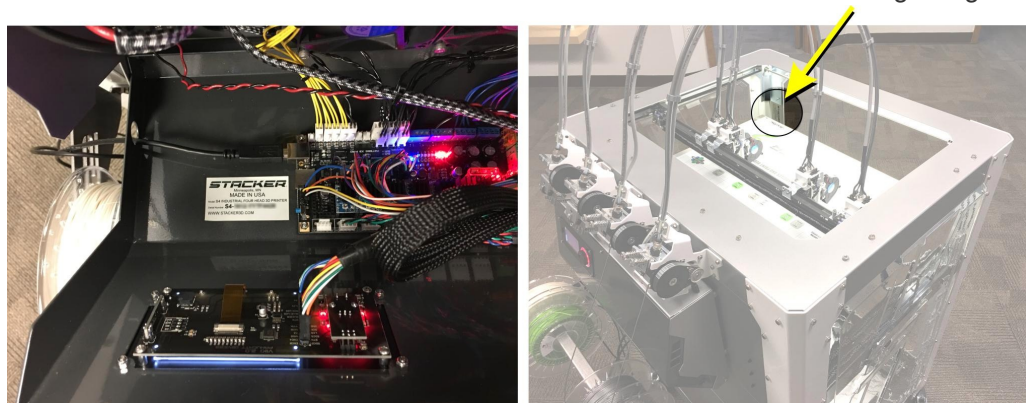
1.2 Software

The 3D objects you will be printing are created using two types of software, (1) computer-aided design (CAD) software and (2) slicing software. The process of using the software is outlined below.

CAD		Slice	Print
Create a model with CAD Software	Export object in .STL format	Import STL model into a Slicing Engine to create .GCODE	Print your object using the .GCODE file

CAD: It is helpful to be familiar with solid modeling CAD applications in order to create and manipulate the parts you want to 3D print. Often a simple design modification or splitting of a model into multiple sections will allow you to print it faster, better, and without the need for support materials. The following list of CAD software is by no means exhaustive, but these programs offer a good balance of power and value, some of which are free and have robust online training and user communities. Nearly all of these apps will export your models to the preferred STL file format.

- SketchUp, Autodesk Meshmixer, Tinkercad
- FreeCAD, openSCAD, Blender

- Autodesk Netfabb, Autodesk Fusion 360, C3D Toolkit, Geomagic Design, Alibr, Autodesk AutoCAD
- SolidWorks, Autodesk Inventor, Solid Edge

Slice: In operating a 3D printer, it is most critical that you have a good understanding of your preferred slicing engine before attempting your own prints. Slicing engines are used to convert an STL file into the GCODE file which operates the printer. A GCODE file provides the commands which enable the printer to print a 3D object. **Stacker RUN** includes two open source slicing engines, **Slic3r** and **Cura**, and both of these slicing engines do a good job. Nevertheless, we highly recommend **Simplify3D**. We have found **Simplify3D** to be one of the best slicing engines available, and we provide a license for a downloadable copy with the purchase of your Stacker 3D Printer. To receive your copy of **Simplify3D**, please be sure to register your printer and contact sales@stacker3d.com.

The links below can help familiarize you with the operation of a slicing engine:

Slic3r   http://manual.slic3r.org/intro/overview

Cura   https://ultimaker.com/en/resources/manuals/software

SIMPLIFY3D®   https://www.simplify3d.com/support/

For assistance setting up a profile for your Stacker 3D printer within your slicing software, please refer to section 9.1.

Stacker RUN software is an enhanced version of *Repetier Host* customized for using Stacker printers. Additional information and **Stacker RUN** software download is available on our website. You can find additional documentation on the Repetier website.

Stacker RUN   http://stacker3d.com/stacker-3d-printer-support

Repetier   http://www.repetier.com/#documantation

If you are interested in controlling your Stacker printer remotely with a laptop, cell phone, tablet or other web enabled device, we recommend **Repetier Server**. Through the combination of a Raspberry Pi and **Repetier Server**, you are able to operate your printer from any web enabled device. Please download the User Guide – Part II for more information.

Repetier Server
Control your 3d printer from everywhere   https://www.repetier-server.com/

1.3 Printer Specifications

	Stacker S4	Stacker S2
PRODUCT		
NUMBER OF EXTRUDERS	4	2
BUILD VOLUME	510mm (X), 365mm (Y), 600mm (Z)	390mm (X), 315mm (Y), 525mm (Z)
WEIGHT	88kg (195 lbs.)	75kg (165 lbs.)
DIMENSIONS	Width: 735mm (29") Depth: 825mm (32½") Height: 1380mm (54")	Width: 610mm (24") Depth: 785mm (31") Height: 1195mm (47")
MACHINE TYPE	Cartesian robot	
FIRMWARE	RepRap Repetier	
PRINT SPEED	1-250mm/sec	
X/Y MOVEMENT SPEED	0 to 250mm/sec	
POSITIONAL ACCURACY X/Y	6 microns	
POSITIONAL ACCURACY Z	4 microns	
LAYER RESOLUTION	0.1mm to 1.0mm	
EXTRUDER TEMPERATURE	Up to 300°C	
HEATED BED TEMPERATURE	Up to 110°C	
STANDARD NOZZLE DIAMETER	0.40mm	
OPTIONAL NOZZLE DIAMETERS	0.25mm, 0.40mm, 0.50mm, 0.60mm, 0.80mm, 1.00mm	
FILAMENT SIZE	1.75mm	
PRINTED MATERIALS	Most filaments which extrude at temperatures below 300°C	
POWER REQUIREMENTS	100-240VAC 8.5 AMP	
INTERNAL VOLTAGE	24VDC/5VDC	
RECOMMENDED UPS SIZE	1000VA or greater	
CONNECTIVITY	USB and SD Card *Wireless and Network with optional Raspberry Pi*	
DEFAULT BAUD RATE	250000	
SOFTWARE LICENCES INCLUDED	Simplify3D and StackerRUN	

2. Warnings

Stacker 3D printers are industrial machines that should never be operated around children or left unattended. Careful setup and training is required for optimal results. Read through this entire User Guide and view online resources before attempting to use your printer. Please note, this printed copy of the User Guide may not be the most up to date version. We recommend downloading the User Guide from our website to confirm you have the most up to date version denoted by the last revision date on the front cover of the User Guide.

Please read and take seriously all Warnings. Unsafe operation of a 3D printer can result in damage to your printer and serious injury to yourself.

Burn Hazard! Do NOT touch hot surfaces!
Both the hot ends and heated bed can get HOT! To prevent burns, avoid touching the hot surfaces of the 3D printer.

Fire Hazard!
Never place flammable materials or liquids on or near the printer. It is your responsibility to operate your printer in a safe manner. To ensure that it is safe, you must incorporate the use of fire and smoke alarms and proper fire suppression technologies like fire extinguishers. Never operate the printer unattended.

Electric Shock Hazard!
The printer must be kept dry. Attempting to operate the printer in a wet environment will damage your printer and could lead to injury. Always power down and disconnect the power cable from your printer before servicing or opening your controller housing.

Static Charge Hazard!
Ground yourself before touching the printer. Static charge can damage your printer's electronic components. Discharge your static before touching your printer!

Pinch Hazard! Keep Hands and Fingers Clear.
During operation, the printer will perform quick and unpredictable movements. To avoid injury, never place your hands, fingers or body near any moving parts of the printer including belts, pulleys, print bed, and hot ends. Be sure to tie back long hair and remove any clothing or jewelry which could become caught in the moving parts of the printer.

Age Warning.
For users under the age of 18, adult supervision is recommended. Printed parts can be a choking hazard for small children. Never operate the printer unattended!

3. Unboxing and Assembly

Your Stacker printer has been shipped in a wooden crate to protect the printer during transit. Should ever need to transport the printer or return it to Stacker for warranty service, we recommend keeping both the crate and packaging materials.

Be very careful when removing printer from the crate – the printer is HEAVY! Begin by removing the Phillips screws to fully detach the top and one side of the crate. Next, remove the hardware box and foam from underneath the printer so that the printer's wheels rest on the floor of the wooden crate. You may need two other people to assist in lifting the printer when removing the foam from beneath the printer. Finally, use the side of the crate as a ramp to roll the printer out from the crate.
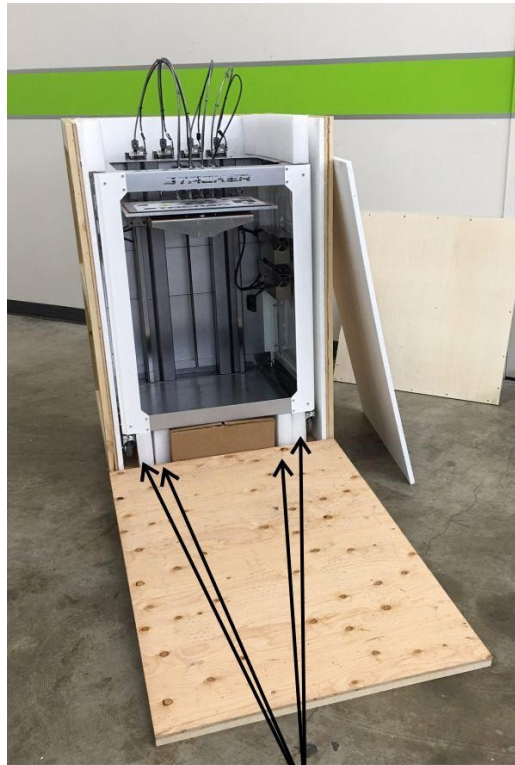
Remove box and four foam pads from beneath the printer, then roll the printer down the ramp.

3.1. Hardware List
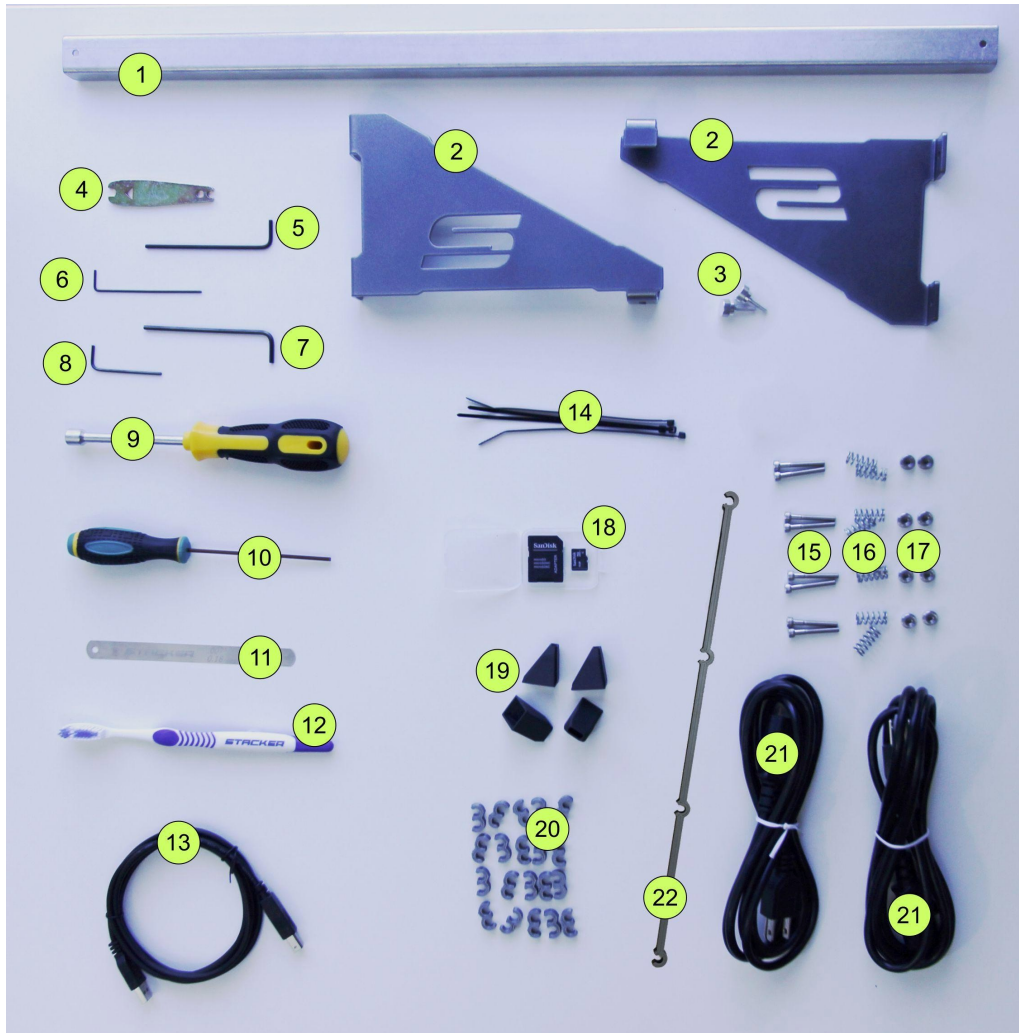
Please note that some of the hardware may already be attached to your printer.
1.	S4 Filament Rail (p/n 30-026) or S2 Filament Rail (p/n 30-180)
2.	Filament Rail Brackets -- Right (p/n 30-095) and Left (p/n 30-098)
3.	(2) Thumbscrews (p/n 40-006)
4.	Nozzle Wrench (p/n 50-069)
5.	3mm Hex Key (p/n 50-032)
6.	1.5mm Hex Key (p/n 50-033)
7.	2.5mm Hex Key (p/n 50-046)
8.	2mm Hex Key (p/n 40-048)
9.	7mm Nut Driver (p/n 50-043)
10.	2.5mm Hex Driver (p/n 50-052)
11.	0.007"/0.18mm Feeler Gauge (p/n 50-051)
12.	Filament Drive Cleaning Brush (p/n 50-044)
13.	USB Cable (p/n 10-042) *pre-installed*
14.	Cable Ties (p/n 10-060)
15.	M4 x 40mm SHCS (p/n 20-071) *pre-installed*
16.	Compression Spring (p/n 20-056) *pre-installed*
17.	M4 Knurled Nut (p/n 20-074) *pre-installed*
18.	SD Card (p/n 10-094)
19.	Blower Fan Duct (p/n 50-071)

20.   Filament Guide Tube Clip (p/n 50-069)
21.   Power Cord (p/n 10-043)
22.   S4 Filament Guide Tube Support Bar (p/n 50-078) or S2 Filament Guide Tube Support Bar (p/n 50-089)

3.2 Assembly

A. Remove Packaging Tape

To protect your printer during shipping, several pieces of low tack tape were attached. **You MUST remove all of this packing tape before attempting to operate the printer.** You will find tape attached to the X-gantry and the Y-gantry on the front of the printer. The USB cord has also been taped to the rear of the printer. After removing the tape, be sure to use a clean dry cloth or rubbing alcohol to remove any tape residue.

B. Rub an oiled cloth along the linear rails and acme screw

The linear rails and acme screw require a thin protective coating of oil to prevent rust and allow optimal performance of the printer. All lubricants eventually break down, and because of shipping, the oil applied at the factory to your printer's linear rails and acme screw may no longer provide adequate protection and lubrication. Therefore, before attempting to operate the printer for the first time, we recommend rubbing an oily rag along the linear rails and acme screw. A coating of synthetic SAE 75W-90 gear oil was applied at the factory. Please free to use a solvent to remove our lubrication and apply your preferred lubricant if you wish.[1]
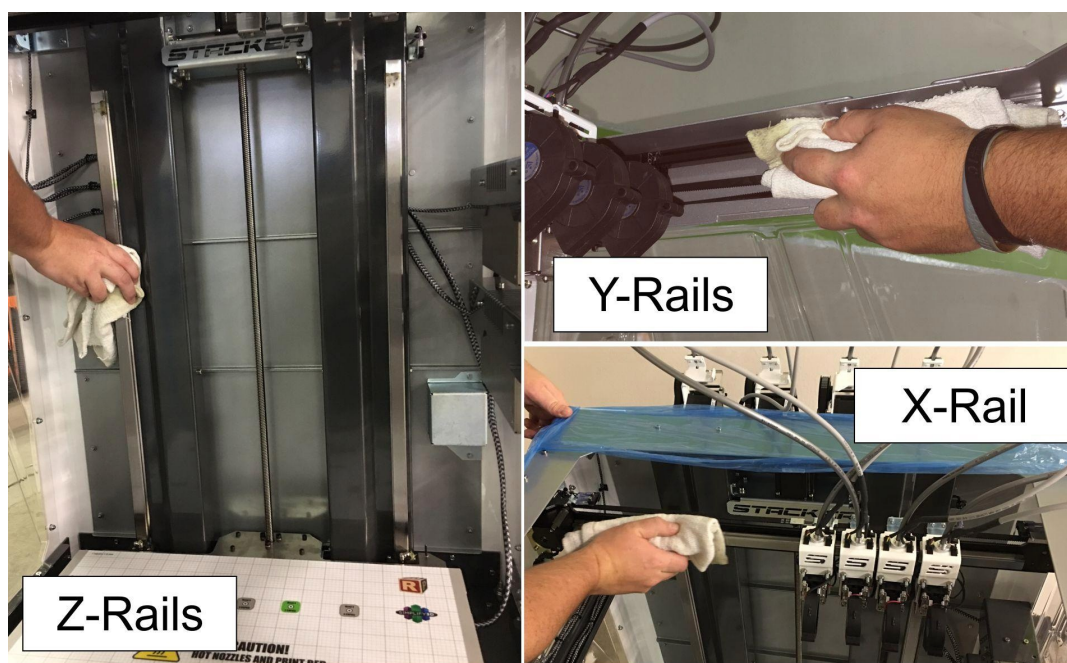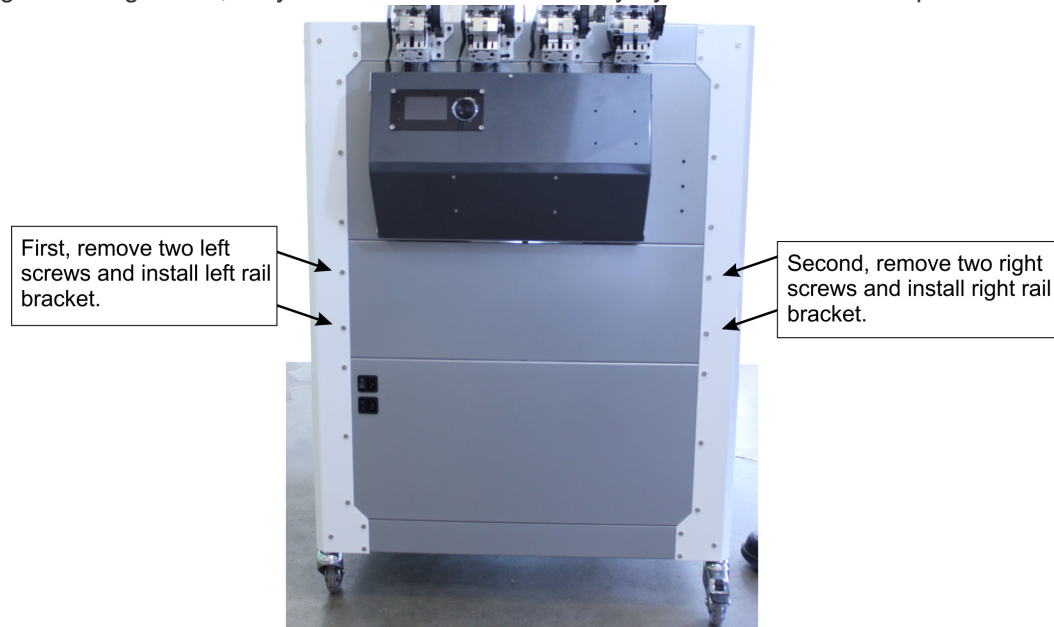

There are two Z-rails, two Y-rails, one X-Rail, and the acme screw. Rub an oiled cloth along all five of these linear rails and the acme screw to assure they are clean and free of debris. For most users, you will likely need to wipe down and apply some oil or grease on a monthly basis. For more information about this routine maintenance, please refer to section 7.

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[1] Note, **do not use WD-40** as a lubricant for linear rails. WD-40 will not provide adequate lubrication.

C. Attach the Universal Filament Rail to the Rear of the Printer

Step 1. Locate the Universal Filament Rail, the two Filament Rail Brackets, and the two Thumbscrews.

Step 2. Use the 3mm hex key to carefully remove two M5 x 12mm Socket Head Cap Screws from the rear left side of the printer frame, see image below. **Remove only the two screws on the left. Remove the screws slowly by hand!** The screws are attached to swage nuts, so to avoid damaging the swage nuts, only remove the screws slowly by hand – do not use power tools**.**

First, remove two left screws and install left rail bracket.

Second, remove two right screws and install right rail bracket.

Step 3. Use the same two screws you removed in Step 2 to attach the left filament guide rail.

Step 4. Remove two M5 x 12mm Socket Head Cap Screws from the rear right side of the printer, and then use these screws to attach the Right Filament Rail Bracket as shown.
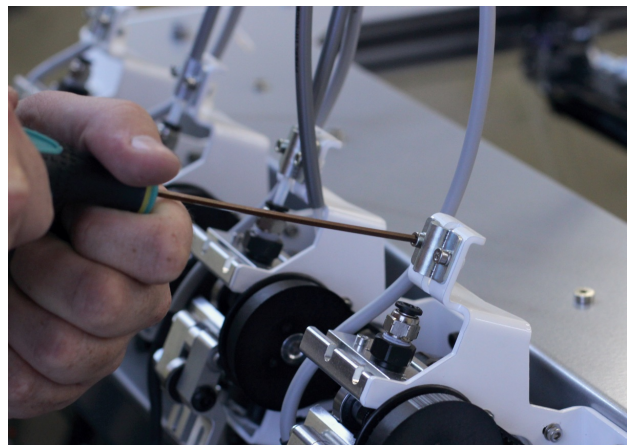
Step 5. Place the Universal Filament Rail on the brackets and secure with the thumb screws.
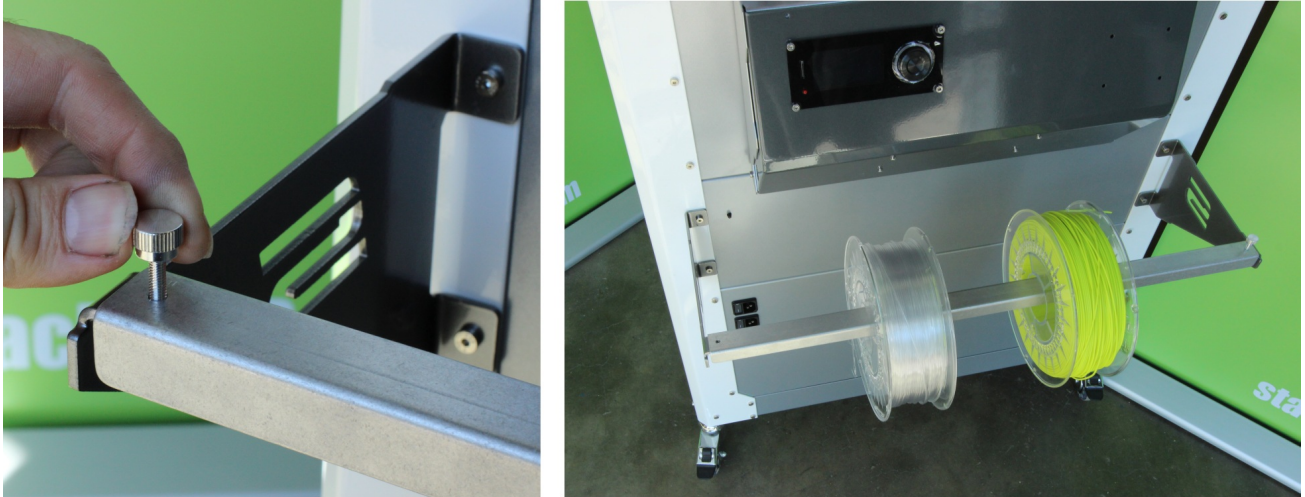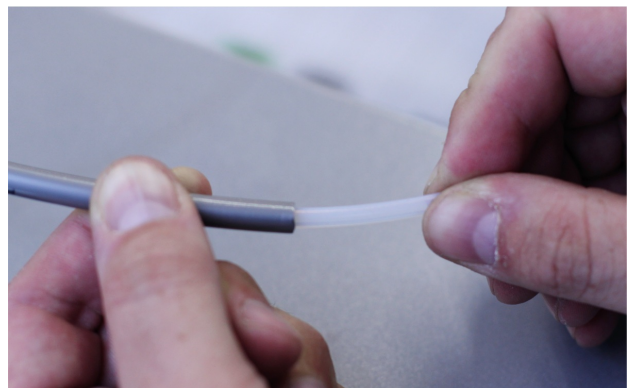

Filament rolls are shown for reference and not included with the printer.
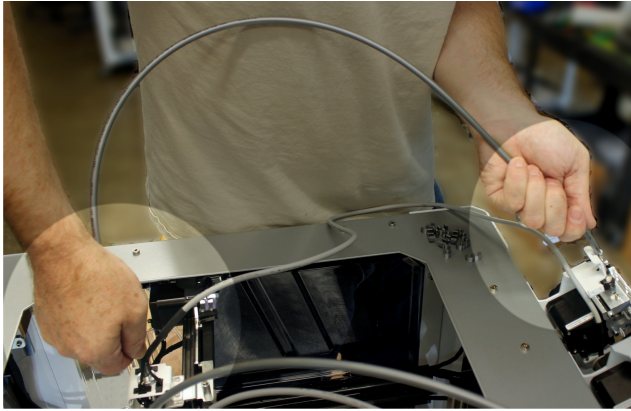
D. Attach the Filament Guide Tubes to filament drives

Step 1. Using the 2.5mm hex driver, loosen the two screws on the filament guide tube mounting bracket.

Step 2. Slide the grey filament guide tube sleeve toward the hot end to remove any slack.

Step 3. Use both hands to hold the grey sleeve as shown below. Push the grey filament guide tube sleeve into the aluminum tube above the hot end and hold it in this position. With your opposite hand, insert the filament guide tube through the filament guide tube mounting bracket and down into the fitting. The filament guide tube will descend approximately 20mm into the fitting.

Step 4. By turning the grey filament guide tube sleeve, you can manipulate the tube's arc. You want the arc to stand as tall as possible.
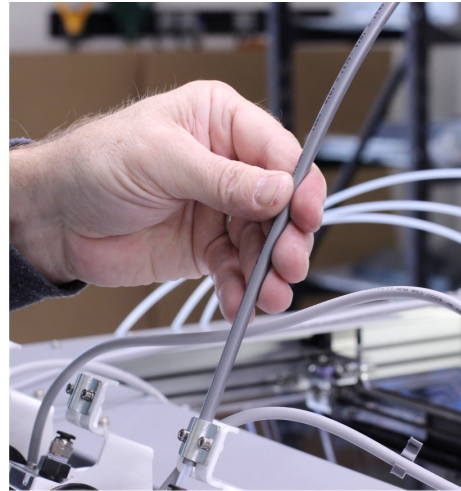
Step 5. Tighten the screws on the filament guide tube bracket to secure the grey sleeve tube.
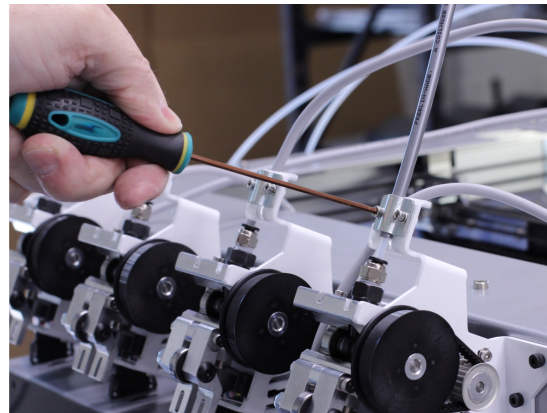
Step 6. Secure the hot end power cable with one cable tie as shown. Trim the tail from the cable tie once it has been tightened.

Step 7. Use the filament guide tube clips to secure the wire harnesses and guide tubes together. Use five clips per guide tube/wire assembly.
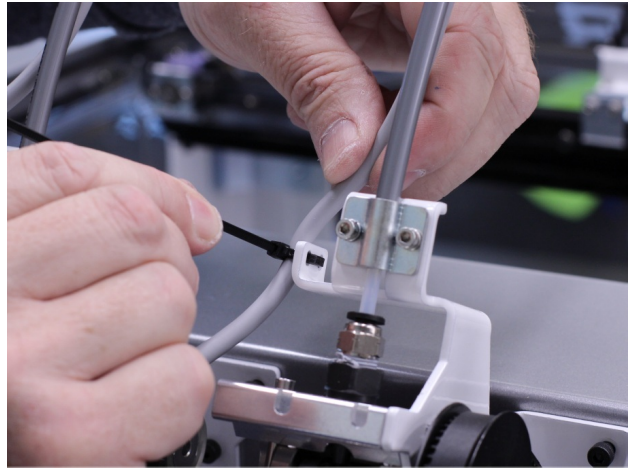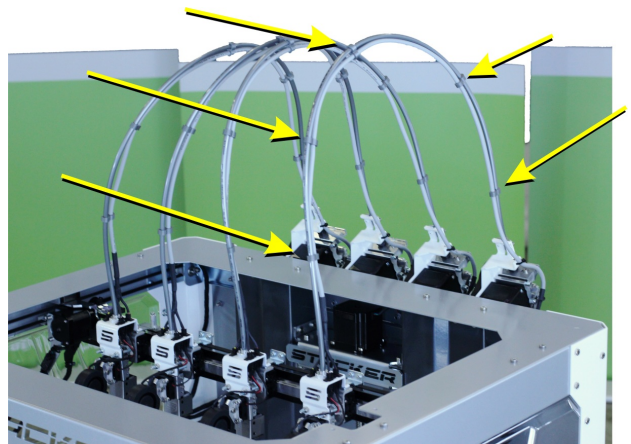

Step 8. Attach the filament guide support tube bar by clipping the bar to the grey filament guide tube sleeves as shown. Note, the location of the filament guide tube bar is below the apex of the arc and toward the rear of the printer to allow full movement of the print heads. The distance from the top of the extruder to the filament guide tube bar should be approximately 235mm for the S4 and 185mm for the S2.

Attach the Filament Guide Tube Support Bar at four locations to the grey filament guide tube sleeves.

≈ 235mm
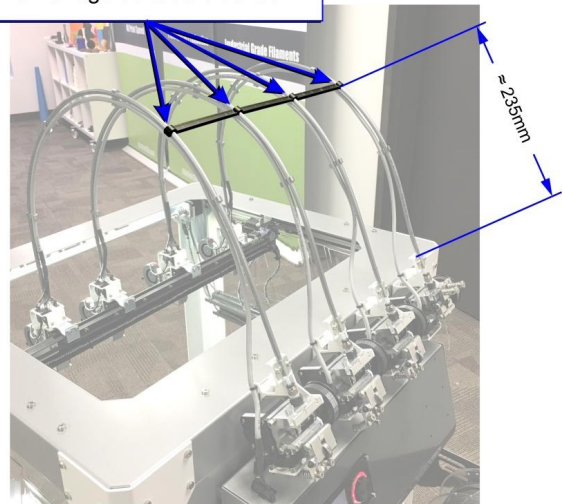
The location of the filament guide tube support bar for the S4 is pictured above.

S4

S2

E. Attach the blower fans Duct:

Although the blower fan ducts are not absolutely necessary, they will improve the cooling performance of the blower fans when pointed directly at the tip of the nozzles. The included blower fan ducts were printed with colorFabb_XT CF20 filament. If you wish to replace these ducts, you can print them with your 3D printer. Two versions of the STL file are available on our website.

- ▸   http://stacker3d.com/stl/blower-duct-solid.stl
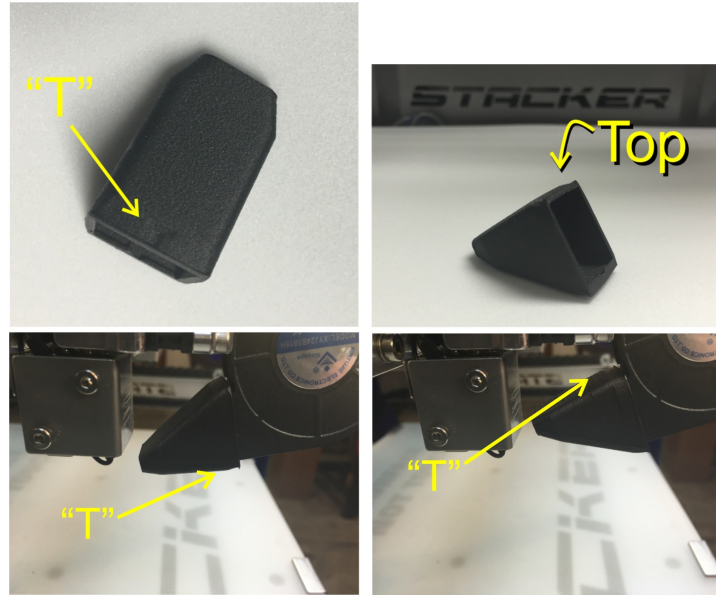- ▸   http://stacker3d.com/stl/blower-duct-1mm-wall.stl

When attaching the blower duct, make sure it is attached with the proper orientation, otherwise the blower duct will scrape on the bed.

The blower duct has a small "T" printed on the top to help identify the top.

Incorrect!
Bower Upside Down

Correct

F. Connect Power Cords

The Stacker S4 uses two and the Stacker S2 uses one C13 power connector. The C13 is a common "computer" type power cord widely available throughout the world to fit your specific power outlets. If you are not using North American 115V AC power and outlets, please purchase a proper cord type at your local electronics store or online retailer.

For typical operation, the Stacker printer should have at least one dedicated 20 AMP circuit. The power supply is auto switching and will accept 115 to 230 volts of AC power. For the data sheet on your power supply, please refer to Part II of the User Guide

3.3. Uninterruptible Power Supply (UPS)

We **strongly advise** the use of a 1000VA or greater uninterruptible power supply (UPS) with your printer. Any sudden loss of power, no matter how brief, will likely cause the electronics in your printer to reset, and this will ruin your print. If you want to avoid the pain and suffering associated with losing a multi-hour print, then we recommend a UPS. Furthermore, power spikes and

brownouts can damage the printer's electronics. Any good quality UPS will save you from momentary power loss or brownouts and will protect your printer from potential damage. We cannot stress enough the importance of this very inexpensive insurance. Uninterruptible power supplies (UPS) are widely available from computer and electronics retailers.

4. Your First Test Print

After you have completed all of the assembly steps in Chapter 3, you are ready to run a test print. Running a test print is the best method of familiarizing yourself with the printer and to confirm it is properly calibrated. The following steps will also help teach you the basic steps used to produce a print.

4.1. Running Your First Print

A. Download and Copy GCODE to an SD Card

In most cases, you will be creating your own GCODE by using a slicing engine such as Simplify3D, but for this test print, we recommend using our GCODE because it should provide proven results. To download the test print GCODE, go to http://stacker3d.com/stacker-3d-printer-support/ and select a test print GCODE file which matches the filament you will be using. Please note, if you click on the link, your web browser may attempt to open the GCODE file as text within the browser. In order to save the file to your computer, right click on the file link and select "save link as…" to download the file to your computer.

Next, transfer the downloaded GCODE file from your computer to the provided SD card. If your computer does not have an SD card slot, you can purchase an inexpensive pocket sized SD card reader that will work with an available USB port on your computer.

B. Power Up Printer

The Stacker S4 has two power supplies and two power switches (one for each power supply), be sure to turn on **both** power switches. The printer will will not operate if only one of the power switches is turned on.

PLEASE BE AWARE! If the printer is ever behaves in a manner in which could cause damage to itself or others, immediately press the Reset/Emergency Stop button. The Reset/Emergency Stop button will disable the printer's motors, hot ends, and heated bed. Unplugging or turning off the printer during operation can cause damage to the printer. It is best practice to use the reset button to stop the printer.

RESET/EMERGENCY STOP RED BUTTON
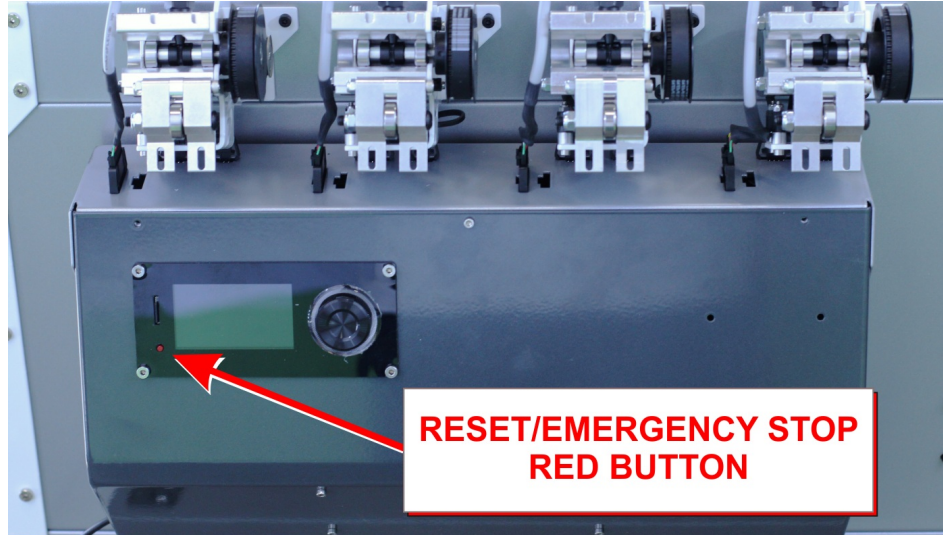
C. Load Filament

Step 1. Load Filament Spool. Loosen and remove one of the thumbscrew on the Universal Filament Rail then carefully lift one side of the Rail to slide the spool of filament onto the Rail. Reattach the Filament Rail thumbscrew to secure the rail in place. Place the filament rolls so the filament goes over the top of the roll as shown by the right image below.
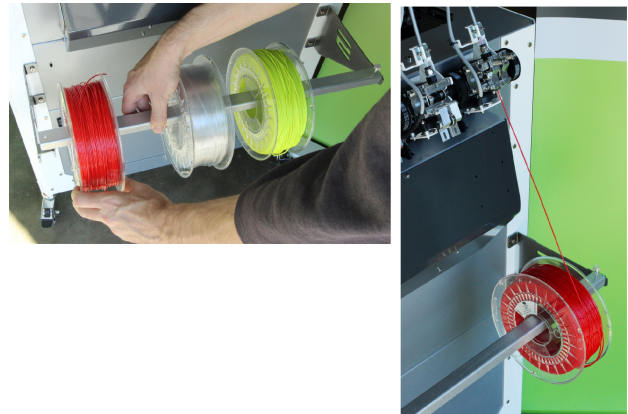
Please note, filament is shown as an example and was not included with your printer.

Step 2. Preheat the print bed and hot end. Every filament has an optimal extruding temperature. Please refer to Section 9.2 to see the recommended settings for a variety of filaments. In this example, we have selected to use colorFabb PLA/PHA filament for our test print.

To preheat the bed and nozzle, begin by depressing the knob next to the LCD panel to open the LCD menu. Next, turn the knob to highlight **Extruder**, then push the knob to enter the Extruder sub-menu.
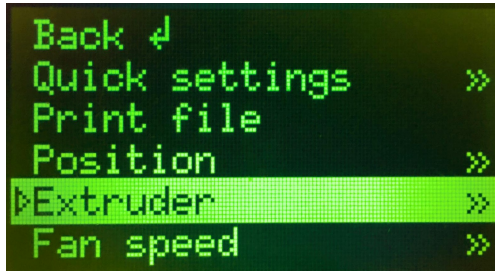
From the Extruder sub-menu, select **Bed temp**. Once selected, you can dial the temperature to where you want it, then push the dial to set the temperature and the printer will immediately begin to warm the bed to the temperature you requested. In our example, we have called for a bed temperature of 50°C.

Next, in the same way you adjusted the bed temperature, dial the knob and set the temperature for **Temp. 1** which sets the nozzle temperature for the first extruder. In our example below, we have called for a temperature to 220°C. Note, the current temperature of the hot end in the image below is 34.3°C and rising to 220°C
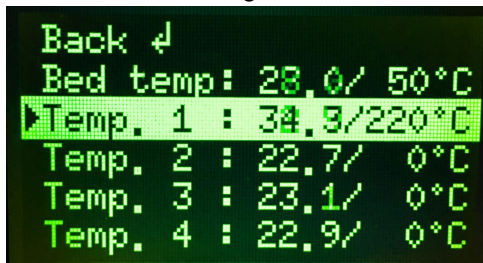
Step 3. Insert the filament. Before you will be able to insert filament into the filament drive, you will need to open the idler assembly. Use both hands to push and compress the springs then lift the heads of the bolts from the bracket.
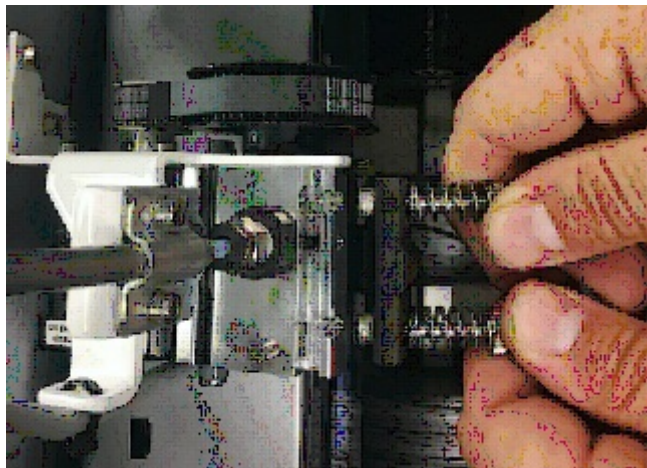
With the filament drive idler assembly open, insert and push the filament upward by hand through the small hole beneath the filament gear then continue upward past the gear and through the filament guide just above the gear.
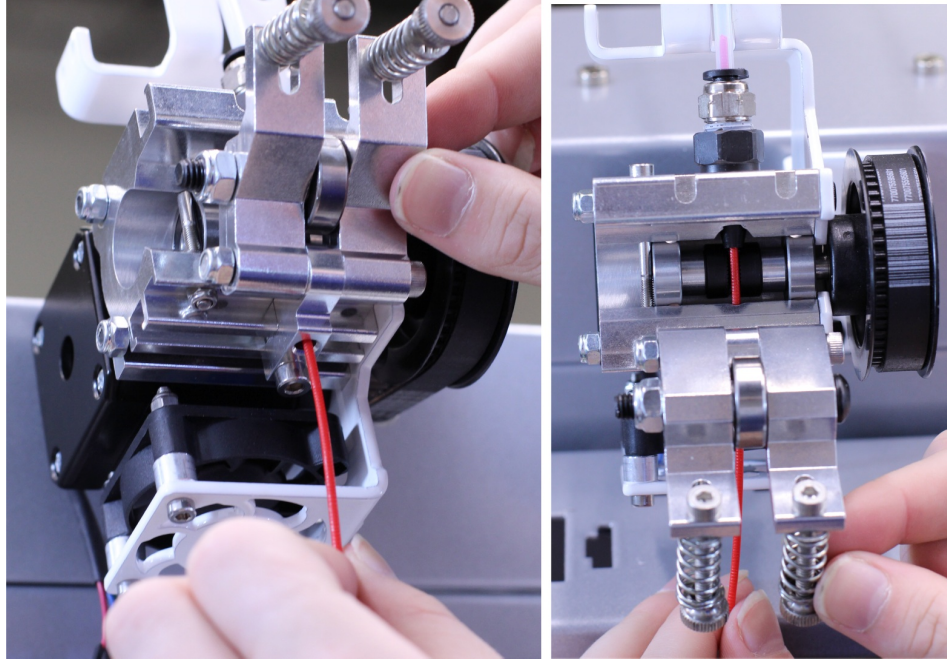
Please note, if filament has already been installed and you wish to remove it. You must wait for the hot end to reach the appropriate temperature to melt the filament before you will be able to pull the filament by hand and remove it from the nozzle, filament guide tube, and extruder.

Step 4. Extrude filament by hand. When extruder 1 has reached the temperature needed for your filament, you will be able to prime the nozzle by gently pushing the filament by hand through the filament guide tube. Note, if extruder 1 has not reached the temperature required to melt the filament, it will be difficult (if not impossible) to push the filament through the nozzle.

By pushing a small amount of filament by hand through the nozzle, you will visually verify that the nozzle is primed and ready to print. Please note, when you initially extrude by hand, you may see a color of filament extruded from the nozzle which does not match the filament you are using. Do not be alarmed. You are seeing the remnants of the filament used during your printer's initial calibration and testing at Stacker. You may continue pushing by hand until you see your color of filament extrude from the nozzle.
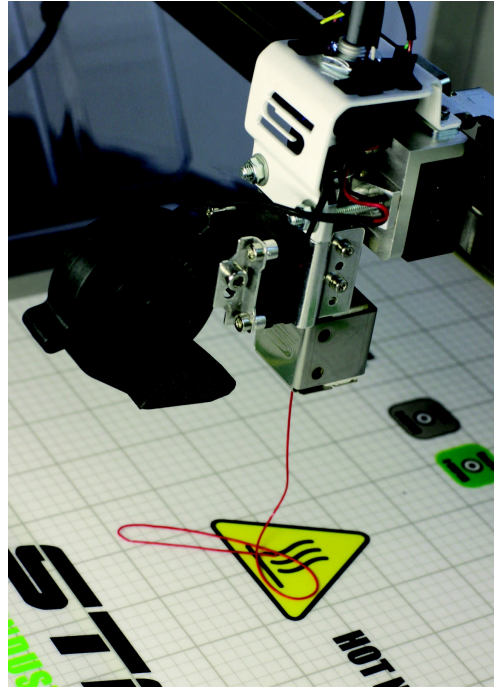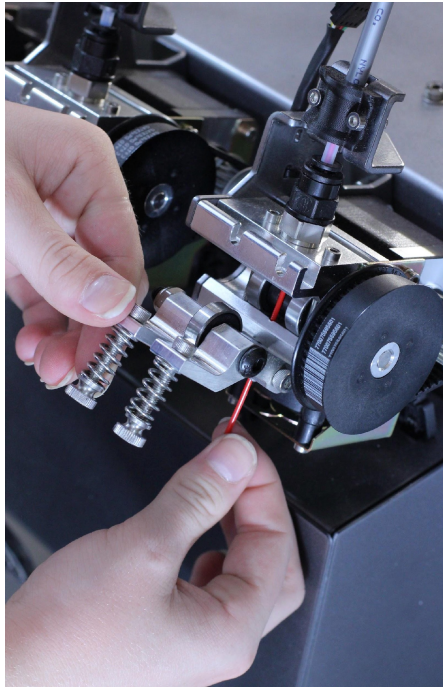
Step 5. Secure the Filament Idler Assembly. To close the Idler Assembly, lock the two heads of the screws into the Filament Idler Assembly. For proper spring tension, the M4 Knurled Nut should be flush with the end of the 40mm SHCS.

Compression Spring

40mm SHCS

M4 Knurled Nuts (pair)
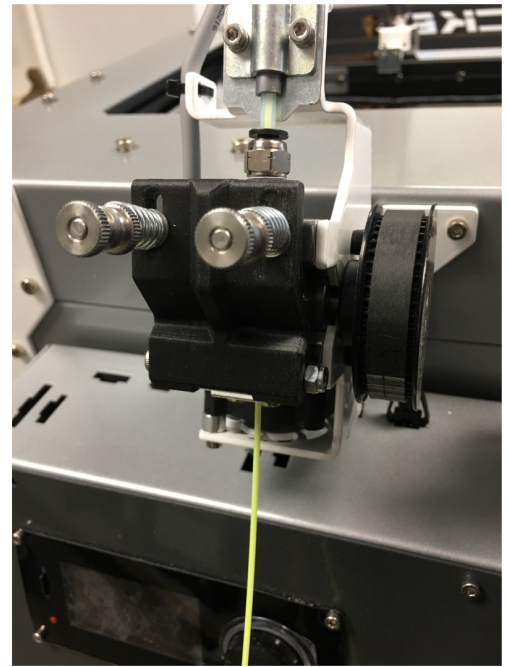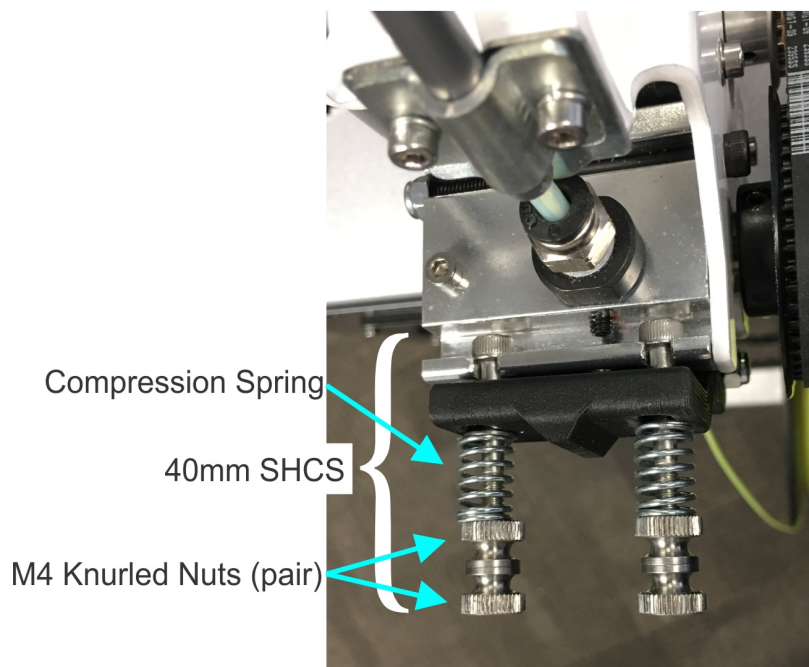
D. FINAL CHECK! Make Sure the Print Bed is Clear and Heads are Properly Positioned to Start your Print

⚠️ **You should always double check your print bed to confirm that it is clear of tools and printed objects before starting a print.**

Stacker performed a test print at our factory, and the test print may still be on the print bed. Confirm the test print has been removed before attempting your test print.

With your first print, you will only be using one printhead. It is best practice to slide the three unused heads to the right side of the gantry away from the printing head.

Important, you do not want the unused heads to trip the X-Max End Stop. If you trip the X-Max End Stop, your printer will think it has reached the edge of the bed at the beginning of the print, and it will only print a single line of filament along the left edge of the print bed. Be careful to avoid tripping the X-Max End Stop with unused heads.

X-Max Endstop
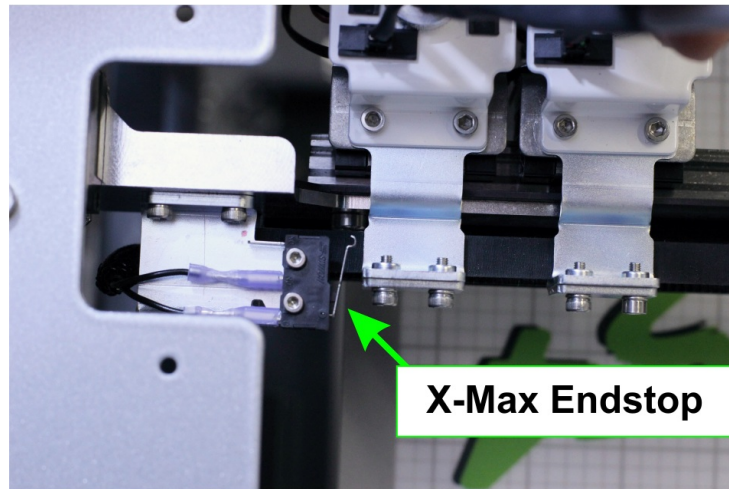
Note, the Guard Plate has been removed to show the endstop, do not operate your printer without the guard plate in place.

E. Insert the SD Card and Select the File

To start your print, carefully insert the microSD card into the controller. When inserting the microSD card into the slot, make sure the orientation of the card is correct. DO NOT FORCE THE CARD OR INSERT THE CARD CROOKED!! If you damage to your SD card reader, it is not covered by the warranty.

⚠ ATTENTION!

Before inserting a microSD card, always make sure the card is orientated correctly. Never force a microSD card into the slot or you will damage the card reader. Damage resulting from improper insertion of a microSD card is not not covered by warranty.

Insert microSD card with care
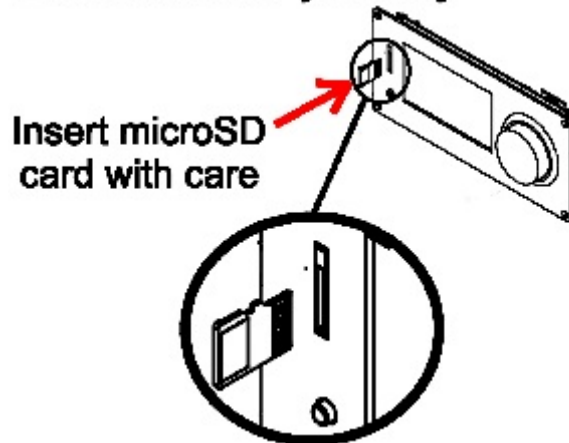
Whenever an SD card is inserted, a menu of available files will appear on the LCD. Turn and depress the knob to select the GCODE file you wish to print. Once the knob has been pressed, the selected GCODE file will begin to run as soon as the bed and nozzles have reach the temperatures specified by the GCODE file.

Insert microSD Card
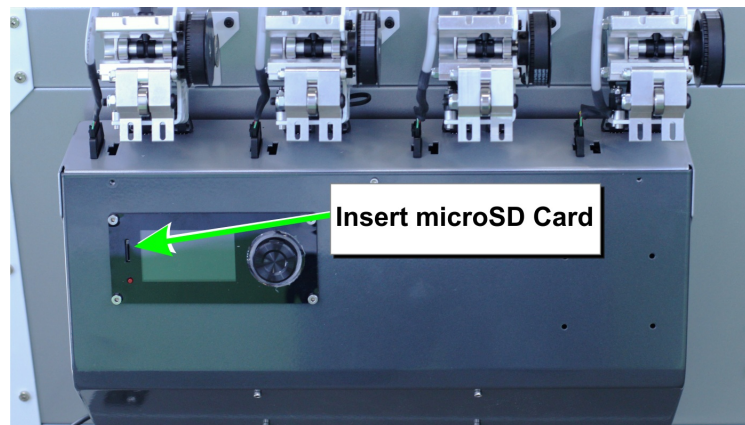
F. Watch your Test Print

While your print is running, watch for any problems with the printer. Although the printer was calibrated prior to shipping, calibration can sometimes be thrown off during shipping. If the printer is not performing adequately, calibration may be necessary to improve print quality. For calibration instructions turn Chapter 6. Please contact info@stacker3d.com if you have any questions.

If something seems seriously wrong with the printer, such as the nozzles crashing or scraping on the bed, you should immediately press Reset/Emergency Stop button.

RESET/EMERGENCY STOP
RED BUTTON
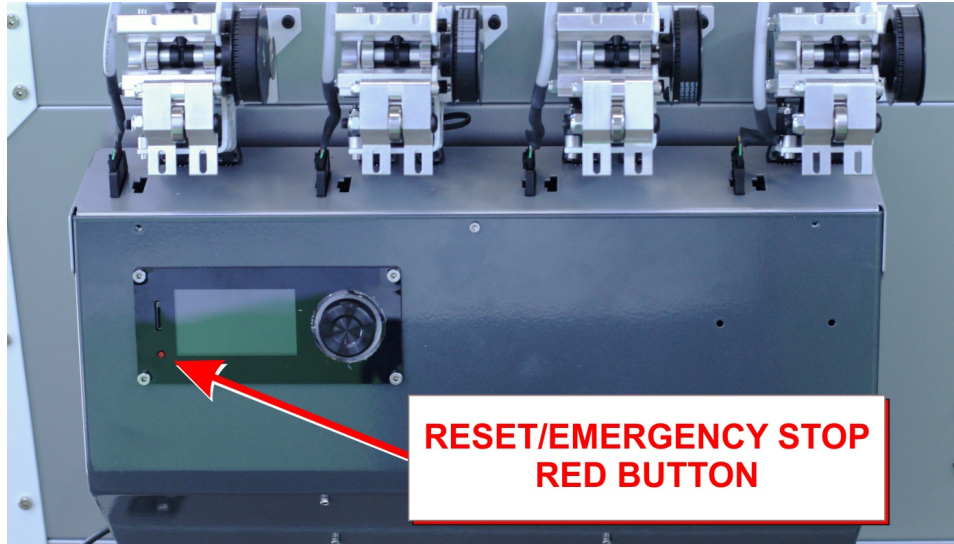
G. Removing your Test Print from the Print Bed

It is sometimes difficult to remove a printed object from the BuildTak. If you allow the bed to fully cool, it can sometimes make print removal easier. Also, using the BuildTak Spatula (sold separately) is a very useful tool which allows you to pry your parts from the build plate.

BuildTak Spatula
p/n 90-050

Sharpened Paint Scraper

Another available option for easy part removal is the BuildTak FlexPlate. The FlexPlate is a removable build plate which enables you to literally "pop" your parts off the BuildTak. Please check our website for the S2 and S4 FlexPlate systems.

4.2. Turning Off the Printer

When turning off your printer, **wait for the cooling fans to fully cool your hot ends before turning off the printer**. You can observe the temperatures on the LCD. Turning off the printer with hot extruders can damage your printer. Proper cooling is necessary to prolong the life of your hot ends. We recommend allowing hot ends to cool below 50°C before turning off the power to the printer.

4.3. Troubleshooting Poor Quality Prints

Common Problem	Possible Solution	Read Section
Print Failed to Stick to the bed	Nozzle too far from bed, adjust the layer height	6.1
	Clean the BuildTak	5.3
	Adjust the speed/flow of the print	PART II
Filament Stripped out in Extruder	Nozzle too close to bed, adjust layer height	6.1
	Clean the drive gear	6.2.B. Step 2
	Confirm the filament guide tube is properly seated inside the nozzle	6.1
	Reduce the print speed	PART II
Filament Oozing/Failing to retract	Confirm the filament guide tube is properly seated inside the nozzle	6.1
	Adjust the retraction settings in your GCODE	software

You can find good images and recommendations for improving print quality on the Simplify3D print quality troubleshooting guide.

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

5. Changing Nozzles, Filament Guide Tubes, and BuildTak

Your Stacker printer comes with 0.40mm mid temp nozzles pre-installed. We recommend experimenting with different nozzle sizes because changing your nozzle size can increase print speeds (with larger nozzle sizes) or improve the fine detail of your prints (with smaller nozzle sizes). A variety of nozzles are available from our website http://stacker3d.com/product/3d-printer-nozzles/.

Although nozzles and filament guide tubes can last for hundreds of hours of operation, both the nozzles and filament guide tubes are wear parts which will eventually need to be replaced to maintain optimal printing performance.

The following steps will instruct you on how to properly remove and install new nozzles and filament guide tubes. Please follow these steps VERY CAREFULLY. Improper installation of nozzles or filament guide tubes will result in poor quality prints and filament jams.

5.1. Removing Nozzles

Step 1. Remove filament. From the LCD controller, depress the knob to open the menu, then turn and depress the knob to select **Extruder**.
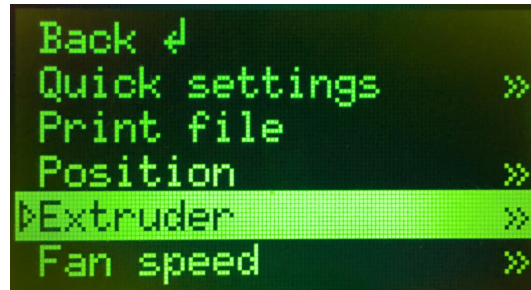
From the Extruder sub-menu, set the temperature for the nozzles you will be removing. The temperature should be the same as the type of filament which is in the nozzle. In our example, we are changing nozzles on head 1, so we have set the temperature for extruder 1 to 220°C because we have been using PLA/PHA with our nozzles.
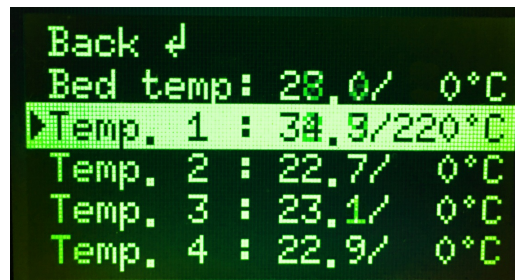
When the nozzle is hot, release the filament drive idler assembly and pull out the filament by hand. Remove the filament completely from the filament guide tube by hand by pulling the filament out of the guide tube.
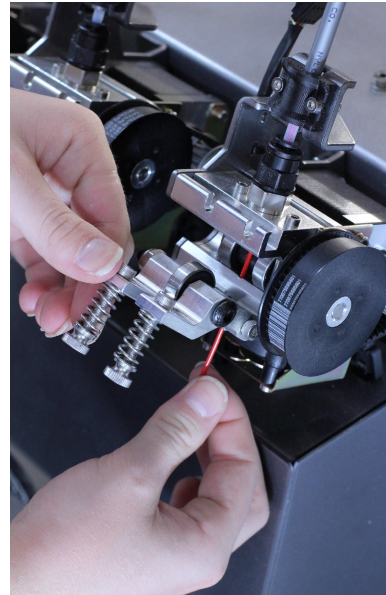
Note: Whenever you return filament to a spool, **avoid filament crossover** by pushing the end of the filament through one of the side holes on the filament spool. Filament crossover will prevent the filament from feeding and cause the printer to jam

Step 2. Clean up any filament around the tip of the nozzle. While the nozzle is hot, use a dry cloth to wipe any melted filament from the nozzle and underside of the heater block. NOTE, THE NOZZLE IS HOT! PROTECT YOURSELF FROM GETTING BURNED! You will want to thoroughly remove all the filament from underneath the hot end. If you fail to remove all of the filament, you may experience difficulty removing the heater block in Step 6.

After the nozzle and heater block are clean, TURN OFF THE EXTRUDER and wait for it to cool. Pressing the Reset/Emergency Stop button will turn off all of the extruders.

IMPORTANT: Turn off the heat and wait until the hot end has cooled down before proceeding with the next step!

Step 3. Remove the Filament Guide Tube Clips and Filament Guide Tube Support Bar. Detach the filament guide tube clips and the filament guide tube support bar from the grey filament guide tube sleeve.

Step 4. Remove the Filament Guide Tube from the Filament Drive. Loosen the filament guide tube support bracket, and then depress the push-fit type fitting with your finger while pulling the filament guide tube up and out of the fitting. Once the filament guide tube is removed from the fitting, remove the grey filament guide tube sleeve by sliding if off the filament guide tube.
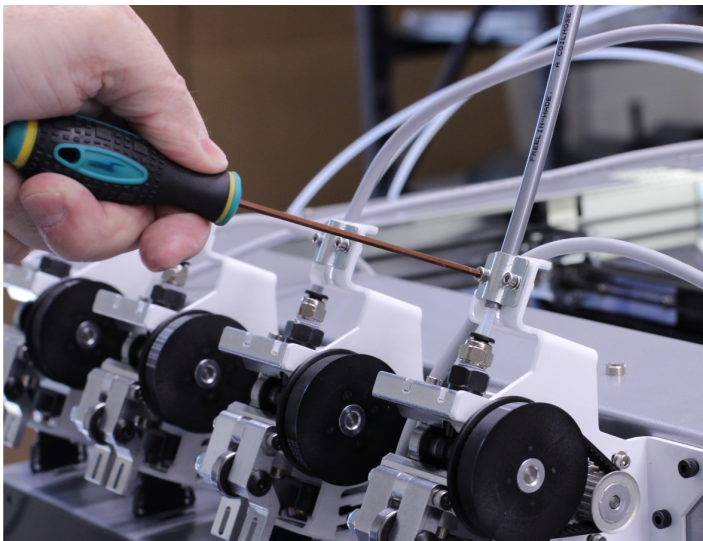
Step 5. Remove the filament guide tube from the nozzle. Use the supplied nozzle wrench or a 5mm open end wrench to release the grip on the push-type fitting on the top of the hot end heat sink. With the fitting compressed, gently pull up on the filament guide tube until it releases from the nozzle. Pull the tube all the way out and set it aside.

Step 5a. What to do if your tube is stuck. If the guide tube is stuck into the nozzle you must remove the nozzle and guide tube TOGETHER. Continue following steps with the guide tube inside the nozzle. In a later step you will be instructed to use a pliers to remove the filament guide tube from the nozzle.
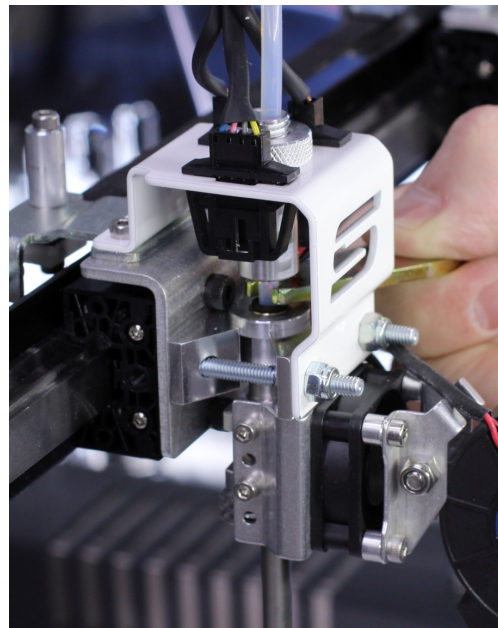
Step 6. Remove the heater block assembly.
First disconnect the electrical connector with your fingernail by pressing down on the tab and sliding off the connector. DO NOT USE A PLIERS because pliers can easily damage these small plastic connectors.

Next, using a 1.5mm hex wrench, loosen the two heater block screws on the right side of the block. These screws hold the block to the nozzle. Once loosened, the heater block should slide down off the nozzle. If the heater block will not slide down, then loosen the two screws a little more until the heater block is free. **Be careful not to drop the heater block because dropping the block can cause damage to heater block's electronics.**
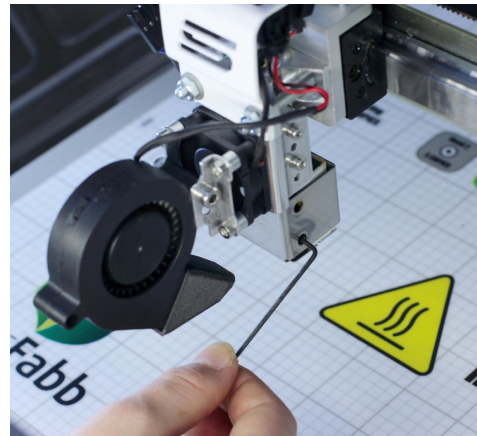
Step 7. Remove the nozzle. To loosen the nozzle from the heat sink, use the supplied nozzle wrench or a 5mm open end wrench to turn the nozzle counterclockwise. Once you loosen the nozzle with the wrench, you can turn with your fingers unit it is removed.
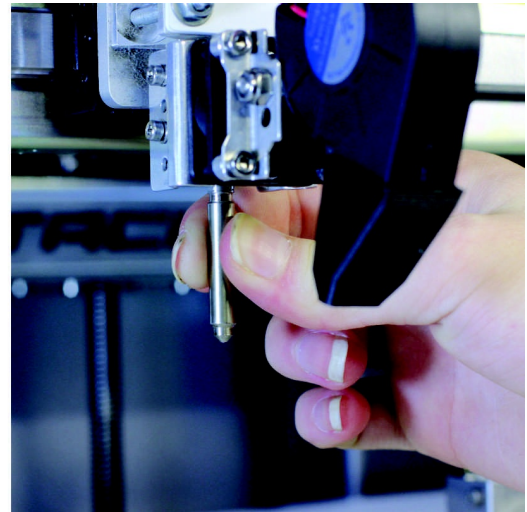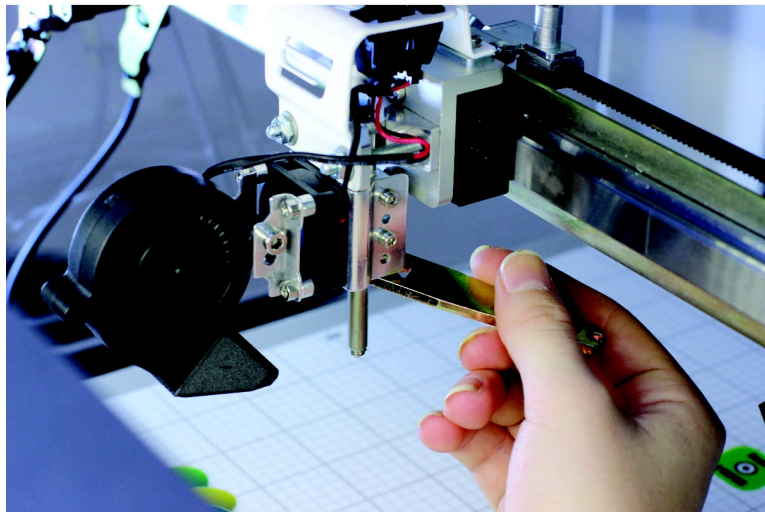
Step 7a. Removing the nozzle when the Filament Guide Tube is stuck. If the filament guide tube is still connected to the nozzle because it was stuck (from Step 5a), no worries. Just let the tube rotate along with the nozzle as you unscrew it with the wrench. Once the nozzle is removed, twist and turn the guide tube until it can be removed from the nozzle. You may need to use a pliers to remove the filament guide tube if it is stuck in the nozzle.

SPECIAL NOTE ON REPLACING FILAMENT GUIDE TUBES. After many hours of use at high temperatures the filament guide tubes may degrade and get stuck inside the nozzle. If you are unable to remove the filament guide tubes by hand, use a pliers. If the tube is damaged during removal, then trim the damaged portion above the point where you gripped it with the pliers. You can usually trim the end of the tube once or twice before the tube becomes too short for use. We recommend trimming the end of your tube with a sharp knife at a 90° angle to ensure the end of the tube properly seals within the nozzle. Make absolutely sure your trim cut is perfectly square. When in doubt, purchase a new Filament Guide Tube.

Filament Guide tubes are sold in lengths of 980mm which is the ideal length for the Stacker S4. With the Stacker S2, you should trim new filament guide tubes from 980mm to a length of 875mm before using.

5.2. Installing Nozzles

Step 1. Confirm nozzle is clear. Look down into nozzle to confirm that it is clear of filament. The image in Step 3 below shows where a filament plug can occur inside the nozzle when it is improperly installed. If you are unable to clearly see the metal surface inside the nozzle where the filament guide tube seats, then you will need to use a different nozzle.
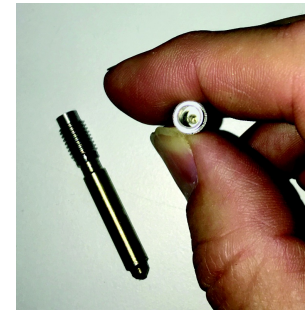
Step 2. Seat and Back out the Nozzle. Screw the nozzle into the heat sink by hand until it is fully seated. Once the nozzle is finger tight, reverse (and loosen) the nozzle ONE-AND-SEVEN-EIGHTS REVOLUTIONS.

Step 3. Insert the filament guide tube. Check the end of the filament guide tube to be sure it is cut square and in good condition. If the tube is not in perfect condition, trim the damaged portion of the tube with a sharp knife at a 90° angle. Install the filament guide tube, and push it all the way into the nozzle. Make sure the filament guide tube is seated at the bottom of the nozzle! If the guide tube is not fully seated within the nozzle, problems can occur with filament extrusion.

SEAT THE TUBE

You must insert the filament guide tube so that it is seated and making contact inside the nozzle. In the left image, the entire blue area shows where the filament guide tube must be positioned.

AVOID THE VOID

If the filament guide tube is not fully seated within the nozzle, the void area will fill with filament and create a plug. A plug will negitively affect retraction and can eventually clog the nozzle.

Step 4. Tighten the nozzle. Use your finger to tighten the nozzle, then use the nozzle wrench to turn and secure the nozzle. DO NOT OVERTIGHTEN! Just turn the nozzle till it is snug. With the nozzle snug, look at the filament guide tube to see that the push-type fitting was lifted by the filament guide tube.

When the nozzle is turned, the push fitting will lift.
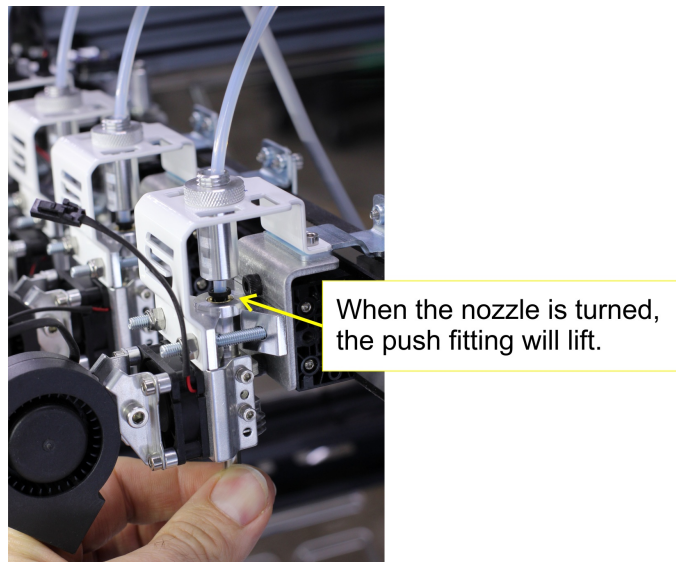
Finally, test for "play" in the filament guide tube system. Take the filament guide tube with your fingers and pull up and push down. While you push and pull, make sure there is no movement in the tube. If the tube and fitting moves up and down, even a little bit, remove the nozzle and go back to Step 1 and carefully redo each step again.
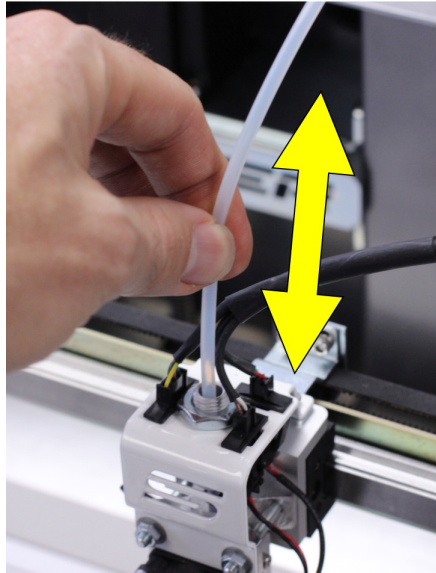
Pull the filament guide tube up and down while watching the push fitting. If you see movement in the push fitting, then there is "play" in your system.
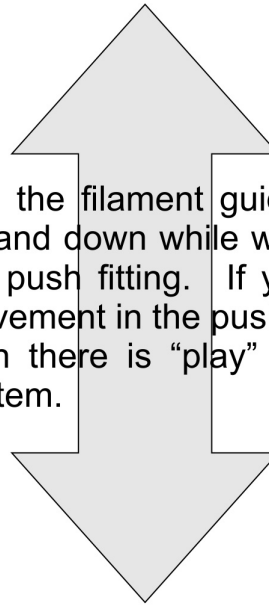
Step 5. Replace the grey filament guide tube sleeves. To complete the installation of the new filament guide tubes, follow the steps in Section **3.1.D. Attach the Filament Guide Tubes to filament drives.**
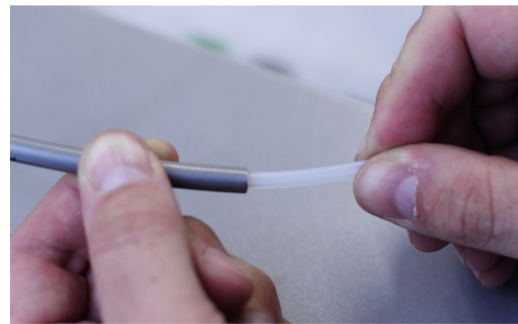
5.3. Replacing BuildTak

Your print bed is covered by a thin, durable plastic sheet of BuildTak that adheres to the aluminum bed. If treated with care, this BuildTak sheet can last for a very long time, but when parts are hastily scrapped from the build surface, it is possible to damage your BuildTak. Furthermore, the BuildTak surface will gradually become less reliable over time with heavy use in the same locations. Shifting the position of parts in your GCODE can reduce the wear upon your BuildTak in a single location.

If you wish to clean the BuildTak surface, wipe it down with isopropyl rubbing alcohol. **DO NOT use acetone** because acetone will destroy the BuildTak.

Replacement BuildTak sheets for Stacker 3D printers are available at www.stacker3d.com.

To replace a sheet of BuildTak,
1. Heat the bed to 50°C.
2. Peel the old worn sheet of BuildTak from the aluminum bed.
3. Use isopropyl rubbing alcohol and a clean cloth to wipe the aluminum bed clean.

4. Carefully peel the backing from the new BuildTak sheet.
5. Starting at the front edge of the bed, slowly attach the new sheet while using a plastic paint scraper to flatten the sheet and remove any air bubbles. Working slowly and methodically will ultimately provide the best and flattest printing surface.

5.4 Installing Glass Build Plate

For users who choose to purchase a glass build plate, the optional kit is available on our website and provides four padded brackets to secure the glass during printing. For installation instructions, please download the User Guide – Part II from our support page.

6. Printer Calibration

6.1. Adjusting First Layer Height

First layer height is critically important to 3D printing. When the printer is calibrated correctly, the first layer has a perfect amount of "squish". If your nozzle is too far away from the print bed, the filament will not adhere properly to the print bed, and if the nozzle is too close to the print bed, the filament will be unable to come out of the nozzle and this will inevitably result in the filament stripping out on the drive gear. Therefore, you want to set all the nozzles at the perfect height.

Although you can alter the layer height in your slicing software, it is always best practice to have your printer's actual (mechanical) layer height set perfectly.

Before making any adjustments to your printer, you should first check the gap between the nozzle and bed with the 0.007"/0.18mm feeler gauge. When sliding the feeler gauge between the nozzle tip and the bed, you should feel a small amount of friction from the nozzle tip. If there is no friction, then the nozzle is too high, and if you are unable to slip the gauge between the nozzle and the bed, then the nozzle is too close to the bed. Be aware that heating the bed will make a difference in the gap between the nozzle and the bed, so for a more precise test, you should heat the bed to the temperature you will be using for your print.

When confirming the gap between the bed and nozzle, all four nozzles should have the same gap. By sliding the feeler gauge between each nozzle and the bed, the friction you feel should be very similar. If you notice inconsistency in the gaps when comparing nozzles, you might need to perform some advanced basic calibration (see section 8.1) to make sure all of the nozzles have equal gaps.

The nozzle gap is easily changed by turning the Z-height adjustment screw with a 2.5mm hex wrench. Turning the screw clockwise (making the screw go upward) will LOWER the bed upon rehoming the Z-axis (increase first layer height). Turning the knob counterclockwise will RAISE the bed into the nozzles upon rehoming the Z-axis (decreasing first layer height). Each full rotation of the Z-height adjustment screw will change the layer height by ±0.2756"/0.7mm, so making quarter-turn adjustments is often sufficient to make noticeable changes in the first layer height.

Z-Min End Stop
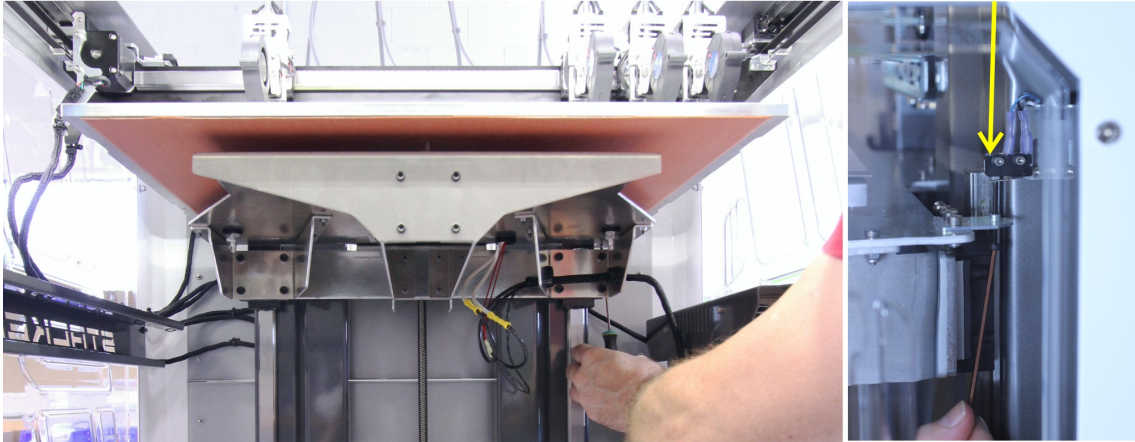
After making any change to the Z-height adjustment screw, you will need to re-home the Z-Axis with either Stacker RUN or the LCD controller (**Main Menu » Position Home Z)** and then test the nozzle gap again. **It is good practice to move the gantry all the way forward on the printer, so the nozzles cannot crash into the bed if you have adjusted the Z-height incorrectly.** Keep in mind, it may take multiple attempts at turning the Z-height adjustment screw before you determine the perfect position.

6.2. STACKER RUN

To assist with printer calibration, it is necessary to download and install **Stacker RUN** software which is available for free on our website.

http://stacker3d.com/stacker-3d-printer-support/

Stacker RUN software is an enhanced version of *Repetier Host* customized for using Stacker printers. Most of the installation and documentation available from the Repetier website is applicable. To familiarize yourself with *Repetier Host*, please visit their website.

https://www.repetier.com/#documantation

Your printer connects and communicated to Stacker RUN using the provided USB cable. *If the USB cable is not connected to your printer, please see Part II of the User Guide for instructions on how to reattach the USB cable*.

Before attempting to use Stacker RUN, **make sure you do not have any other software running on your computer. If Simplify3D is open, you may be unable to connect to your printer with Stacker RUN.**

When all other software has been closed on your computer, click the Connect button located in the upper left corner of Stacker RUN. A drop down menu will allow you to select the four or two head model.
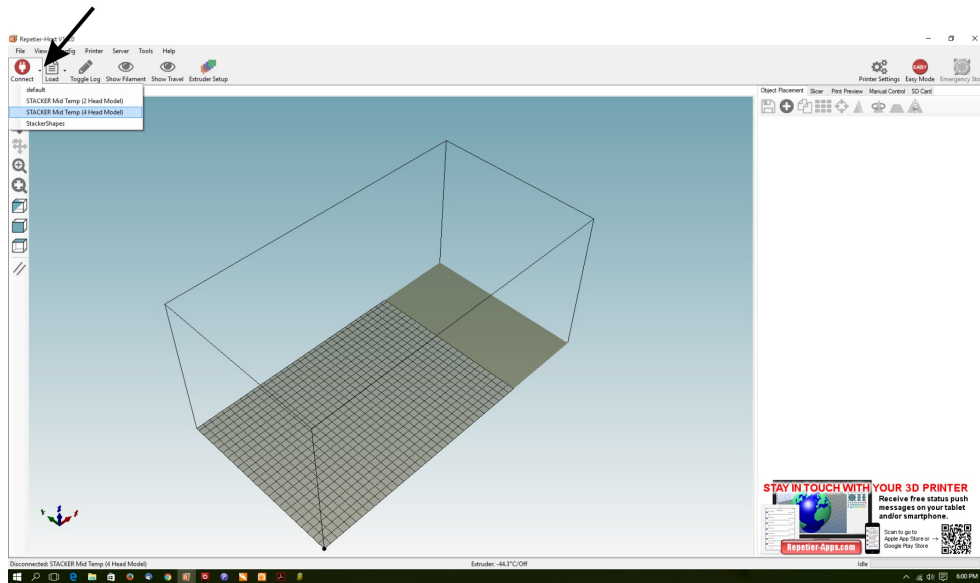
With some computers, you may need to go into the Printer Settings menu of Stacker RUN and change the Port setting from Auto to an available COM port. Also note, the Baud Rate should read 250000. In rare cases, some computers seem to have lackluster USB to Serial Bridge communication. If you are having trouble connecting, even after (1) making sure the printer's power is on, (2) making sure the USB cables are connected properly, (3) restarting the computer, and (4) specifying a specific COM port number within Stacker RUN, then we recommend trying Stacker RUN with a different computer.

When your printer is connected to Stacker RUN, you are ready to calibrate.

6.3. Volumetric Calibration

One secret to accurate prints and beautiful surface finish is proper volumetric flow control. Stacker 3D printers use four variables to control volume: (A) filament diameter, (B) filament drive E-STEPS, (C) nozzle size, and (E) extrusion multiplier. Slicing engines use these variables to determine exactly how much filament to extrude. Therefore, it is essential to set these variables carefully and accurately for the best quality prints.

A. Filament Diameter

Stacker printers use 1.75mm diameter filament. It is very important to use filament with a highly consistent diameter. A reason why Stacker sells and recommends I-BEAM and colorFabb filaments is because these filament manufacturers use highly advanced laser tools for precise diametric measurements, as well as a host of other controls to ensure consistent filament diameters.

Regardless of what filament brand you use, always confirm consistent filament diameter with a digital caliper. Measure the diameter of your filament in few different places to see if it is consistent. If the diameter is not consistent, return the filament from where you purchased it. Filament with an inconsistent diameter will inevitably provide inconsistent results and filament jams.

B. Test Filament Drive E-STEPS

Calibrating your filament drive E-STEPS (*extruder steps*) is essential to achieving the best quality prints, and it should be done every time you change filament types or brands.

The calibration process only takes a few minutes and does not require you to waste filament. The only tools you will need is the filament guide cleaning brush, a metric ruler, a calculator, and an ink pen for marking the filament.

Step 1. Preheat the Extruder. Preheat your extruder to the filament's required temperature.

Step 2. Clean the Drive Gear. Release the filament drive idler bearing assembly and remove any filament from the filament drive. Look closely at the drive gear with a bright flashlight. Turn the gear manually and inspect it for filament debris. If the drive gear is dirty, you will not get an accurate measurement during calibration. Use the filament drive cleaning brush to be sure the gear is clear of any filament debris. When the gear is completely clean, you are ready for the next step.

Step 3. Insert the Filament: Insert the filament upward through the small hole beneath the filament gear, then push the filament upward past the gear and through the filament guide just above the gear. To avoid wasting filament during this measuring process, you do not need to push the filament all the way to the extruder. Push the filament so it has just entered the filament guide tube and then reattach the idler bearing assembly. Note, you have preheated your extruders just in case the filament is advanced to the hot ends during this test.
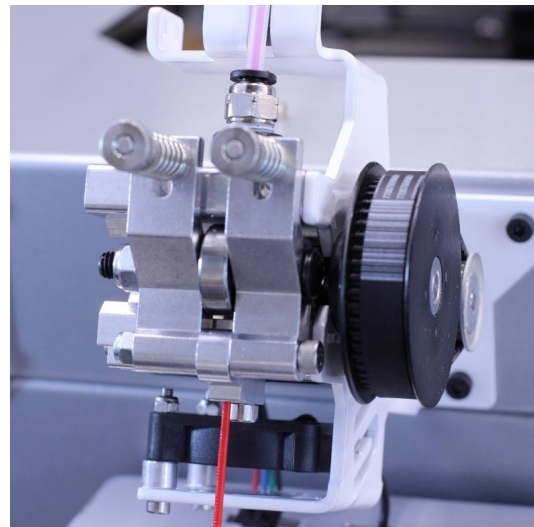
Step 4. Mark 120mm of filament: With a permanent marker and a ruler, mark the filament at 120mm.
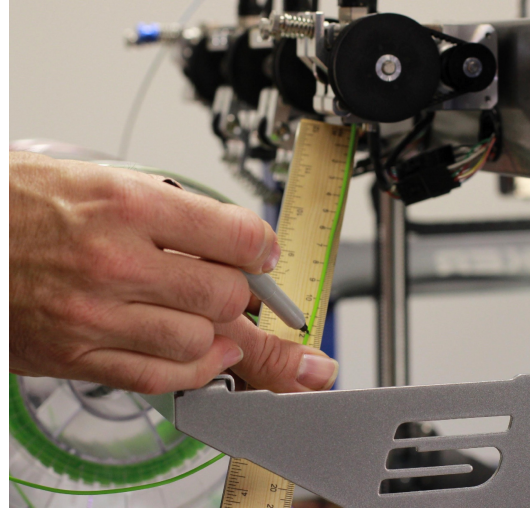
Step 5. Slow Extrude 100mm of Filament: Open Stacker RUN, connect to your printer, and use the Manual Control tab to slow extrude (▼) exactly 100mm of filament.
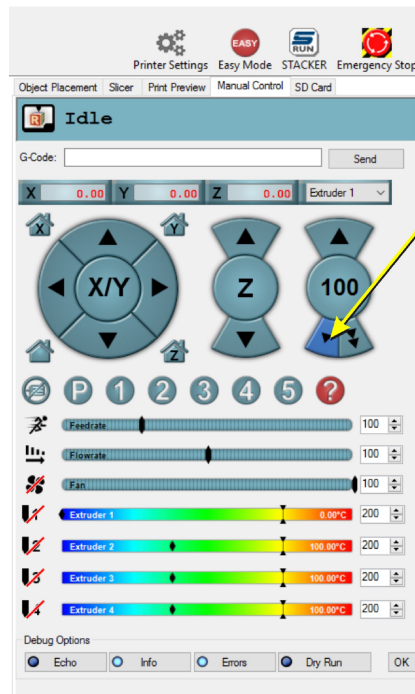
Click here to extrude 100mm of filament.

After attempting to extrude 100mm, measure to see what was actually extruded and write down the number. Because you marked 120mm and extruded 100mm, your mark should show 20mm of filament. In other words, you extruded 100mm of filament, so you should have 20mm of filament remaining. In the image to the right, we extruded 115mm of filament because we only measure 5mm of filament.
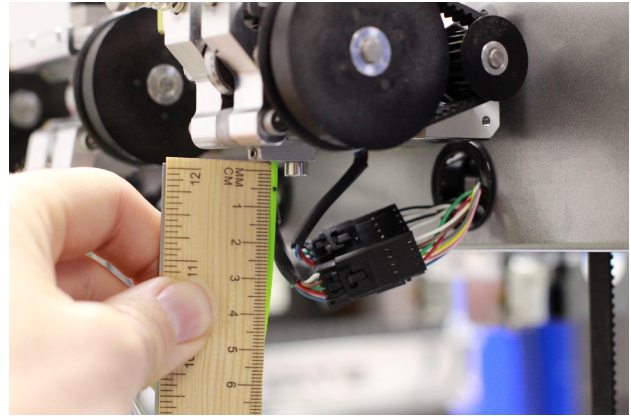
Step 6. Open your EEPROM window in Stacker RUN by pressing Alt+E or select "Firmware EEPROM Configuration" under the Config menu to see your current E-STEPS for each extruder.
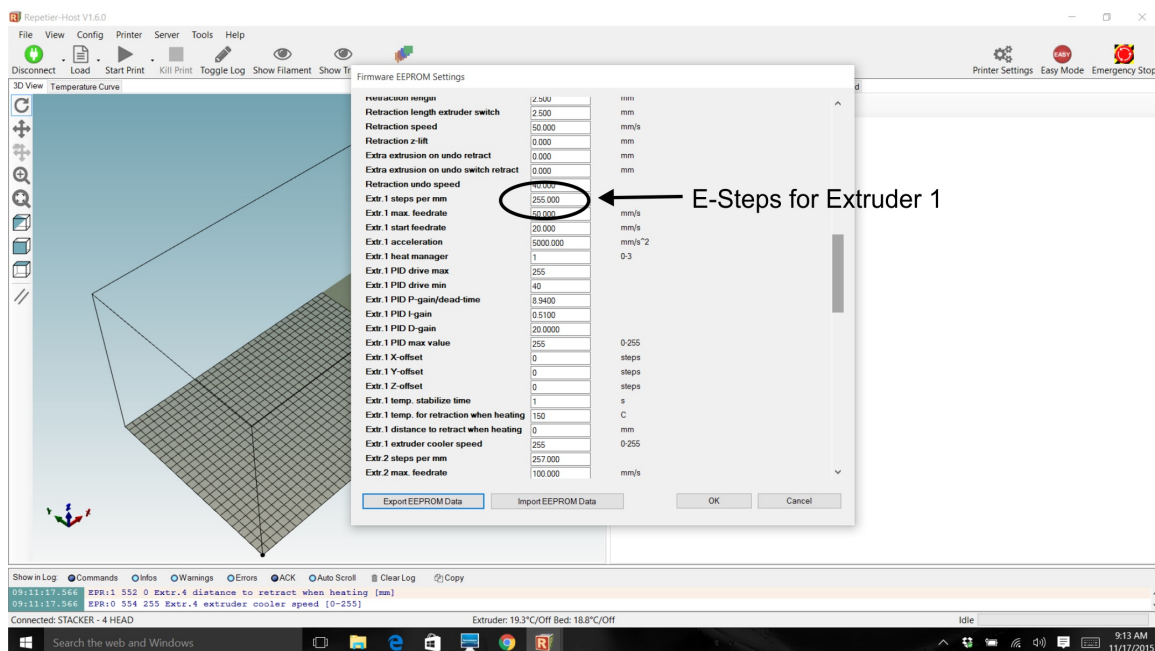
To calculate the new E-STEPS number, use this formula:

(100mm ÷ Your Measurement) x (Your current E-Steps) = Your New E-Steps

For example, I attempted to extrude 100mm of filament but the printer actually extruded 115mm of filament, so I would get the following result:

100 ÷ 115 = 0.869565

Because my current "steps per mm" in the EEPROM is set to 255, I would do the following:

0.869565 x 255 = 221.739

Thus, in this example, I should change the "steps per mm" from 255 to 221.739.

Step 7. Enter your new E-Steps for your extruder, but before you start printing, be sure to confirm these results. Go back and repeat steps 4 through 6 again to confirm your E-Steps setting.

C. Verify Nozzle Size

Stacker nozzles use a system of small machined dots around the tip for identification purposes. Be sure to enter the correct nozzle size in your slicing software. Stacker's standard nozzle size is 0.40mm, also called a 040 nozzle, and these were pre-installed on your printer.

Nozzle Identification

one dot = 040 nozzle (0.40mm orifice diameter)
NO dots= 050 nozzle (0.50mm orifice diameter)
two dots = 060 nozzle (0.60mm orifice diameter)
three dots = 080 nozzle (0.80mm orifice diameter)
four dots = 100 nozzle (1.00mm orifice diameter)

HIGH Temp Nozzle 270-300C (w/band)

MID Temp Nozzle 180-265C (no band)

"band"

"dots"
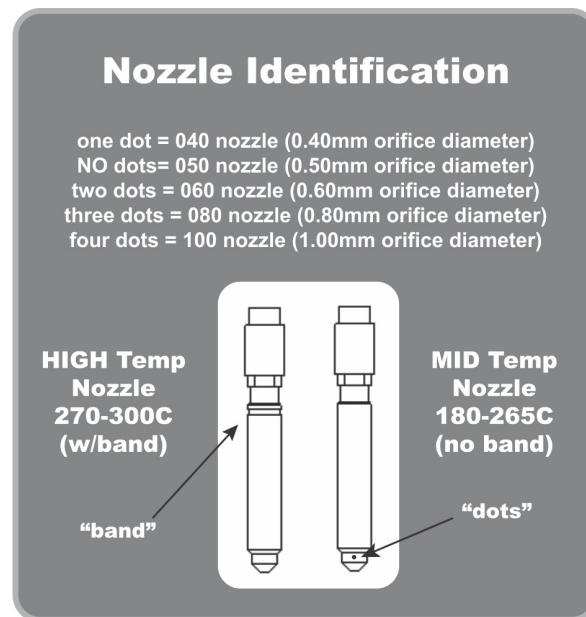
A Note about Stacker's MID and HIGH temp nozzles: For most filaments and applications, it is best to use our MID temp nozzles. Our HIGH temp nozzles are only necessary when using filaments which require temperatures between 275°C and 300°C. HIGH temp nozzles are identified by a special machined "band" to distinguish them from our MID temp nozzles.

D. Extrusion Multiplier

For even finer volumetric calibration you can adjust the extrusion multiplier in your slicing engine. Most filaments will print very accurately with a 100% extrusion multiplier setting in your slicing engine. Nevertheless, some filaments like XT-CF20 Carbon Fiber filament will over extrude due to die swell, and will therefore require a lower extrusion multiplier, often a multiplier of 0.95 is sufficient to compensate for die swell, but sometimes a multiplier as low as 0.88 is necessary. Printing a simple single wall test cube will allow you to verify the accuracy of your print widths.

7. Basic Printer Maintenance

Other than periodically replacing nozzles, filament guide tubes, and BuildTak as needed, the basic maintenance required on a Stacker 3D printer is minimal.

7.1. Keep Your Printer Clean

Inevitably, from regular use, small bits of filament debris will land on your printer. You must periodically remove this filament debris to protect your printer from damage. The combination of blower fans and small bits of filament can result in debris landing upon the moving parts of your printer. Clean filament debris to prevent damage to your printer's moving parts.

7.2. Linear Guides

The linear rail system on Stacker 3D Printers use recirculating linear bearings and profile rail guides. For optimal performance, lubrication of these parts is essential. Lubrication promotes smooth operation, minimizes friction and wear along the raceways, dissipates heat, and prevents corrosion. The absence of proper lubrication will eventually lead to machine failure.

The frequency with which you will need to re-apply lubricant to your linear rail system will largely depend upon use and environmental conditions. More humid environments will generally require more frequent re-application of lubricant to protect the printer's raceways from rust.

> **X/Y/Z Rails:** To lubricate the horizontal X and Y rails and the vertical Z rails, apply a 40 to 90 weight 100% synthetic oil to a cloth and apply liberally to the raceways. For the X and Y rails, you can then manually slide the blocks by hand to work the oil into the blocks. For the Z rail, you will need to run the bed up and down a few times. Finally, use a clean dry cloth to remove any excess oil by wiping down the raceways
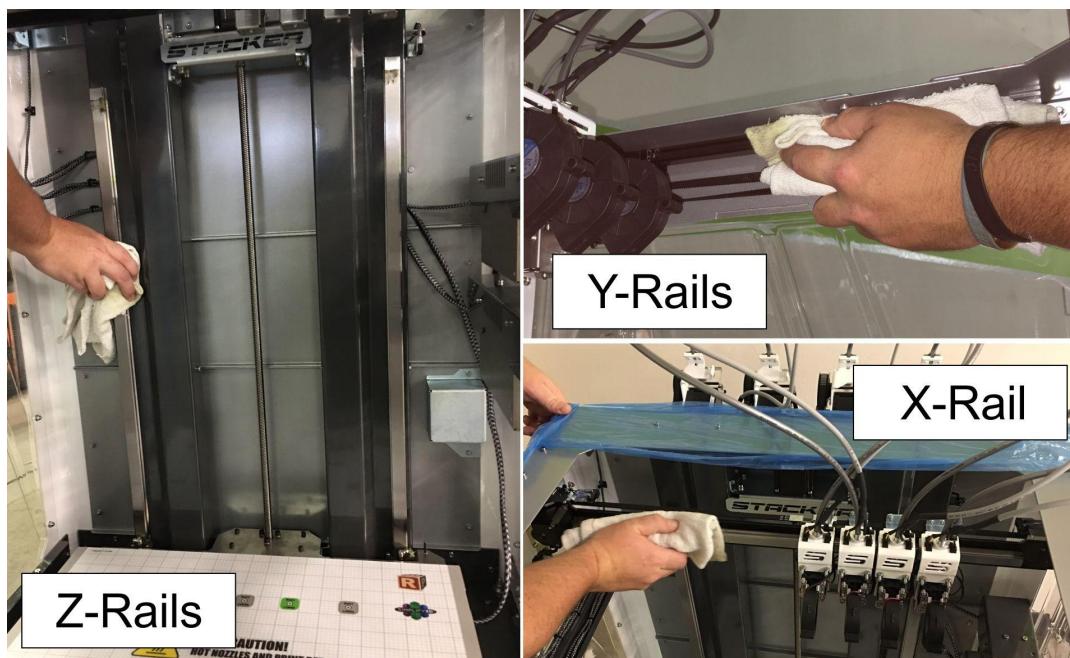
8. Advanced Basic Calibration

Although it is unlikely you will need to perform advanced basic calibration on your printer in the short term, it is possible that during shipping or over time, the nozzles or bed will not be as level as they were when they left the factory.

8.1. Nozzle Height Adjustment

With *multi-head printing,* all the four nozzles must be at the same height for consistent printer operation. The easiest way to adjust the height is to use the 0.007"/0.18mm feeler gauge. **Note, this method only works if your bed is level. If you suspect your bed is not level, complete the steps in section 8.2 first before attempting to adjust the individual nozzle heights.**

1. Heat your bed to 50°C.
2. Select a location in the middle rear of the bed where the feeler gauge provides a good gap for the second nozzle tip.
    a. If you cannot find a good gap for the second nozzle in this area. Make a changes with the Z-height adjustment screw (see section 6.1) until head two has a good gap in the rear middle of the bed.
3. When the gap is set for nozzle number two, move head one to the same location on the build plate and use the feeler gauge to access the gap.
    a. To make changes in the height of nozzle one, use the supplied 7mm nut driver to loosen the two nuts on the front of the hotend (shown below). Loosening the two nuts will enable you to move the entire hotend assembly up or down. Allow the nozzle height to be set by the thickness of the feeler gauge. To do this, simply move the entire assembly up or down with the feeler gauge under the nozzle. When the feeler gauge gap feels the same as it did with nozzle two, re-tighten the nuts.
4. If you have an S4, repeat the process in step 3a with heads three and four.
5. When all of your nozzles all are set to the same height, move them by hand to the four corners of the build plate.
    a. If none of the heads scrape the build surface, you should be good to print.
    b. If you feel the nozzles scraping, your bed may note be level. .
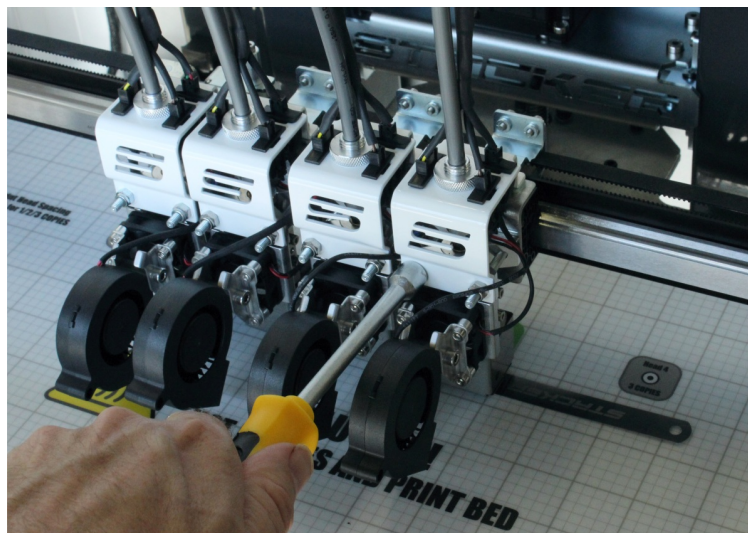
8.2 Leveling the Bed

Your print bed was leveled (adjusted to be coplanar to the nozzles) at the factory, and for most users, the bed will remain level during the shipping. Nevertheless, if you notice inconsistent layer heights across the bed, or nozzles are scrapping on your build surface in some areas, you may need to re-level the bed. Test the gap between the nozzle and the bed using the 0.007"/0.18mm feeler gauge in several areas across your bed with the same printhead. If you discover inconsistent gaps across the bed, then you should probably re-level your bed.

Step 1. Heat the Bed. Heat your bed to 50°C

Step 2. Home the Z Axis. Use the LCD controller to home the Z-axis (**Main Menu » Position » Home All**).

Step 3. Position the printheads. First, disable the stepper motors using Stacker RUN or the LCD controller (**Main Menu » Quick Settings » Disable Stepper**), then use both hands to push the X/Y gantry to the rear of the print bed as shown below. Finally, slide two heads to the far right and two heads to the far left of the X gantry.
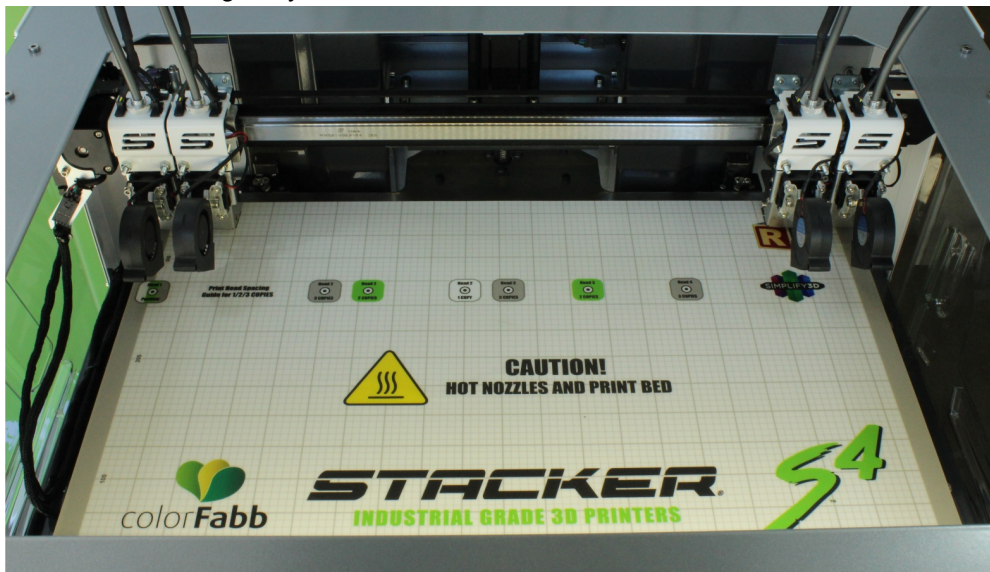
Step 4. Using only head 2, level the rear of the bed (make X/Y gantry coplanar to print bed). Underneath the bed are three special bed leveling screws. You will be adjusting the two rear bed leveling screws with a 7mm nut driver to make the X/Y gantry coplanar to the print bed. To begin, slide the 0.007"/0.18mm feeler gauge between the nozzle tip of head two and the print bed. You should feel *slight friction* from the nozzle tip as you move the feeler gauge. If the gap is too large or too small, you will need to make an adjustment to the bed leveling screw underneath the bed.

Start by adjusting the left rear leveling screw. Turn the nut driver clockwise or counter-clockwise until the feeler gauge slides beneath the nozzle with a small amount of friction from the nozzle.
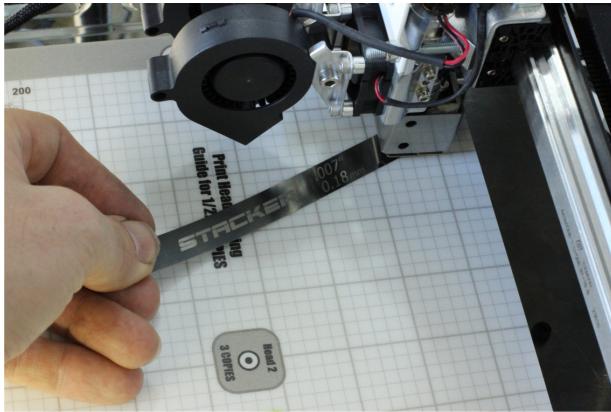
When you have a small amount of friction on the left side, slide printhead number two by hand to the far left side of the gantry. Again, use the 0.007"/0.18mm feeler gauge to determine the gap between the nozzle tip and the bed. You should feel slight friction from the nozzle tip as you move the feeler gauge. If the gap is too large or too small, you will need to make an adjustment to the right rear bed leveling screw found underneath the bed.
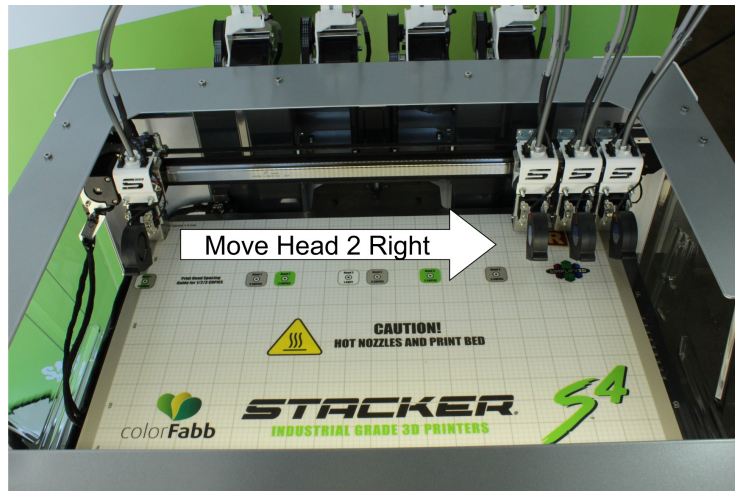
Turn the nut driver clockwise or counter-clockwise until the feeler gauge slides with a small amount of friction from the nozzle. You want to achieve the same feeler gauge height at all leveling locations.

Now, repeat the same process again by sliding head 2 back to the far left side of the bed. Slide head 2 back and forth making the necessary adjustments to the two rear bed leveling screws until the nozzle on head 2 provides a small amount of friction in both locations at the rear of the bed.
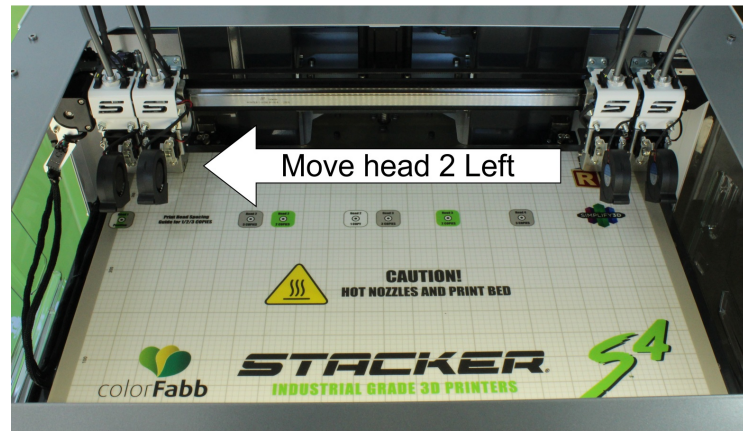
Step 5. Confirm the Crown Position: When you apply heat to your aluminum bed, the middle rear of the bed will crown slightly decreasing the gap between the nozzle and the bed. Move head number two to the middle rear of the bed and test the location with the feeler gauge. If you are unable to get the feeler gauge between the nozzle and the bed, you will need to increase the your nozzle gap in step 4.

Step 6. Slide the X/Y gantry forward and level the front of the bed. Move the gantry forward to the front of the bed, and place the nozzle for head two directly over the front middle leveler screw and test the gap with the feeler gauge. Turn the 7mm hex driver clockwise or counterclockwise until the feeler gauge slides with a small amount of friction.

Now that the front of the bed is set, slide the gantry to the rear of the bed and repeat step 4. Repeat steps 4, 5, and 6, until the nozzle gap is consistent in all these areas of the bed.

After leveling the bed, you must set the nozzle heights as described in section 8.1.
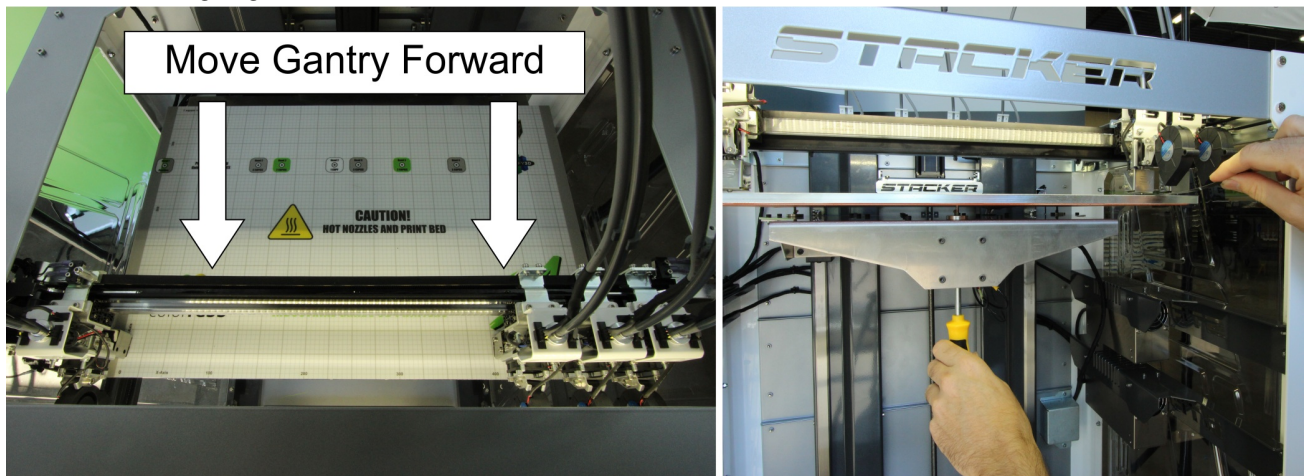
9. Useful Information

9.1. Printer Settings for a Slicing Engine

Most slicing software will not have a default profile available for Stacker printers. To create a profile, you will likely need to enter the follow information:

Printer Name: Stacker S4 - 040 Nozzle or Stacker S2 - 040 Nozzle
Machine type: Cartesian robot
Firmware: RepRap Repetier
Baud Rate: 250000
Build Volume:

For the S4	For the S2
X-Axis: 510mm Y-Axis: 360mm Z-Axis: 600mm	X-Axis: 390mm Y-Axis: 315mm Z-Axis: 525mm

Nozzle Diameter: 0.40mm
Filament diameter: 1.75mm
Number of Extruders: 4 for the S4 and 2 for the S2
Heated Bed: Yes

Simplify3D Settings: Stacker's support page (http://stacker3d.com/stacker-3d-printer-support/) offers factory files for Simplify3D. Please download and Import these FFF files into your copy of Simplify3D to use with your Stacker printer.

9.2. Filament Settings Reference

The numbers below are being provided as a starting point when attempting to use various filaments.   Because the size and shape of printed parts varies greatly, some prints may require adjustments to temperatures and speed. If you are struggling in finding good settings for a part, please contact Stacker info@stacker3d.com and ask for help. We will gladly help to find working settings for your printed parts.

Filament	Nozzle Temp. (C)	Bed Temp. (C)	Speed	Fan After First Layer
I-BEAM IMPACT PLA	225°	55°	45mm/sec	Yes
PLA/PHA	220°	60°	45mm/sec	Yes
colorFabb_XT	255°	75°	35mm/sec	No
colorFabb_HT	280°	100°	40mm/sec	No
colorFabb nGen	237°	70°	45mm/sec	No
colorFabb nGen Flex	260°	75°	15mm/sec	No

NinjaFlex SemiFlex, MakeShaper TPU	225°	60°	15mm/sec	No
Woodfill‡, Bamboofill, Corkfill	220°	60°	40mm/sec	Yes
Brassfill, Bronzefill, Copperfill, Steelfill	225°	60°	30mm/sec	Yes

‡Due to the fibrous nature of Woodfill filament, it is prone to jamming on smaller nozzles (e.g., 0.40mm and 0.50mm nozzles). If you are experiencing clogged nozzles with Woodfill, switch to an 0.60mm or larger nozzle.

10. Terms and Conditions

STACKER, LLC
TERMS AND CONDITIONS OF SALE & LICENSE

As used herein, "Seller" shall mean Stacker, LLC, a Minnesota limited liability company, or any wholly-owned subsidiary of Stacker, LLC.

These terms and conditions, and any applicable Seller quotation, sales order acknowledgement and Separate Software License, along with any other documents incorporated by reference in any of the foregoing (hereinafter collectively the "Agreement"), bind the buyer ("Buyer") and Seller as to any hardware products sold by Seller to Buyer ("Hardware"), any services sold by Seller to Buyer ("Services"), and any software (including without limitation, any embedded software) licensed or sublicensed by Seller to Buyer ("Software"), and constitute the entire agreement between Buyer and Seller regarding such sale and/or license.

Also as used herein and as applicable: (1) Hardware, Software and Services are collectively, and as applicable, referred to as "Goods" and (2) the term "Separate Software License" shall mean a set of terms and conditions that govern the licensing of specific Software and which is communicated to the Buyer by Seller or by a third party software owner.

This Agreement is subject and expressly limited to the terms and conditions contained in this Agreement. Any terms or conditions stated by the Buyer in any prior, concurrent and/or subsequent request for proposal, offer, purchase order and/or other documents are deemed by Seller to be a material alteration of this Agreement and are hereby rejected and inapplicable unless specifically agreed to in writing by an authorized representative of Seller. **Buyer shall be deemed to have accepted the Agreement and all of its terms and conditions, without exception, if any of the following events occur: (1) Buyer communicates to Seller its acceptance of the applicable Seller's quotation and/or sales documents; (2) Buyer issues Seller a purchase order which includes the same Goods and prices as set forth on the corresponding Seller's quotation and/or sales documents; and/or (3) Seller delivers any of the Goods covered by the applicable Seller's quotation and/or sales documents.**

1. **PRICES:** Except as otherwise set forth in writing by Seller, the price for Goods shall be as set forth in the applicable Seller's quotation and/or sales documents, or if the price is not set forth in any such quotation or documents, in accordance with Seller then-current list price. Prices set forth in a Seller's quotation shall be valid for thirty (30) days from the date of such quotation.
2. **SHIPPING, RISK AND TITLE:** All shipping dates are approximate and are based on Seller's prompt receipt of all necessary information from Buyer to properly process the order. Goods are shipped Ex Works Seller's facility (pursuant to Incoterms 2010). Subject to Section 8(a) below, title to the Goods and risk of loss thereto shall transfer to Buyer upon tender of the Goods to a carrier at Seller's factory. Buyer shall be responsible for all of the following related to the Goods: freight, duty and tax costs, risk, securing insurance, customs clearance and related costs, and arranging for a carrier and determining the method of shipment.
3. **TAXES AND DUTIES:** Prices do not include applicable taxes, duties or fees, including without limitation, any sales, excise, value added or goods sold taxes, or any customs duties or fees. Except for taxes due on Seller's net income, any taxes, duties or fees payable on any transactions hereunder shall be the responsibility of Buyer, and Seller may invoice Buyer for any such taxes, duties or fees that are or may be payable by Seller.
4. **PAYMENT:**(a) Except as otherwise required by Seller in its sole discretion (e.g., payment in advance, payment by letter of credit), Buyer agrees to pay Seller's invoice, in U.S. currency, net thirty (30) days from the invoice date. (b) If any payment owed to Seller hereunder is not paid when due, Seller may charge Buyer a late payment charge of one and one-half percent (1½%) per month or, if less, the maximum rate allowed by law, on all past outstanding balances. In the event Buyer fails to make any payment when due, Seller shall have the right, among other remedies, to terminate this Agreement or to suspend further delivery of Goods under this and/or other agreements with Buyer. Buyer shall be liable to Seller for all expenses attendant to collection of any past due amounts, including without limitation, reasonable attorneys' fees. (c) Seller reserves a purchase money security interest in the Goods sold only to the extent of the invoiced amount and solely for the purpose of securing Buyer's payment obligation hereunder. This Agreement is a security agreement. At Seller's request, Buyer agrees to promptly execute any instrument or statement, and otherwise cooperate with Seller, in order to perfect the aforesaid security interest; provided, however, that in the event Buyer fails to comply with any such request, Buyer authorizes Seller, or a representative on behalf of Seller, to sign and file the necessary instruments or statements for the Buyer.

5. **DOCUMENTATION:** Seller shall provide Buyer with that data/documentation that: (1) is specifically identified in the applicable Seller's quotation and/or order documents; and (2) is made commercially available and provided by Seller with the applicable Goods in Seller's normal course of business.

6. **RECEIVING:** Except as set forth in the applicable Seller quotation and/or other applicable Seller documentation provided with the Goods, Buyer shall be responsible for receiving, storing, installing, starting up and maintaining all Goods.

7. **CANCELLATION:** Buyer may cancel its order at any time prior to shipment by providing written notice thereof to Seller and paying Seller liquidated damages in the following amounts: (a) if the order is cancelled within 10 calendar days of the Buyer's purchase order date, then an amount equal to twenty-five percent (25%) of the total order price; (b) if the order is cancelled within 11 to 30 calendar days of the Buyer's purchase order date, then an amount equal to fifty percent (50%) of the total order price; and (c) if the Buyer's order is cancelled between 31 and 60 days of the Buyer's purchase order date, then an amount equal to seventy-five percent (75%) of the total order price. The parties agree that actual damages stemming from any order cancellation will be difficult to calculate and as such the parties agree that the aforesaid amounts do not represent a cancellation penalty, but rather a reasonable and good faith estimate of the actual damages incurred as a result of the cancellation. To the extent Buyer has made any payments prior to cancellation, Seller may apply any payments against any liquidated damages or other amounts due Seller under this Agreement.

8. **RETURNS:** (a) **Allowable Period:** For all electronic items, the Seller will accept returns only within ten (10) calendar days from the date of the Buyer's receipt of merchandise, subject to a 10% restocking fee. For non-electronic items, excluding filament, the Seller accepts returns only on unopened items within thirty (30) calendar days from the date of Buyer's receipt of merchandise. Filament may not be returned. (b) **Return Process:** The Buyer shall arrange and pay all shipping, freight, and customs, taxes, and duties related to returning merchandise to the Seller. For credit, all merchandise must be returned in its original packaging. The customer must contact the Seller to be issued a return authorization account (RMA) number. Any returns made by a Buyer without a return authorization account number will be considered an "Unauthorized Return" and will not be subject to a refund or credit by the Seller. If the returned product is not received by the Seller in "Resalable Condition", the Buyer may not receive credit. "Resalable condition" means the Product has no sign of: use, wear and tear, cosmetic damage, or any other damage; furthermore, the Buyer is responsible for any damage to the returned product incurred during the shipping.

9. **SOFTWARE:** (a) Seller and/or any applicable third party owner shall retain exclusive right, title and ownership in and to their respective Software, and the license provided herein does not convey to Buyer any interest in the Software or any part thereof. Buyer acknowledges and agrees that the Software consists of proprietary material and information of Seller and/or any applicable third party owner, and is protected under U.S. and foreign copyright and other intellectual property laws, as well as international treaty provisions. (b) If a Separate Software License is provided with the Software, referenced on Seller order documents and/or otherwise communicated to Buyer, then such Software shall be governed, in order of precedence, by the terms of the Separate Software License and then by any non-conflicting terms hereof. If no Separate Software License applies, then Seller hereby grants to Buyer, and Buyer accepts, a limited, personal, non-exclusive license, without the right to sublicense, to use the Software only: (1) with the specific Seller's manufactured Hardware that such Software is intended to operate with; or (2) if the Software is not intended to operate with Seller's manufactured Hardware, on a single computer owned, leased or otherwise controlled by the Buyer. Any concurrent use of the Software and any use on any local area network or other type of network are not authorized. Notwithstanding any term in this Section 8(b) to the contrary, Buyer's license rights in the Software shall include the right to use the Software in any manner expressly described in any Seller supplied documentation as described in Section 5 above.(c) Except as required to be permitted by applicable law, Buyer may not copy, reverse engineer, decompile, disassemble or modify the Software in any way. The aforesaid Software license does not entitle Buyer to any Software source code. (d) Repair of Software may be in the form of available corrections, fixes and/or patches to address Software bugs or inconsistencies, and/or to address non-conformance with the applicable Software specifications (collectively "Updates"). Following expiration of the Software warranty, Updates available from Seller shall be provided to Buyer either: (1) in accordance with Seller's quoted price therefore; or (2) at no charge if Seller provides such specific Updates at no-charge on a commercial basis to all of its customers. Seller shall not be required to make available any new versions and/or releases of any Software that provide new and/or enhanced features, performance and/or capabilities for the Software ("Upgrades"). In the event Seller does, in its sole discretion, make any Upgrades available, such Upgrades shall be subject to Seller's quoted price therefore. As used in this Agreement, Software shall include any Updates and Upgrades made thereto. (e)   Notwithstanding any term or provision in this Agreement to the contrary, and with respect to any Software and/or any part thereof for which the intellectual property rights are not owned by Seller, including any third party commercial software and any software commonly referred to as open source code or open source software (collectively "Third Party Software"): (1) any such Third Party Software shall be governed exclusively by the Third Party Software owner's applicable license terms if such terms are provided with or as part of the Third Party Software; (2) nothing in this Agreement, a Separate Software License or any other agreement shall restrict or otherwise affect any rights and/or obligations Buyer may

have, or conditions to which Buyer may be subject to, under any open source licenses to any open source code or software provided in or with the Software; and (3) Seller provides no warranty of any kind, express or implied, with respect to any such Third Party Software, which is provided "AS IS"; provided, however that Buyer may avail itself to any warranty provided by the supplier of any such Third Party Software. (f) The aforesaid Software license(s) shall be nontransferable except as follows: (1) any embedded Software that is included in and intended to operate with any Hardware shall be transferable with the transfer of the Hardware to another party provided that such transfer is on terms that do not materially conflict with the Software license terms in this Agreement; and (2) for Software that is not embedded Software, Buyer shall have a permanent right to transfer all its Software rights under this Agreement to another party, provided Buyer passes all the copies of the Software licensed to the other party along with the accompanying documentation and a copy of this Agreement, and provided that the other party accepts the terms of this Agreement. If you transfer the Software as permitted herein, you may not retain any copies of the Software for your own use and your license rights under this Agreement are terminated.

(g) The aforesaid Software license(s) shall continue until and automatically terminate upon Buyer's breach of any of the terms hereof.

10. **LIMITED WARRANTY:** With respect to all Goods, the following warranty terms ("General Warranty Terms") shall apply solely during the applicable warranty period set forth in Sections 9(a) through 9(f) below. If Buyer has used the Goods under normal use and care and discovers any defects in material or workmanship, or any material deviation from the Goods' applicable published specifications, and notifies Seller in writing thereof during the applicable warranty period, Seller shall, at its option, use reasonably commercial efforts to repair or replace that portion of the Goods found by Seller to be defective in material or workmanship, or in material deviation from the applicable specifications, or refund the purchase price of such Goods. Any Goods to be returned to Seller for repair or replacement under this warranty must be returned to Seller's designated facility and in accordance with Seller's then-current return material authorization (RMA) procedures and Buyer must contact Seller and obtain a RMA number and such procedures prior to any such return. This limited warranty shall not apply in the event any such defects and/or deviations are based in whole or part by improper or inadequate maintenance, unsuitable power sources or environmental conditions, improper maintenance, alteration or modification by any party other than Seller or its authorized representative, storage or handling, accident, repair by a party other than Seller or its authorized representative, or any other cause not the fault of Seller. Except as expressly set forth in this limited warranty, all costs incurred by Buyer relating to or arising out of this warranty, including without limitation, those related to dismantling and reinstallation of the Goods, shall be borne by Buyer. Except as expressly agreed to in writing by Seller prior to shipment, Seller makes no warranty or representation that the Goods supplied hereunder comply with any local laws, rules, regulations or ordinances, and Buyer shall be responsible for obtaining all permits, licenses, authorizations and/or certificates required by any regulatory body for installation or use of the Goods. This limited warranty is the only warranty made by Seller, and SELLER DOES NOT WARRANT THAT THE USE OF THE GOODS OR ANY PARTS THEREOF WILL BE UNINTERRUPTED OR ERROR FREE, AND THERE ARE NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO THE GOODS OR ANY PARTS THEREOF, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, THOSE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT.

(a) Hardware (including embedded Software therein) is warranted for a period of twenty-four (24) months from the date of shipment by Seller.

(b) Notwithstanding the foregoing, the following parts ("Wear Parts") are warranted for a period of forty five (45) days: 1) filament drive gears, 2) belts, 3) bearings, 4) pulleys, and 5) hot ends. Hot ends include the following components: (i) heater cartridges, (ii) heater blocks, and (iii) thermistors. Adhesive print bed coatings or sheets and glass print beds carry no warranty.

(c) Services are warranted for a period of ninety (90) days from the date the Services are provided by Seller.

(d) Notwithstanding any of the foregoing, Goods repaired or replaced during the warranty period, or Goods identified as rebuilt regardless of when purchased, are warranted for the longer of the remainder of the original warranty period or ninety (90) days from the date of shipment by Seller.

(e) Software is warranted for a period of ninety (90) days from the date of "shipment". As used herein, "shipment" shall mean either: (1) the date the Software is physically shipped by Seller to Buyer (with or without Hardware); or (2) the date the Software is electronically transmitted to Buyer by Seller.

(f) No warranty is extended with respect to third party owned software. Notwithstanding any language in this limited warranty to the contrary, Seller shall have the right to discontinue the availability of any Goods or components or replacement parts therefore, or to make design changes or improvements in the Goods at any time and such discontinuance or change shall not constitute a breach of warranty, or result in any liability or obligation to Seller whatsoever, including, without limitation, any obligation to retrofit, change or improve Goods purchased by Buyer prior to the discontinuance or change.

11. LIMITATION OF REMEDY AND LIABILITY: THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF WARRANTY HEREUNDER SHALL BE LIMITED TO REPAIR, REPLACEMENT OR REFUND UNDER THE LIMITED

WARRANTY SET FORTH IN SECTION 9 ABOVE. IN NO EVENT, REGARDLESS OF THE FORM OF THE CLAIM OR CAUSE OF ACTION (WHETHER BASED IN CONTRACT, INFRINGEMENT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE), SHALL SELLER'S LIABILITY TO BUYER AND/OR BUYER'S CUSTOMERS EXCEED THE PRICE TO BUYER OF THE SPECIFIC GOODS PROVIDED BY SELLER GIVING RISE TO THE CLAIM OR CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT, SHALL SELLER'S LIABILITY TO BUYER AND/OR BUYER'S CUSTOMERS EXTEND TO INCLUDE INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES. THE TERM "CONSEQUENTIAL DAMAGES" SHALL INCLUDE, WITHOUT LIMITATION, LOSS OF ANTICIPATED REVENUE OR PROFITS, LOSS OF USE OR DATA, DAMAGES BASED ON ANY DELAY IN PERFORMANCE, AND CLAIMS OF BUYER'S CUSTOMERS. SELLER AND BUYER AGREE THAT THE LIMITATIONS SET FORTH IN THIS PROVISION SHALL BE ENFORCED TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW. TO THE EXTENT PERMITTED BY APPLICABLE LAW, THE LIMITATIONS SET FORTH HEREIN SHALL EXTEND TO THE BENEFIT OF SELLER'S SUPPLIERS.

12. **CONFIDENTIAL INFORMATION**. Any information disclosed by Seller to Buyer related to this Agreement, including quotations, pricing, technical information or otherwise, shall be deemed "Confidential Information". Buyer shall not disclose any Confidential Information to any third parties without Seller's prior written consent and shall use such Confidential Information only for the purposes reasonably related to the purchase and use of Seller's Goods. Seller shall, at all times, retain all right, title and interest in the Confidential Information and all copies thereof. Notwithstanding the foregoing, Confidential Information shall not include information which is or becomes publicly known through no wrongful act of Buyer.

13. **GOVERNING LAW / DISPUTES:** (a) This Agreement shall be construed, performed and enforced under the laws of the State of Minnesota, U.S.A. (b) If Buyer's address is in the United States, the sole and exclusive venue for any claims or actions under or related to this Agreement shall be in the applicable court(s) in the city of Minneapolis, Minnesota, U.S.A. If Buyer's address is not located in the United States, then Seller and Buyer agree that any controversy or claim arising out of or relating to this Agreement shall be determined by arbitration in accordance the then-current rules of the American Arbitration Association by one or more arbitrators appointed in accordance with said rules, and such arbitration shall be conducted in the city of Minneapolis, Minnesota, U.S.A. Notwithstanding the foregoing, either party may, at anytime, apply to a court having jurisdiction for a preliminary injunction and/or other equitable relief where such relief is necessary to protect the party's interests pending completion or anticipated beginning of any arbitration. (c) This Agreement shall be interpreted and construed in the English language and any proceedings and/or arbitration conducted hereunder shall be in English. (d) Notwithstanding the foregoing, if applicable law requires that any of the terms and conditions set forth in the Agreement be different than those set forth in the Agreement, including without limitation, the governing law, arbitration and/or other dispute resolution terms set forth in this Section 14, then the Agreement shall be deemed modified and amended to the minimal extent necessary to comply with and incorporate such applicable law, and the rest of the terms and conditions of the Agreement, as so amended, shall continue in full force and effect.

14. **GENERAL PROVISIONS:** (a) Except as expressly set forth in this Agreement, Buyer may not assign this Agreement, or any rights or obligations hereunder, without Seller's prior written consent. (b) No action, regardless of form, arising out of or related to this Agreement, may be brought by Buyer more than two (2) years after the cause of action has accrued. (c) Seller shall not be liable for delays in performance or for non-performance due to acts of God, war, terrorism, riot, fire, labor trouble, unavailability of materials or components, accident, compliance with governmental laws, rules, regulations, orders or requests, or any other circumstances or causes beyond Seller's reasonable control. (d) In the event any of the terms of this Agreement are in conflict with any rule of law or statutory provision, or are otherwise unenforceable under any applicable laws or regulations, such terms shall be enforced to maximum extent permitted by the applicable laws or regulations, and to the extent unenforceable, such terms shall deemed stricken from this Agreement, but such invalidity or unenforceability shall not invalidate any of the other terms of this Agreement. (e) No failure by Seller to take any action or assert any right hereunder shall be deemed to be a waiver of such right in the event of the continuation or repetition of the circumstances giving rise to such right. (f) Any modification of these terms and conditions must be set forth in a written instrument signed or issued by duly authorized representative of Seller. (g) This Agreement is the entire agreement between the parties with respect to the subject matter herein and supersedes all oral and written communications regarding the subject matter hereof. There are no understandings, agreements or representations, express or implied, not specified in the Agreement.