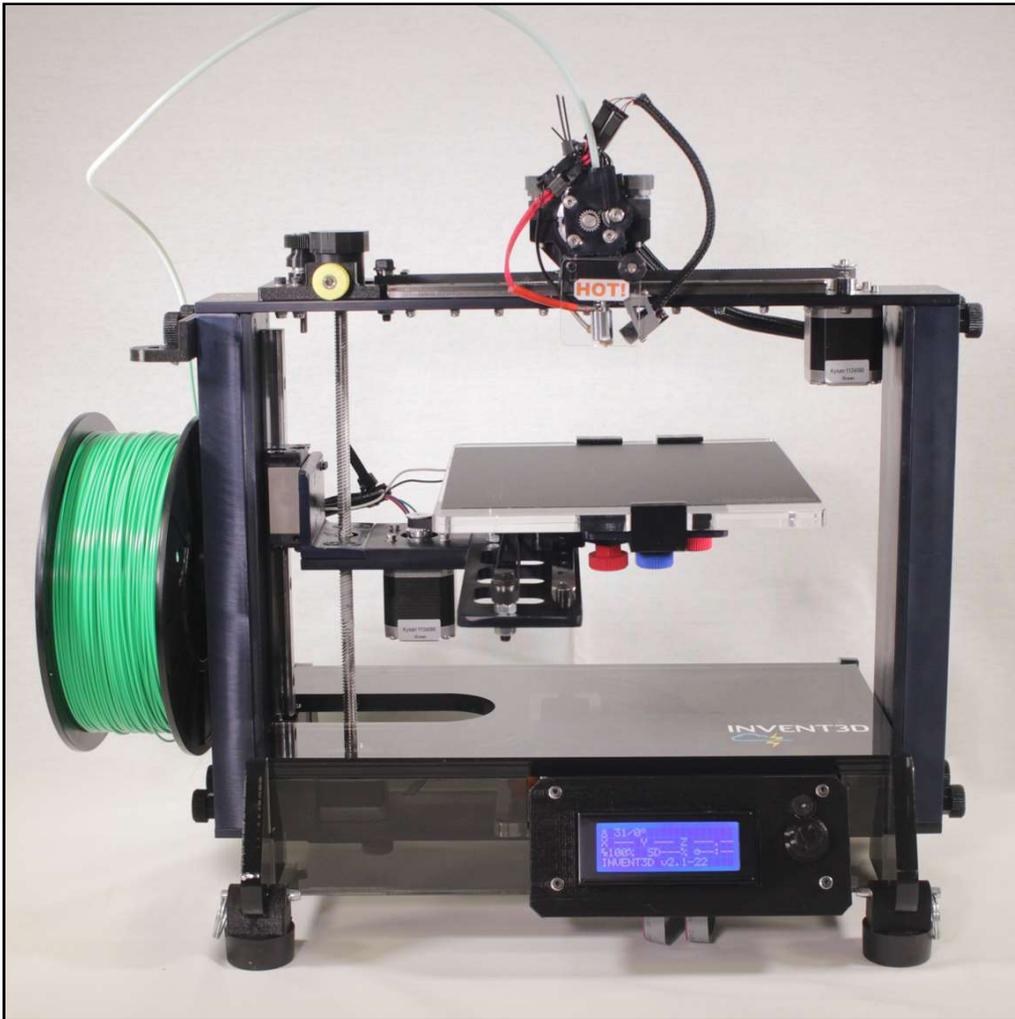


# INVENT3D Printer

## Operating Instructions & Troubleshooting Guide



**Version 6**

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**OPERATING VIDEOS**

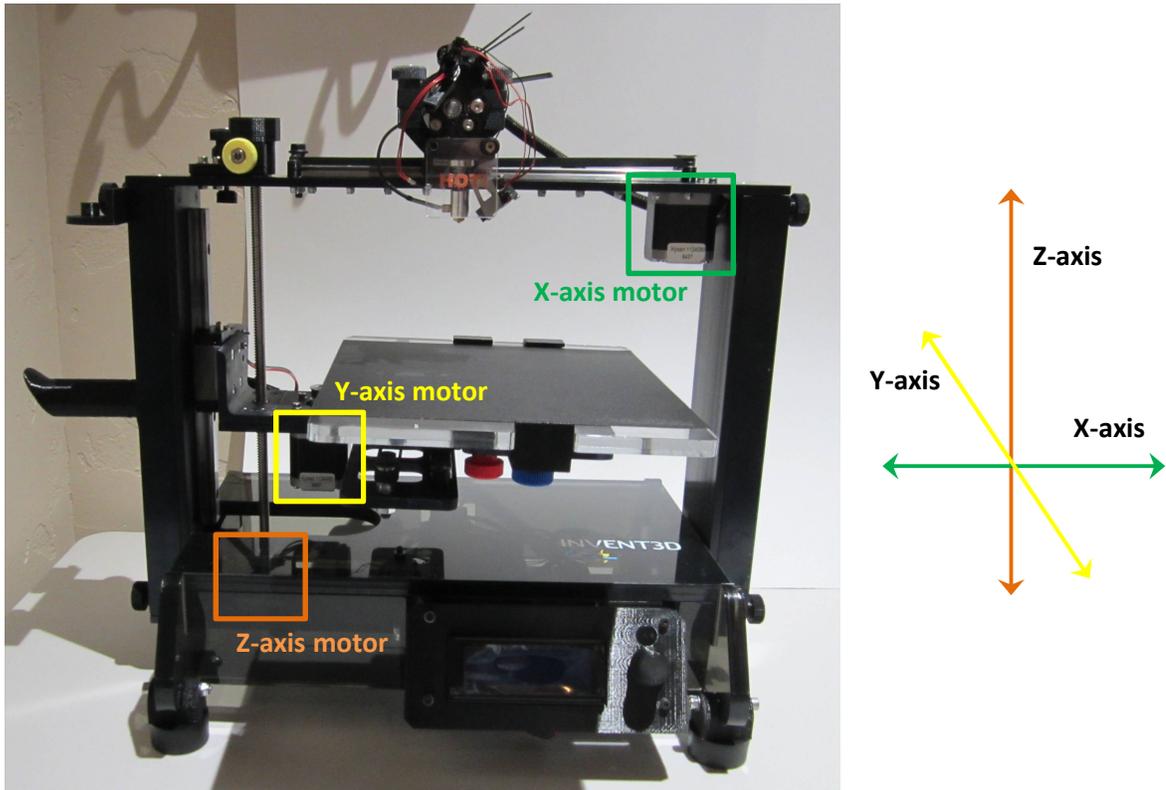
Videos are available on YouTube and INVENTORcloud website ([www.inventorcloud.net](http://www.inventorcloud.net))

- Installing Slic3r: <https://youtu.be/-kWy8JPh2IQ>
- INVENT3D – Keys to Success: <https://youtu.be/4-TP87f Dtk>
- Changing Filament: <https://youtu.be/GkhGFjllO9Y>
- Part Removal: <https://youtu.be/YI2lwoVA114>
- Print Board Leveling: <https://youtu.be/t5xmp9knYew>
- Routine Maintenance: <https://youtu.be/GVPg4gXYw9w>
- Z-Axis Calibration: <https://youtu.be/jwzYRii9fM0>

## I. OVERVIEW OF PRINTER COMPONENTS

- *X, Y and Z Axes*

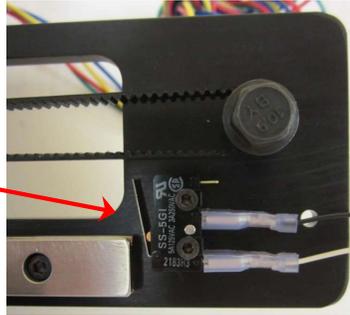
The INVENT3D printer creates three dimensional objects by moving the printer hot end assembly and print board along X, Y, and Z axes.



- **X-axis:** The printer hot end assembly moves along the X-axis, located on the top of the printer. The 0 position on the X-axis is the farthest left position along the X-axis rail, closest to the Z-axis lead screw. Movement along the X-axis is powered by the X-axis motor, which hangs from the top of the printer on the right side.
- **Y-axis:** The print board itself moves along the Y-axis rail toward the front or back of the printer. The 0 position on the Y-axis is the furthest toward the back of the printer, toward the power plug. Movement along the Y-axis rail is powered by the Y-axis motor, which hangs from the print board assembly.
- **Z-axis:** The print board assembly moves up and down along the Z-axis lead screw, located on the left side of the printer. The 0 position on the Z-axis is the uppermost position on the lead screw. Movement along the Z-axis is powered by the Z-axis motor, which is attached to the bottom frame plate.
- **Limit Switches:** Each of the three axes utilizes a limit switch to detect the 0 point along the axis. Each axis has a limit switch end stop that activates the limit switch.

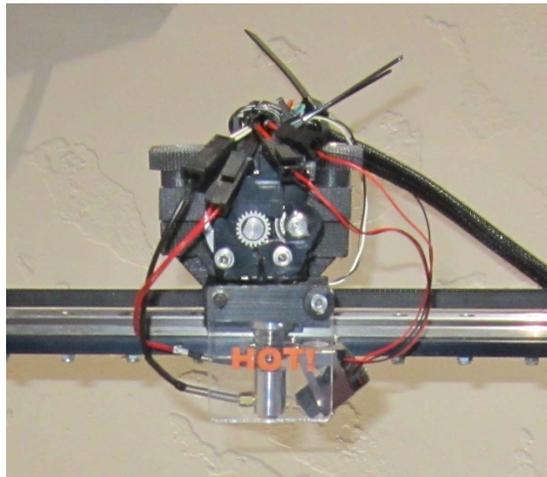
The X-axis and Y-axis limit switch end stops are fixed. The Z-axis end stop is adjustable to allow for a wider range of adjustment when leveling the print board.

Y-axis Limit  
Switch



Please see Section V for more information on calibrating the Z-axis end stop, and Section VI for more information on how to level the print board.

- **Printer Hot End Assembly**

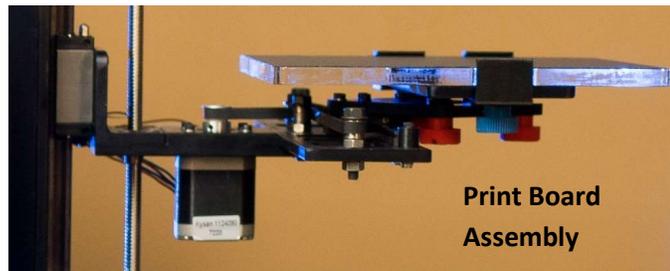


The printer hot end assembly is mounted on the top of the printer and moved horizontally along the X-axis. The printer hot end assembly is comprised of two main components: the extruder motor and the hot end. The extruder motor sits on top of the assembly, and it pushes the filament to the hot end. The hot end sits below the extruder motor, and it heats the filament to the specified temperature. The filament then passes through the hot end nozzle. The hot end has a thermistor embedded which relays the temperature of the hot end to the printer's operating program which is referred to as firmware and is located in the RAMBo board.



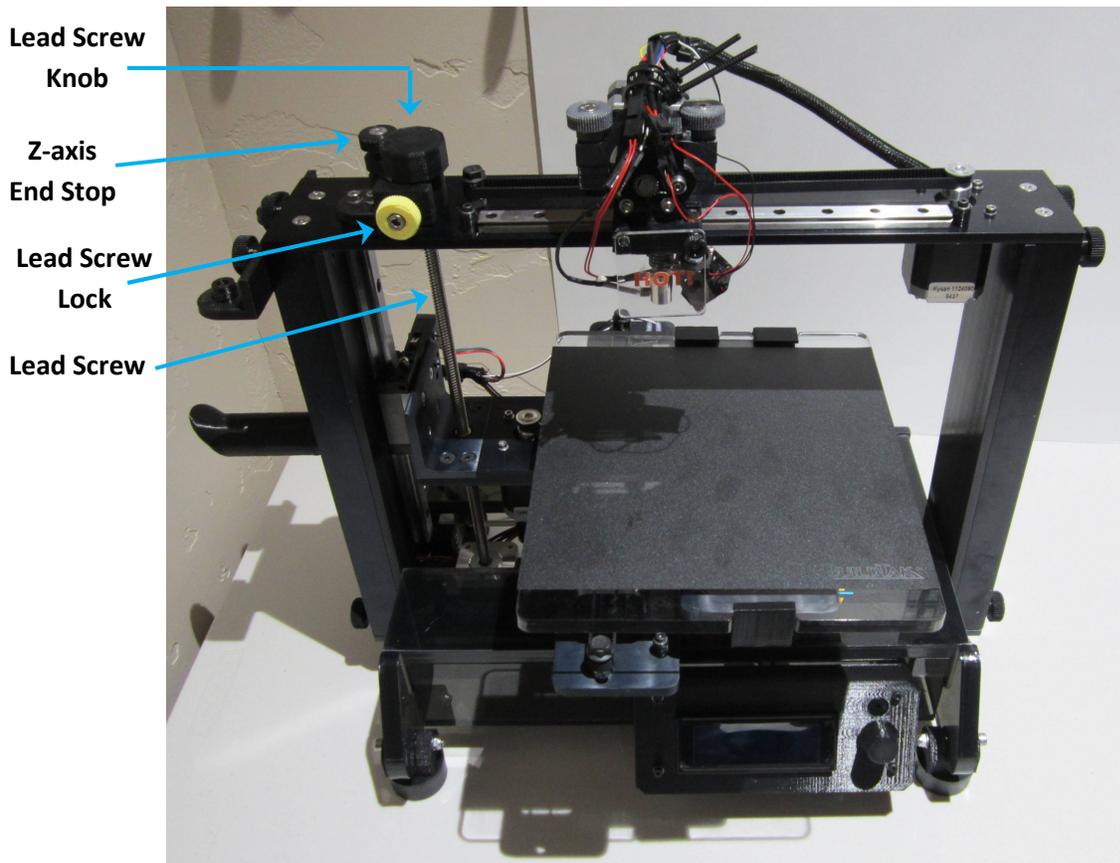
Additionally, the printer hot end assembly includes two fans. These fans turn on when the hot end temperature rises above 50 C, and turn off when the hot end temperature is below 50 C. Both fans run at the same speed and cannot be adjusted. The upper fan cools the hot end and extruder motor so that heat from the hot end does not rise up and cause the filament to melt inside the extruder drive. The upper fan should never be disconnected or turned off while the hot end is above 50 C. The lower fan cools the layers of the printed part quickly to allow for spherical and non-supported shapes to be printed. The lower fan may be turned off before or during print using the quick disconnect on its wiring. Some part geometries may print better without the lower fan.

- ***Print Board Assembly***



The print board assembly is located in the center of the printer. The print board itself is held in place by three clamps, one in the front and two in the rear. While the two clamps at the rear are fixed in place, the front clamp can slide out by loosening the blue thumb screw that locks it in place, which allows the print board to be removed. The print board should always be securely locked in place while printing and the print board should always be removed before removing a part from the print board. The print board is mounted to the print board plate via the clamps. The print board plate is held in place by three red thumb screws that are used to adjust the level of the print board with respect to the hot end. For more information on board leveling please see Section VI. The print board plate and print board move along the Y-axis rail toward the front and rear of the printer. The entire print board assembly moves up and down along the Z-axis via the Z-axis lead screw. For the best results, the print board assembly should be approximately 2" or more below the hot end before starting a print.

- *Z-axis Components*

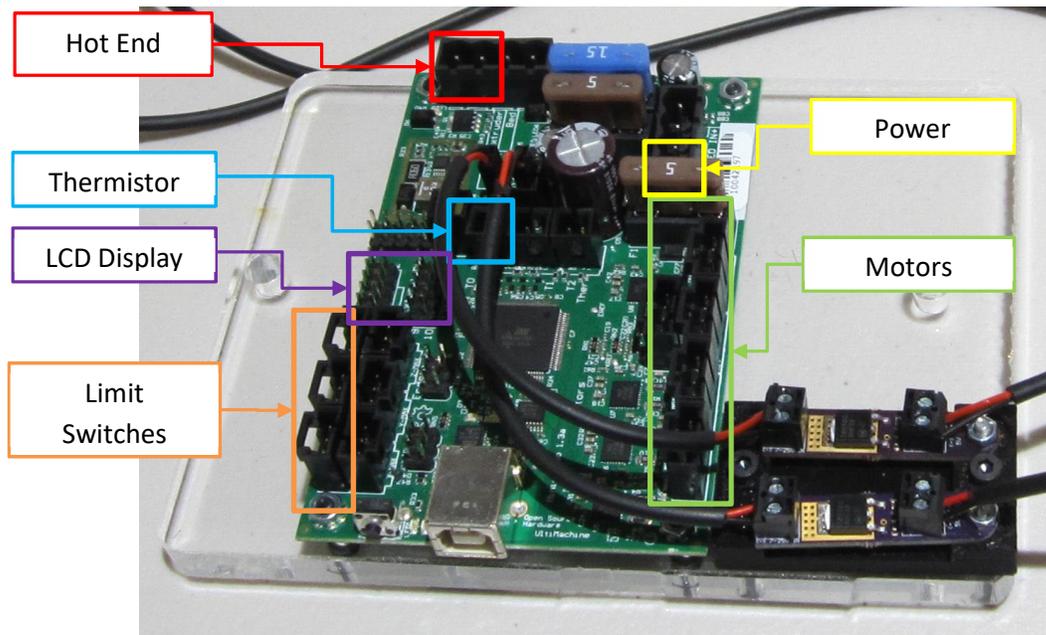


The Z-axis components consist of the Z-axis motor with lead screw, the lead screw knob, lead screw lock, and Z-axis end stop. The Z-axis motor moves the print board assembly up and down via the lead screw. The lead screw knob sits on top of the lead screw, and turning the knob by hand allows the user to manually raise and lower the print board as needed. The lead screw lock consists of a yellow thumb screw and housing and is located on the top frame. Tightening the yellow thumb screw will lock the lead screw in place, which is useful for leveling the print board and calibrating the Z-axis end stop. **Be sure that the yellow thumbscrew is loose before attempting to print; starting a print with the Z-axis locked may damage the printer.** The Z-axis end stop is a black thumb screw located on the top of the printer. The screw engages the Z-axis end stop, telling the printer that the 0-position on the Z-axis has been reached. The Z-axis end stop is calibrated manually to provide for a greater range of adjustment when setting the gap between hot end and the print board.

- *Wiring*

All wired components connect to the RAMBo circuit board mounted to the bottom of the printer. Wired components include 4 motors (X-axis, Y-axis, Z-axis, extruder), three limit switches (X-axis, Y-axis, Z-axis), two fans, hot end, thermistor, LCD screen, and power.

For ease of differentiation, wiring for the motors and limit switches are color coded using zip ties. The X-axis motor and X-axis limit switch have green zip ties, the Y-axis motor and Y-axis limit switch have yellow zip ties, the Z-axis motor and Z-axis limit switch have orange zip ties, and the extruder motor has a clear zip tie.



- **Filament**

The INVENT3D Printer uses 1.75mm PLA (polylactic acid) filament. PLA is a bio-degradable polymer created from various plant products including corn and potatoes. PLA is a type of thermoplastic, becoming soft and moldable when heated and returning to solid when cooled. PLA is available in a wide variety of colors. It may be purchased online or from INVENTORcloud directly. The INVENT3D Printer is not compatible with ABS or any filament which requires a heated print board.

The filament spool hangs from the filament spool holder on the left of the printer. The side of the filament spool with the deeper cut-out should always be facing the printer. Filament runs from the spool, through the filament guide mounted to the top of the left channel of the printer, through the guide tube, and into the extruder drive.

## II. TURNING THE PRINTER ON AND OFF

To turn on the printer, plug in the power cable to the back of the printer and plug the power supply into an outlet. To turn off the printer, disconnect the power supply. It is recommended to plug the printer into a surge protector and use the power switch on the surge protector to turn the printer on and off. **To prevent plugging the hot end, be sure that the hot end temperature is less than 50 C before turning off the printer. The fans should turn off at 50 C.**

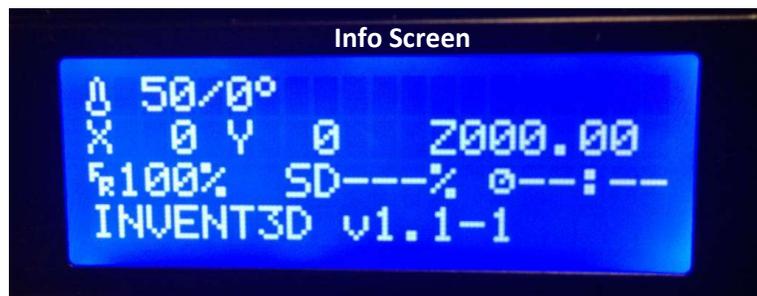
### III. OVERVIEW OF PRINTER INTERFACE

The INVENT3D Printer is controlled by the user via the control knob on the front of the LCD. Rotate the knob to the left or right to scroll through menu options. Push the knob in to select the highlighted field. The first option in any menu is always go up a level, and it will always have an up arrow next to it. Subsequent options are either actions or sub menus. Sub menus are indicated by an arrow pointing to the left.

**The following section outlines some firmware options. Printer settings and commands in the firmware that should not be adjusted are highlighted in red. It is not recommended that the user select or adjust the fields highlighted in red as doing so may prevent the printer from functioning properly and can damage the printer.**

#### *Info Screen*

When INVENT3D printer is plugged in, the LCD will light up and the **Info** screen will be displayed. The Info screen is the home screen, and after a short period of inactivity, will return to the Info screen.



The Info screen displays the following information:

- **Temperature:** Current temperature of hot end/specified temperature of hot end displayed in Celsius. When not printing, the specified temperature should be 0 C. When printing, the specified temperature should be 220 C. The fan turns on at 50 C when heating and turns off at 50 C when cooling. When not operating, the left setting should show room temperature.
- **X:** Coordinate of hot end on X-axis
- **Y:** Coordinate of hot end on Y-axis
- **Z:** Coordinate of hot end on Z-axis
- **FR %:** Feed rate percentage which determines print speed. Default is 100%. Increasing from 100% will increase speed but slightly lower quality. Decreasing from 100% will decrease speed but slightly improve quality. *Rotating the control knob will change the feed rate if the rate has been changed in the "tune" menu on the LCD.*
- **SD%:** Completion percentage of the part being printed in terms of number of layers complete.

- **Print Time** (represented by image of clock): Time elapsed from start of print. The clock will continue to run after print is completed until the printer is configured for another print or is unplugged. The time to complete print will be displayed in the Notification field when print is finished.
- **Notification** (text field at bottom of screen): Changes based on status of printer. When the printer is turned on the notification field will display the current firmware installed on the printer. After a part is selected for print the notification field will display “Heating...” While the part is printing the notification field will display “Heating done.” When the part is finished the time to complete print will be displayed.

### **Home Screen**

Clicking (pushing in) the control knob will bring up the **Home** screen, which allows the user to select one of three printer sub menus as follows:

- **Prepare:** Prepare printer to print.
- **Control:** View and change print parameters. *It is not recommended to change print parameters from the control screen as changing them could prevent the printer from operating properly.*
- **Print from SD:** Print G-code files saved to the SD card.

### **Prepare Screen**

The **Prepare** screen allows the user to perform all functions necessary to prepare the printer to print. The **Prepare** screen allows the user to select from the following options:

- **Disable Steppers:** Cuts power to motors and allows motors to move.
- **Auto Home:** Hot end moves to coordinate (0,0,0).
- **Preheat PLA:** Heats hot end to 225 C to allow loading and unloading of filament.
- **Cooldown:** Sets temperature of hot end to 0 C. Hot end will cool down to room temperature.
- **Switch Power Off:** Turns off power to hot end.
- **Move Axis:** Submenu that allows user to move motors in increments from .1mm to 10 mm. Used when loading and unloading filament. This function cannot be performed when setting is more than 1mm.

### **Move Axis Submenu**

The Move Axis submenu allows the user to move the X, Y, Z, and extruder motors in increments of .1mm, 1mm, and 10mm by rotating the control knob. After selecting **Move Axis**, the user will be able to select the distance to move the motor. **It is recommended to always select 1 mm.** After selecting the distance, the user will be able to select the motor that they wish to move. After selecting the desired motor, a control screen will be brought up and the user can turn the knob clockwise or counterclockwise to move the motor forward or backward. Push the control knob in to go back to the motor select submenu.

## Control Screen

It is not recommended that the **Control Screen** and its submenus be used as changing the print parameters may cause the printer malfunction and cause damage. **Control Screen** options are:

- **Temperature:** Changes printer parameters with respect to temperature.
- **Motion:** Changes printer parameters with respect to motion.
- **Store Memory:** Save changes made in temperature and motion.
- **Load Memory:** Restore saved changes previously made in temperature and motion.
- **Restore Failsafe:** Restore to default temperature and motion settings.

If any changes are made to temperature and motion settings, they can be undone by selecting **Restore Failsafe**.

## Print From SD Card Screen

The **Print From SD Card** screen allows the user to select from G-code files that were saved to the SD card. G-code files are created by the slic3r program based on a .stl CAD model. Upon clicking on **Print From SD Card** using the control knob, the printer will display filenames of the G-code files saved to the SD card. If the most recent file saved is not last on the list, the SD card is full. This can impact printing. Use a new SD card or deletes files from current SD card. Rotating the control knob allows the user to select the desired file to print. Upon selecting a file, the printer will begin heating up and preparing to print.

## Options Only Available During Print

These options, in addition to **Control** described above, are only displayed on **Home** Screen while the printer is printing

- **Tune:** Allows the user to change certain print parameters specifically for the ongoing print:
  - **Speed:** Change print speed. Slower printing yields higher quality while faster printing results in lower quality.
  - **Nozzle:** Change temperature of the hot end. 220 C is the default.
  - **Fan Speed:** Always set at 0 as the fan speed of the INVENT3D printer is not adjustable.
  - **Flow:** Change flow rate through the hot end nozzle. Should always be set at 100.
- **Pause Print:** It is not recommended to pause for more than 1 minute as melted filament will drip onto the part.
- **Stop Print:** Stops the print, and the print may not be resumed. The hot end will not cool down automatically if the print is stopped. The user will need to navigate to and select the **Cooldown** option described above to begin the cooling process.

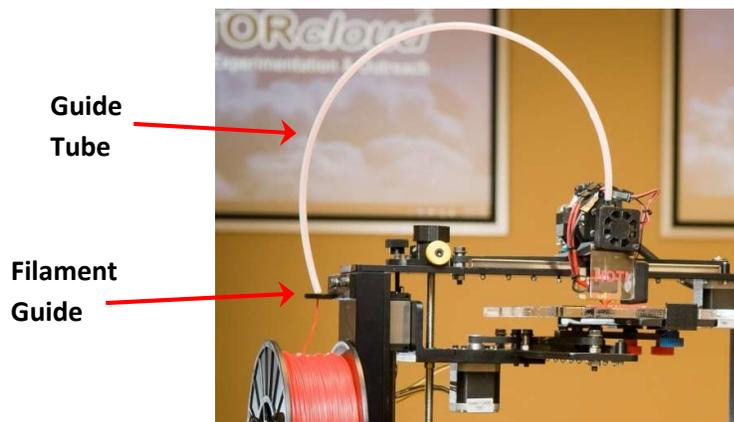
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#### IV. LOADING / UNLOADING FILAMENT

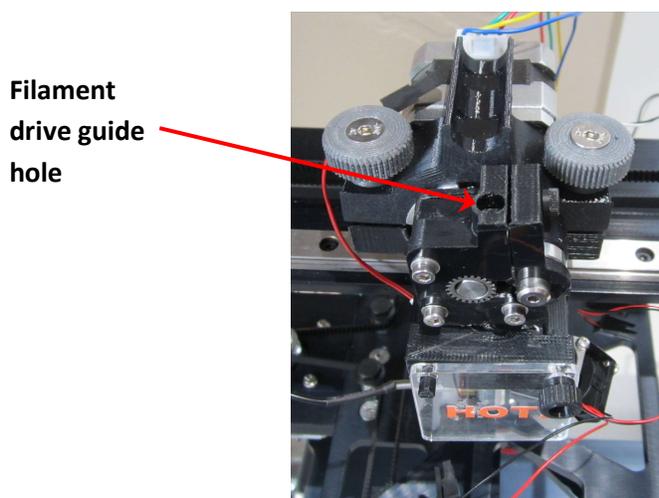
It is important to remember that the INVENT3D printer is only compatible with 1.75mm PLA.

##### *Loading Filament*

1. Place the spool on the spool holder. Each filament spool has one side where the center is cut deeper; this side should be facing the printer to ensure that the spool seats correctly on the holder and that material does not get trapped behind the spool and impair printing.
2. Locate the end of the filament and cut away any bent or twisted filament from the end.
3. Feed filament through the filament guide (accommodates filament wound clockwise or counter-clockwise) so that it is coming off spool on the side that the filament is feeding.
4. Run filament through guide tube.

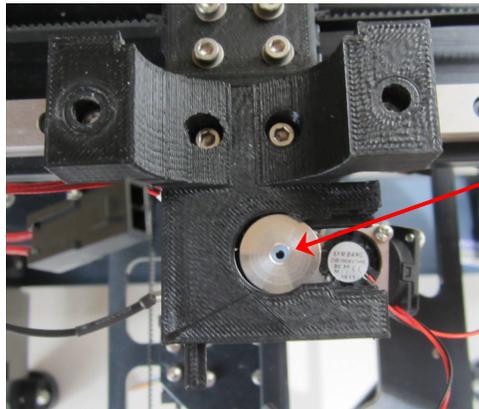


5. Insert filament into filament drive guide hole.



6. Turn on printer, go to **Info** screen, select **Prepare**, and then select **Preheat PLA**.

7. Wait until temperature of hot end reaches 200 C.
8. Go to **Info** screen, select **Prepare**, select **Move Axis**.
9. Under the **Move Axis** submenu, select **Move 1mm**, then select **Extruder**. Extruder motor will not move if 10mm is selected.
10. Rotate control knob clockwise until filament comes out of the hot end.
11. *If filament does not feed through hot end, the hot end is not seated flush in its mount. Push the hot end as far as possible into its mount.*
12. *If filament still does not feed, remove the extruder top that holds the extruder motor into place. Lift up the extruder motor and extrude out about 1" of filament. Insert filament into the top hole of the hot end and set the extruder motor back on the extruder bottom. Replace the extruder top to lock down the extruder motor. Extrude filament until it comes through the hot end nozzle. The filament will not feed if hot end temperature is less than 200 C.*



13. When using a new roll of filament, watch how the filament is leaving the spool when beginning to print as well as when spool is placed on the printer. If the filament is wound too tightly, it can jump off the spool and become trapped between the spool and the printer.

### ***Unloading Filament***

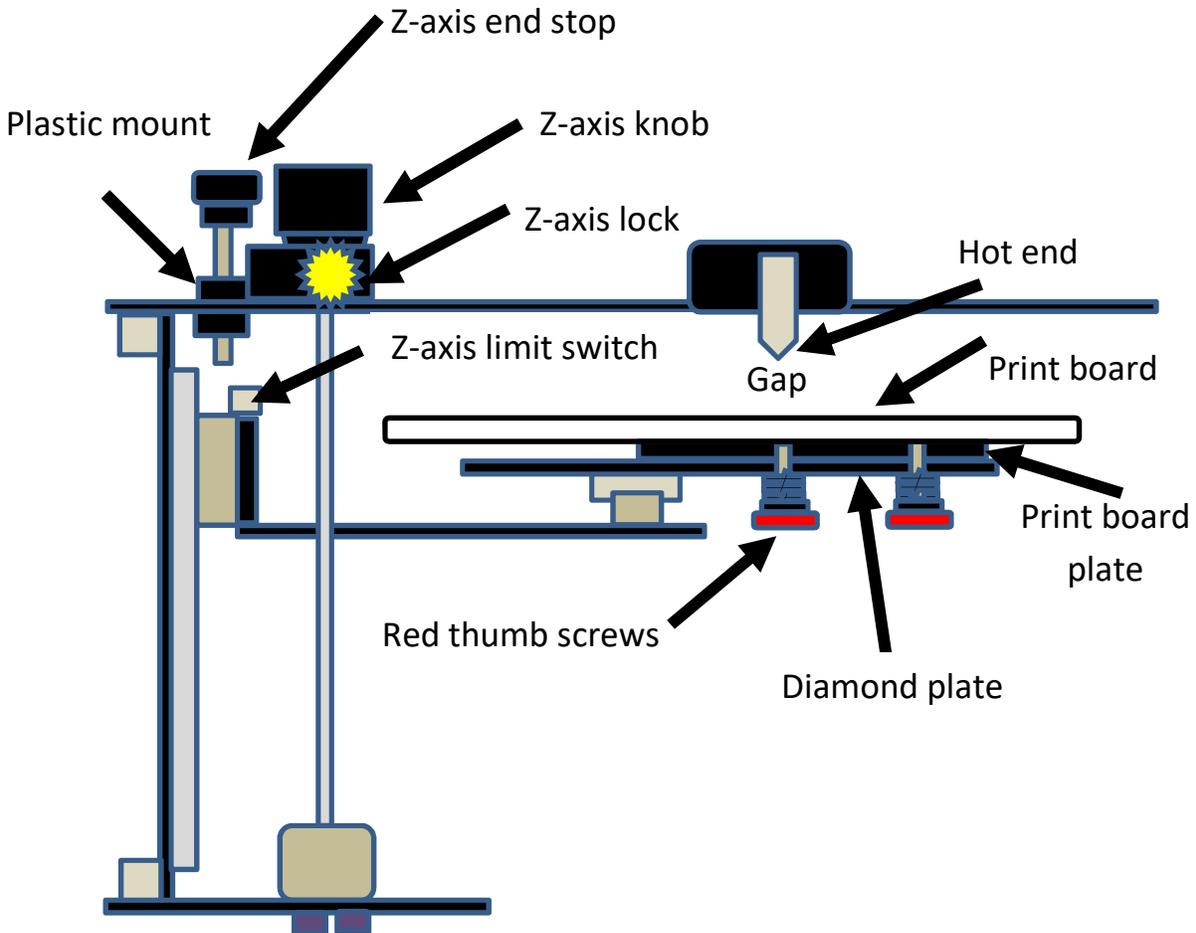
1. Turn on printer, go to Info screen, select Prepare, and then select Preheat PLA.
2. Wait until temperature of hot end reaches 200 C.
3. Go to Info screen, select Prepare, select Move Axis.
4. Under the Move Axis submenu, select Move 1mm, then select Extruder.
5. Rotate control knob counter-clockwise until filament backs out of the hot end.
6. *Do not attempt to unload filament without first heating the hot end. The extruder motor will not function if the hot end is not at least 200 C.*

## V. CALIBRATING THE Z-AXIS LIMIT SWITCH END STOP

Calibrating the Z-axis limit switch end stop is required if the user is unable to level the print board using the three red thumb screws, which occurs when the thumb screw falls out of the hole or cannot be tightened any further or are too loose. Additionally, the Z-axis limit switch end stop will need to be recalibrated if it is removed from the printer or becomes loose. *The Z-axis limit switch end stop should only be calibrated when the hot end is cold.* Refer to Section VI for instructions on board leveling and setting hot end gap.

## VI. LEVELING THE PRINT BOARD

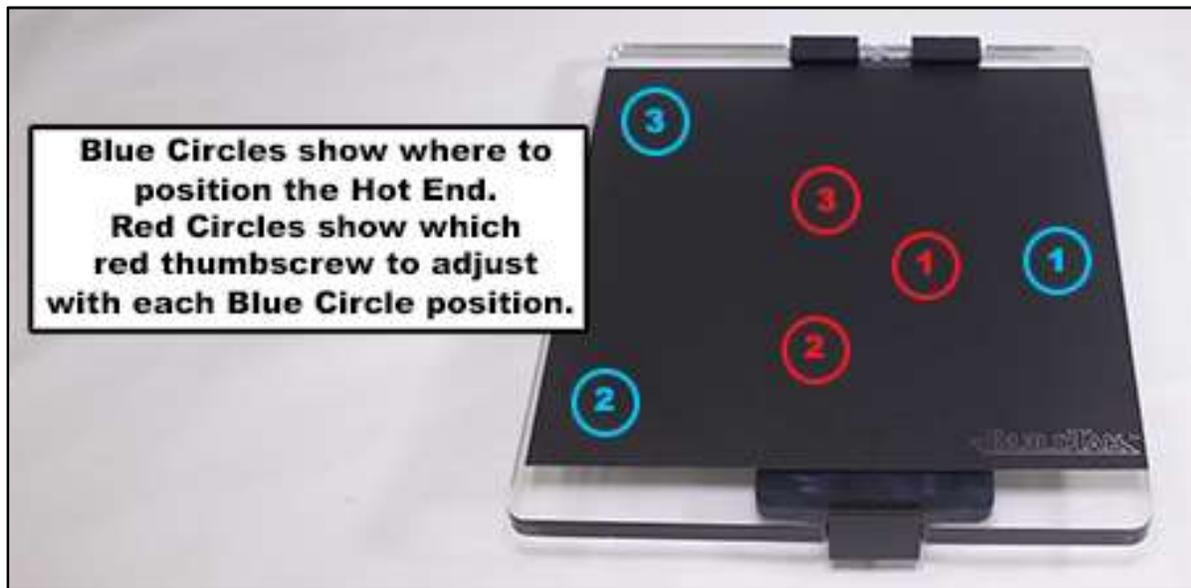
**It is imperative to understand each component of the schematic to successfully and easily level the board.**



The print board must be level for printer to print correctly. The print head is too close if the printed filament is transparent or if the hot end touches the print board. The print head is too far away if the printed filament is lifting up from the print board or accumulating around the hot end. Obtaining a level board is integral to successful printing and production of high quality parts. Therefore, it is imperative to check and maintain the level of the print board before printing begins.

- 1) Remove the print board.
- 2) Visually locate the ends of the red thumbscrews in the print board plate.
- 3) Tighten all three red thumbscrews until they are flush with top side of the print board plate.
- 4) Loosen each red thumbscrew 1 ½ turns. Confirm that each screw is recessed the same amount below the surface of the print board plate. **NOTE:** If you are having difficulty determining how much to turn the red thumbscrews, re-tighten all three red thumbscrews until they are flush with the top of the print board plate, then place a mark on the right side of each red thumbscrew.
- 5) Grab the print board plate and gently wiggle it up-and-down and back-and-forth to make sure the wave springs are properly seated in the print board spacer, and to check for any loose screws missed during assembly. Tighten any screws that feel loose.
- 6) Install the print board by pressing it firmly into the rear print board clamps, then press the front board clamp firmly against the print board, and finally secure the front print board clamp by tightening the blue thumb screw located below the print board.
- 7) Loosen the Z-axis end stop screw so that the end of the screw extends no more than ½" from the bottom side of the top plate.
- 8) Place a business card or index card (approximately 0.2mm) on the print board.
- 9) Move the hot end and the print board so that the hot end is located directly over the center of the print board. Using the Z-axis knob, lift the print board until the card is just slightly trapped by the hot end. The card should be moveable with only slight resistance. **NOTE:** Try to not press down on the print board when moving the card as this will make the gap between the hot end and the print board appear larger than it is. (If the Z-axis end stop screw prevents you from lifting the print board high enough, go back and redo Step 7 above.)
- 10) While holding the Z-axis knob, hand tighten the yellow Z-axis lock thumbscrew to lock the print board so it can't move up or down along the Z-axis.

- 11) Move the hot end and print board to position the hot end at Blue Circle 1 in the picture (approximately 1" from the right side of the print board). Using the card, measure the gap between the hot end and the print board. Adjust only the right red thumbscrew (Red Circle 1) until the card is moveable with only slight resistance.
- 12) Repeat Step K above, moving the hot end to Blue Circle 2 in the picture (approximately 1" from the left side of the print board) and adjust only the front red thumbscrew (Red Circle 2).
- 13) Repeat Step K above, moving the hot end to Blue Circle 3 in the picture (approximately 1" from the left side of the print board) and adjust only the rear red thumbscrew (Red Circle 3).



- 14) Repeat the last three steps with each red thumbscrew to confirm that you have a consistent gap between the hot end and the print board in all three locations.
- 15) Gently press and release the Z-axis limit switch and listen for it to click. Now slowly tighten the Z-axis end stop screw until you hear it press the Z-axis limit switch and make it click.
- 16) Loosen the yellow Z-axis lock thumbscrew, then use the Z-axis knob to lower the print board a few inches.

17) To check the adjustment of the Z-axis limit switch:

1. Press the LCD button; menu will display.
2. Go to “Prepare” and select; menu will display.
3. Go to “Auto Home” and select.
4. The hot end and print board assembly will move to 0,0,0 position. **NOTE:** If you hear any noise, stop and troubleshoot. Causes may include: belts may not be aligned, yellow thumbscrew not released, may need to apply grease to Z-axis lead screw, end stop switches are not functioning properly, etc.
5. Tighten the yellow Z-axis lock thumbscrew to lock the print board so it can't move up or down along the Z-axis.
6. Press LCD button; menu will display.
7. Go to “Prepare” and select; menu will display.
8. Go to “Disable Steppers” and select. This will allow you to move the hot end and print board to check the gap with the card. The card should be moveable with only slight resistance.
9. If the gap is correct, you're done. If the gap is too tight, turn the Z-axis end stop screw  $\frac{1}{4}$  turn clockwise. If the gap is too large, turn the Z-axis end stop screw  $\frac{1}{4}$  turn counter-clockwise.
10. Loosen the yellow Z-axis lock thumbscrew, then use the Z-axis knob to lower the print board a few inches.
11. Re-check the adjustment of the Z-axis limit switch by repeating the previous 10 steps until the gap is correct.

**NOTE:** This full process for print board leveling typically only needs to be done when you are assembling the printer from the kit or if the print board get way out of level. For day-to-day use the print board should stay level. Always remove the print board before attempting to remove a printed part from the print board. Attempting to remove a part from the print board while it is still connected to the printer is a quick way to get your print board way out of level, and very well may damage the printer.

## VII. CONVERTING .STL FILE TO G-CODE

CAD files saved as .stl must be converted to a G-code file prior to printing on INVENT3D using a slicer program. The G-code file tells the printer how to print a desired part, controlling print parameters such as temperature, speed, orientation, and scale as well as part options such as fill type (rectilinear, honeycomb, etc.) and support material usage. Default print parameters are calibrated specifically for the INVENT3D printer and cannot be changed. The print settings defined in the slicer program will always take precedent over the settings programmed into the INVENT3D printer firmware.

The recommended slicer program for use with the INVENT3D printer is slic3r, an open source slicing program. Instructions for downloading slic3r are posted to the INVENTORcloud website at [www.inventorcloud.net](http://www.inventorcloud.net). It is absolutely essential that slic3r program be downloaded from the INVENTORcloud website to prevent printer damage and provide quality prints. This assures that the settings correspond to the INVENT3D Printer. Using settings designed for any other printer will damage the INVENT3D Printer and/or result in poor quality.

*IMPORTANT: Do not use a slicer program that is not calibrated specifically for INVENT3D printer as doing so may break the printer. Do not download the program from any other generic website.*

Instructions on how to convert a .stl file to a G-code file using slic3r:

1. Open slic3r from desktop button.
2. Use the **Platter** screen to set up the print.
  - 2.1. Select **Add**, then search for the file to be printed
  - 2.2. Select file and click **Open**.
  - 2.3. Double click on drawing to view in 3D.
    - 2.3.1. Be sure the object is facing the direction desired for printing.
    - 2.3.2. If rotation is needed, use the **Rotate** buttons change model orientation. The design may need to be rotated in the CAD program.
  - 2.4. **Scale** button allows for increasing or decreasing the size of the part to be printed. This size of the part is shown in mm. Verify that part is correct size.
  - 2.5. To copy part, click "+" to add a copy of the part, or use "-" to subtract a copy of the part.
  - 2.6. The **Add** button allows adding another file to the same print.
  - 2.7. **Delete / Delete All** will allows removing parts from print.

2.8. **Arrange** moves the location of part(s) on the board. It is recommended to always use this when printing multiple parts.

3. Use **Print Settings** to change parameters of part to be printed.

**NOTE:** Changing print settings should only be done by someone with extensive experience with 3D printing. It is recommended that pre-programmed, default settings be used for normal printing which can be found at [www.inventorcloud.net](http://www.inventorcloud.net).

3.1. **Layer Height** alters the height for each individual layer. It can be used to change print speed. A layer height of 0.15 is recommended.

3.2. **Infill** – 20 to 40% recommended, do not exceed 65% as this will plug hot end.

3.2.1. **Fill Pattern** –Changes the pattern of the fill of the part. Rectilinear is recommended.

3.2.2. **Top/Bottom Fill** – Changes the pattern of the fill of the top and bottom of the part to be printed. Rectilinear is recommended.

3.2.3. **Combine Infill Every** – Should be set at 1 layer.

3.2.4. **Solid Infill Every** – Should be set at 0 layers.

3.2.5. **Fill Angle** – Should be set at 45 degrees.

3.2.6. **Solid Infill Threshold Area** – Should be set at 70mm.

3.2.7. **Only Retract When Crossing Perimeters** – Should be checked.

3.3. **Skirt and Brims** – It is not recommended to change defaults.

3.4. **Support Material**

3.4.1. **Generate Support Material** - Should be checked if part will not print without support.

3.4.2. **Raft** – Do not use. It should always be 0.

3.4.3. **Pattern** – Changes the pattern of the support material. Pillars is recommended.

3.4.4. **Pattern Spacing** – A setting of 4 mm is recommended.

3.4.5. **Don't Support Bridges** – Should be checked.

3.5. **Notes** – Notes are not needed.

3.6. **Output options** – It is not recommended to change default settings.

3.7. **Multiple Extruders** – It is not recommended to change default settings.

3.8. **Advanced** – It is not recommended to change default settings.

3.8.1. **Filament Settings** is used to change the parameters of the filament to be used for the print. It is recommended to leave default settings as they are programmed for the INVENT3D Printer.

#### 4.1. Filament

4.1.1. **Diameter** – Should be set at 1.75mm.

4.1.2. **Extrusion Multiplier** – Should be set at 0.95.

4.1.3. **Temperature** – Should be set at 220°C / 220°C. It is recommended to change temperature using the 3D printer itself and not in the slic3r program.

4.1.4. **Board** – Should be set at 0°C / 0°C. The INVENT3D printer does not use a heated board.

4.2. **Cooling** – It is recommended not to change default settings.

5. **Printer Settings** – It is recommended not to change default settings as they have been programmed for the INVENT3D printer.

6. Go back to **Platter** when finished with the various **Settings**

6.1. Select **Export G-code**.

6.2. Save file on SD card. Be certain that file is completely saved before moving SD card.

6.3. Insert SD into INVENT3D printer to print.

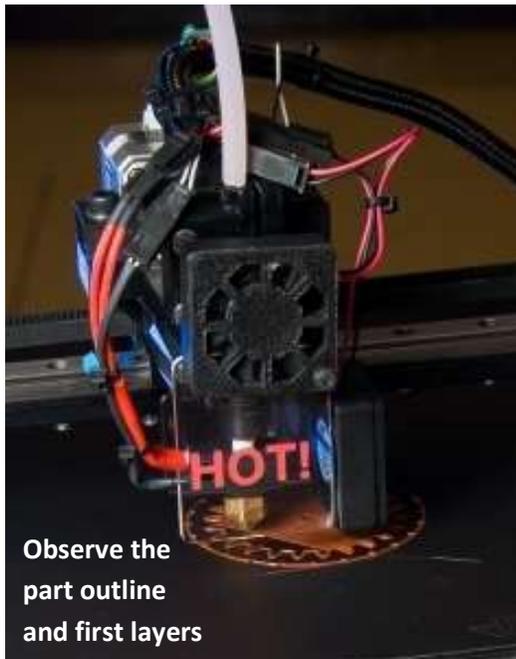
7. The CAD design must in millimeters (mm) or the slicer program will show a very small print if the design is in inches. Conversion to mm is required.

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## VIII. PRINTING A PART AND REMOVING THE PART FROM THE PRINT BOARD

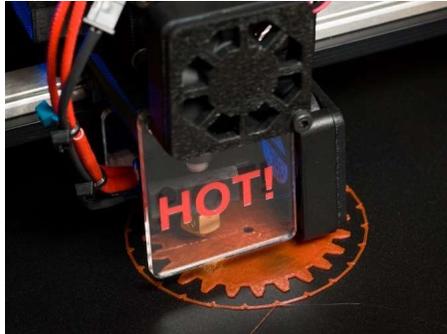
To print:

1. Ensure that the print board is at least two inches below the print head. Ensure that the Z-axis is not locked in place by checking that the yellow thumb screw that locks the Z-axis is loose and is not making any contact with the Z-axis lead screw knob.
2. Go to the Main menu and select **Print** from SD. Use the control knob to find and select the file to be printed. For normal operations, no additional printer settings or adjustments are needed.
3. Watch the printer as it performs its start-up routine and begins to print. The temperature will automatically increase from room temperature to 220°C. Once heated, the printer will move the hot end to point (0, 0, 0). Then the hot end will move to the side of the board and extrude a small amount of filament to ensure that the print head is not clogged. If the filament does not extrude, refer to Troubleshooting Guide. This extra material should be cleared from the hot end by the edge of print board as the hot end moves to being the print. If any of this material is dragged onto the print board, remove it as soon as possible so it does not affect the print.
4. The print will begin with an outline of the object to be printed. Be sure that the outline is clear and aligns with the part to be printed. If there are any irregularities, select **Stop Print** from the Main Menu. Lower the print board by hand using the knob on top of the Z-axis lead screw. Remove the print board (see Step 8 of this Section), clear the filament from the board, replace the board, and try the print again. If irregularities persist, refer to Troubleshooting Guide in this document.



5. Look at the first few layers of the print. If there are notable spaces between fill lines of the first layer, then the print board is too far away from the hot end. If the first layer is highly transparent or there is noise from the hot end grinding against the first layer as the second layer is printed, then the print board is too close to the hot end. If the print board is either too high or too low, select **Stop Print** from the Main Menu, and then select **Cooldown**. Lower the print board by hand using the knob on top of the Z-axis lead screw. Remove the print board (see Step 8 of this Section), clear the filament from the board, and replace the board. When the hot end has cooled down below 50°C, perform board leveling.

**Example of good print quality**



6. If the printed object is lifting off of the print board on one of the sides, the print board is too far away from the hot end. Select **Stop Print** from the Main Menu, and then select **Cooldown**. Lower the print board by hand using the knob on top of the Z-axis lead screw. Wait for the hot end to cool down to room temperature, and then perform board leveling.
7. Upon completion of the print, the hot end will move to the 0 point on the X-axis. The hot end will automatically cool down to room temperature.
8. To remove the part from the print board, lower the board and loosen the blue thumbscrew underneath the print board and slide the front clamp forward. Remove the print board. Use a sturdy, bent angled paint scraper. Do not use a putty knife since it does not have a beveled edge. Slide the scraper underneath the part. Be careful not to scratch or gouge the BuildTak. If print is difficult to remove and the board is level, adjust the gap by turning Z-axis end stop thumb screw approximately 1/4 turn clockwise. This will slightly increase the distance of the hot end from the board and ease print removal. This can be repeated until desired result achieved. Slide the print board back into place by pushing the front of the board while holding the rear clamps. Push the front clamp back into place and tighten the blue thumbscrew. Move the print board from side to side to ensure that it is locked in place.

## IX. REPLACING BUILD TAK AND OTHER PRINT BOARD MATERIALS

If the BuildTak print board cover is showing significant wear, holes, or gouges that cannot be repaired with blue painter's tape, then replace the BuildTak. Submit a Support Ticket or contact [info@inventorcloud.net](mailto:info@inventorcloud.net) to order.

1. BuildTak is an adhesive for the print board that allows for easy removal of printed items. There are other materials that can be used (ie: painter's tape, hairspray, etc) but BuildTak provides ease of use. Parts must be removed carefully to prevent damaging the BuildTak sheet.
2. Loosen the blue thumbscrew and back out the front print board clamp.
3. Slide print board out from the rear board clamps.
4. Remove old BuildTak and if necessary, clean board if cloudy layer of adhesive remains.
5. Remove the plastic covering over the back of new BuildTak sheet to expose the adhesive.
6. Center over board, start by laying one side down and smoothing the surface as the sheet is laid down. Apply slowly and avoid bubbles. If necessary, pull section back up, press out bubbles and smoothly lay it down.
7. Insert the print board back into the rear board clamps. Slide the front board clamp forward to lock the print board in place and lock by turning the blue thumbscrew clockwise.

### Other Print Board Materials

The optimum material is one that allows the first layer of the printed part to firmly stick to the print board and then allows the print to be completed without the part unsticking, moving, or warping. However, it must also allow the part to be removed when printing is finished without damaging. It has to withstand the heat from the hot end and extruded plastic without burning. Also, it should not degrade or rupture quickly and the surface finish is smooth.

Besides BuildTak, there are a few common materials used to coat the surface of the print board. A primary alternative is blue painter's tape. Other options include a glue stick, which contains PVA, can be applied to build surface and hairspray that is "extra hold" with ingredients such as vinyl, acetate, and copolymer.

BuildTak's advantages are that the part sticks firmly to print board, but not so firm that it can't be removed, reduced part warping, more forgiving with board leveling due to how well part sticks to surface, easiest to achieve high print quality even on larger parts and with careful removal of parts from board, can be used for many prints. It is more expensive, not as readily available and is fragile as it can be gorged or scratched when parts are removed.

Blue painter's tape can tear very easily and needs to be replaced after every print, printed part does not stick easily to tape and there is no margin for error with print board leveling (must be perfect level), and there can be significant warping when printing larger parts. However, it is inexpensive and readily available. Brown painter's tape secures the part better but may be difficult to remove from the printed part.

## X. TROUBLESHOOTING GUIDE AND OPERATING VIDEOS

### Filament

- Not extruding
- Not sticking to board
- Shavings in extruder

### Print quality

- Print stops
- Shifting during print
- Print is oval instead of round
- Print shape is erratic
- Print is hard to remove
- Print part lifts or is warped
- Print is stringy or messy
- Print quality not good

### LCD

- Blue screen
- Nonsensical characters

### Power

- No Power

### Print Board

- Not level
- Does not lift to print

### Hot end

- Leaking filament
- Does not maintain temperature

### Limit Switch Wires

- Broken

### Grinding of Y-Axis

- Noise when raising on lead screw

If you do not find information regarding your issue or the remedies prescribed do not resolve issue, please submit a Support Ticket to <http://support.inventorcloud.net/>.

## **OPERATING VIDEOS**

Videos are available on YouTube and INVENTORcloud website:

- Installing Slic3r: <https://youtu.be/-kWy8JPh2IQ>
- INVENT3D – Keys to Success: [https://youtu.be/4-TP87f\\_Dtk](https://youtu.be/4-TP87f_Dtk)
- Changing Filament: <https://youtu.be/GkhGFjLo9Y>
- Part Removal: <https://youtu.be/YI2lwoVA1l4>
- Print Board Leveling: <https://youtu.be/t5xmp9knYew>
- Routine Maintenance: <https://youtu.be/GVPg4gXYw9w>
- Z Axis Calibration: <https://youtu.be/jwzYRii9fM0>

**Note:** Certain components on the INVENT3D Printer have been redesigned and therefore, the printers displayed in videos may look slightly different, however, functionalities have not changed and all content is relevant to all versions of INVENT3D Printer.

## **FILAMENT**

**Problem:** *Filament does not extrude or stops extruding*

**Probable Cause:** Filament not coming off filament roll.

- **Remedy 1:** Filament may be wrapped over itself on the spool. Unwind the filament from the spool until the filament smoothly leaves the spool and the over-wrap is eliminated. Wind the filament tightly back onto the spool in a back and forth manner, ensuring not to over-wrap again. The filament spool may need to be removed from the spool holder if the over-wrap is deep on the spool. Be careful that the filament does not break.
- **Remedy 2:** Filament may be tangled around the spool holder. Remove the spool from the spool holder and unwrap the filament from around the spool holder. Wind the filament back onto the spool, being careful not to overlap the filament to ensure that the filament will smoothly unwind from the spool. When placing the spool back on the filament holder, ensure the side with the cutout faces the printer so that the spool sits flush with the printer.
- **Remedy 3:** Filament may be getting pinched in the filament guide. Ensure that the filament passes through the filament guide on the same side that it leaves the spool. For example, if the filament leaves the spool on the side closest to the rear of the printer, it should pass through the rear filament guide hole. If filament is not passing through the appropriate side of the filament guide, remove the filament and pass it through the appropriate side. If filament is passing through the proper side of the filament guide but still pinching, ensure that the filament guide tube is seated properly in the top opening of the filament guide.

**Probable Cause 2:** Extruder motor not turning.

- **Remedy 1:** Extruder motor wire maybe unplugged or is not correctly plugged into RAMBo board. Verify that the extruder motor wire is correctly and completely plugged into the top of the extruder motor. Facing the front of the printer, the blue wire should be on the left hand side. Remove the top cover of the printer to observe the RAMBo board. Facing the front of the printer, the motor wire ports are located on the front right side of the RAMBo board. Verify that the extruder motor wire is plugged into the port labeled E0 (the motor port closest

to the rear of the printer). When plugged in, the blue motor wire should be closest to the front of the printer.

- **Remedy 2:** Extruder motor gear may be loose. Observe the rotation of the extruder motor shaft and gear while the extruder motor is operating. If shaft is rotating but the gear is stationary, the extruder motor gear is loose and must be tightened. Remove the filament from the hot end and extruder motor. Unscrew the silver thumbscrews on the top of the hot end assembly to access the extruder motor. Remove the three screws and washers that attach the filament drive to the extruder motor and remove the filament drive. Use a 1mm Allen wrench to tighten the set screw that affixes the extruder motor gear to the extruder motor shaft (the gear should sit flush with the top of the motor shaft). Ensure that the set screw seats onto the flat portion of the motor shaft; rotate the gear as required to align the set screw with the flat portion of the motor shaft. Reattach the filament drive to the extruder motor. Place the extruder motor back onto the hot end mount and tighten the upper mounting bracket onto the extruder motor using the silver thumbscrews.
- **Remedy 3:** Hot end may not be preheated; if so, the extruder motor will not turn as a safety precaution in the firmware. Verify that the hot end is heated to at least 200°C.
- **Remedy 4:** Motor may be defective. Submit Support Ticket.

**Probable Cause 3:** Hot end plugged

- **Remedy:** If the hot end is plugged, DO NOT insert any foreign object into the top of the hot end such as a paper clip or tooth pick. Turn on the printer, go to the Info screen, and select **Preheat PLA**. Once the hot end is heated, go to the Info screen and select **Move Axis**, then **Move 1mm**, then **Extruder**. Rotate the knob counter clockwise to remove the filament from the hot end. Cut off the partially melted end of the filament at a 45 degree angle. Allow the hot end to sit heated for 10 minutes; filament may drip from the hot end. After 10 minutes, re-insert the filament into the filament drive. Go to the Info screen and select **Move Axis**, then **Move 1mm**, then **Extruder**. Rotate the knob clockwise and attempt to push the filament through the hot end to remove the plug. If filament extrudes, the issue has been resolved. It may help to raise the temperature of the hot end to 250°C using the LCD temperature control. Temperature needs to be immediately reset after clearing the filament. If filament still does not extrude, submit a Support Ticket.

**Probable Cause 4:** Filament melted between hot end and filament drive.

- **Remedy:** If the fan that cools the hot end is not working, either due to malfunction or if it has become unplugged, it may cause the hot end to overheat to the point that filament melts just below the filament drive. If the fans are not working, verify that the quick disconnects are completely attached at the top of the hot end assembly. If fans still do not work, submit a Support Ticket. If filament has melted between the filament drive and hot end, attempt to remove the extruder motor and clean the melted filament with a small flathead screwdriver. Fracture the filament both above the hot end and below the filament drive. Once this filament

is cleaned, try to feed the filament back on top of the existing filament in the hot end. If unable to remove the melted filament, submit a Support Ticket.

**Probable Cause 5:** Print board too close to hot end.

- **Remedy:** If the hot end is touching the print board while printing, the print board may block the hot end nozzle and prevent filament from extruding. There may be a scraping noise as the hot end grinds against the print board, and scrapes on the BuildTak. Stop the print and allow the hot end to cool. Select “**Stop Print**” from the Main Menu, then select “**Prepare**”, and then select “**Cooldown**.” Remove the failed print from the print board. If the BuildTak has been significantly damaged, replace the BuildTak. Once the hot end is cooled down, level the print board and attempt to print. If the problem persists, re-level the board.

**Probable Cause 6:** Filament pressure adjustment screw not tight enough.

- **Remedy:** If the screw is not tight enough, there will not be sufficient pressure placed on the filament by the extruder motor gear, causing the gear to spin but not drive the filament forward. Facing the front of the printer, the pressure adjustment screw is on the right hand side of the filament drive near the silver thumbscrew cap. Tightening this screw tightens the extruder motor gear against the filament. As the screw is tightened, the slot in the top of the filament drive will narrow; the ideal width is approximately one business card width. Be careful not to overtighten as it will create filament shavings in the filament drive or cause the filament to rupture.

**Probable Cause 7:** Filament may be bent.

- **Remedy:** When inserting filament into the filament drive for the first time or when changing filament, ensure that the tip of the filament is not significantly bent in one direction. If it is, the filament may not pass directly from the filament drive to the hole in the top of the hot end. The filament will not extrude through the hot end, producing a clicking noise as the extruder motor attempts to drive the filament forward. Back the filament out of the filament drive and cut off the bent tip. Reinsert the filament back into the filament drive and attempt to extrude.

**Probable Cause 8:** Hot end and filament drive may be misaligned.

- **Remedy:** If the filament is not passing from the extruder drive to the hot end when replacing or inserting filament for the first time, there may have an alignment issue of the filament drive and hot end. Remove the filament from the filament drive and allow the hot end to cool down. Loosen the silver thumb screws and remove the extruder top. Raise the extruder motor. Review the position of the hot end in the extruder bottom - the hot end should be fully inserted into the slot on the hot end and sit flush with the end of the slot. If the hot end does not sit flush, loosen the small black thumbscrew that holds the “HOT” sign at the front of the extruder bottom. Once the screw is loose, push the hot end as far as possible in the slot in the extruder bottom. Replace the extruder motor on top of the extruder bottom. Ensure that the extruder motor sits flat on the extruder bottom; if the extruder motor is angled it may cause an alignment issue. Place the extruder top back on the extruder motor and tighten the silver thumbscrews. Heat the hot end and feed the filament through the filament drive to verify that the issue is corrected.

**Probable Cause 9:** Filament may be fractured below the extruder gear.

- **Remedy:** Loosen the silver thumbscrews and remove the extruder top. Remove the extruder motor. While the hot end is heated, use pliers to grip the top of the filament above the hot end and pull up to remove. Replace the extruder motor, extruder top, and silver thumbscrews. Continue with the filament replacement process.

**Probable Cause 10:** Non-recommended low quality filament may have been used.

- **Remedy:** Low quality filament can have inconsistent diameter or be made from poor quality feedstock. When piece of filament with a very narrow diameter passes through the filament drive, sufficient pressure is not applied to the filament by the extruder motor gear. Tighten the pressure adjustment screw slightly and then back the filament out of the filament drive by selecting “**Preheat**” from the Info screen, and then selecting “**Move Axis,**” then “**1mm,**” then “**Extruder**” and rotating the knob counter-clockwise. Discard filament. Loosen the filament pressure adjustment screw back to the standard business card width. Reinsert recommended high quality filament.

***Problem:** Filament will not stick to board*

**Probable Cause 1:** Not using quality PLA filament.

- **Remedy:** It is important to use quality PLA from a recommended supplier. It is important that the diameter is consistent and the feedstock is good quality. Poor quality PLA may not stick properly to the print surface. Remove the incorrect filament and replace with quality filament from a recommended supplier.

**Probable Cause 2:** Print board too far from hot end.

- **Remedy:** If it appears that the print board is level but simply too far from the hot end, rotate the Z-axis limit switch end stop counter-clockwise half a turn so that the limit switch engages closer to the hot end. Rotate another half a turn if the problem is not solved. If filament is not sticking in one specific place, the print board is not leveled properly. Stop the print, remove the part and allow the hot end to cool down, and level the board. Initiate a print to verify that the problem is resolved; repeat leveling process if the problem persists.

**Probable Cause 3:** Wrong print board material.

- **Remedy:** Filament may not stick well if not using BuildTak. Try to re-level the print board to close the distance between the hot end and print surface, but the best solution is to apply BuildTak to print board.

***Problem:** Filament shavings in extruder*

**Probable Cause:** Filament pressure adjustment screw too tight.

- **Remedy:** If there are filament shavings in the filament drive, too much tension is being placed on the filament by the extruder motor gear. Locate the filament pressure adjustment screw

on the top right of the filament drive. Loosen this screw using an Allen wrench until the gap on the top of the filament drive is approximately the width of a business card.

## **PRINT QUALITY**

***Problem:*** *Print stops without finishing*

**Probable Cause 1:** Improper slicing of CAD design.

- **Remedy:** Re-slice the CAD model using the slicing software. First, re-slice using basic settings. Save the re-sliced g-code file onto the SD card and attempt to print. If this does not work, re-slice using advanced settings. If print still stops without finishing, the SD card may be corrupt.

**Probable Cause 2:** Corrupt SD card.

- **Remedy:** If re-slicing the CAD model does not resolve the issue, the SD may be corrupt. Save the g-code file to another SD card and re-print.

**Probable Cause 3:** Loose power connector.

- **Remedy:** Verify that the power cord is completely plugged into the back of the printer. Check the wire that connects the power plug breakout board to the RAMBo board and verify that the ends are completely inserted. The six pin connector may be inserted at an angle so that all contacts are not hitting.

***Problem:*** *Print shifts while printing*

**Probable Cause 1:** Print board moved.

- **Remedy:** The print board may be loose and shifted. Stop the print, remove the print board, and remove the part. When inserting the print board, ensure that it seats all the way into the rear clamps. Push the front clamp tight against the front of the board and lock it into place with the blue thumbscrew. Attempt to wobble the board slightly to verify that the print board is locked in place. Attempt the print again.

**Probable Cause 2:** Hot end moved.

- **Remedy:** Observe the print to see if the hot end is loose. If so, stop the print and tighten the small black thumbscrew at the front of the hot end assembly which will lock the hot end in place. Remove the part and attempt to print again.

**Probable Cause 3:** Improper slicing of design.

- **Remedy:** Re-slice the CAD model and save on SD card. Use the basic slicer settings with re-slicing; advanced settings can be used once the problem has been identified. Remove the bad print from print board and re-attempt the print using the re-sliced g-code file.

**Probable Cause 4:** Gear attached to motor drive shaft or belt is loose.

- **Remedy:** Release the tension on the belt. Loosed the two set screws with Allen wrench. Rotate the gear so that one set screw aligns with flat side of motor drive. Retighten set screws and belt.

***Problem: Print is oval instead of round***

**Probable Cause:** Not correct stepper motor.

- **Remedy:** If the print has a consistently distorted shape, the stepper motor is incorrect. Watch print to determine which motor is the cause of the problem. Submit a Support Ticket for a replacement motor.

***Problem: Print shape is erratic***

**Probable Cause:** Loose drive gear on stepper motor.

- **Remedy:** If the printer is printing very erratically, there may be a loose drive gear on either the X-axis or Y-axis motor. Stop the print, allow the hot end to cool down, and remove the part. Observe the gears on the X-axis and Y-axis motors to determine which gear is loose. Confirm that the gear is loose by attempting to slide the gear up and down or rotate the gear on the shaft. Check to see that one set screw is perfectly aligned to the middle of the flat side of the motor drive. If it is not, the gear is slipping. Once determined which gear is loose, remove tension on the applicable belt by loosening the idler bolt used for tension adjustment. Remove the belt from the gear. Align one of the set screws so that it is perpendicular to the flat portion of the motor shaft. Adjust the gear height if necessary - on the X-axis approximately 5mm of motor shaft should protrude from the top of the gear, and the Y-axis the motor shaft should be recessed approximately 5mm. Tighten the set screws to affix the motor gear to the shaft. Loop the belt around the motor, place tension on the belt and tighten the idler bolt. Re-attempt the print to verify that the issue is corrected. It may be necessary to remove the motor for access to the screws.

***Problem: Printed part is very hard to remove***

**Probable Cause:** Print board too close to hot end.

- **Remedy:** Carefully remove the stuck part so not to damage the BuildTak. Place the scraper perfectly flat on the print board at the edge of the part that appears is the easiest place to wedge the scraper under the part. Sharply to tap the end of the scraper to remove the part. Once the hot end is cooled down, level the print board. Initiate a print to verify that the board level is correct; repeat board leveling if necessary.

***Problem: Printed part lifts or warps***

**Probable Cause 1:** Print board too far from hot end or board not level on one side.

- **Remedy:** If the part is lifting off of the BuildTak or warping, the print board may be too far from the hot end. If it appears the board is perfectly level but simply too far from the hot end, rotate the Z-axis end stop counter-clockwise half a turn so that the limit switch engages closer to the hot end. Rotate another half a turn if necessary.

**Probable Cause 2:** Wrong print board material.

- **Remedy:** If not using BuildTak material, there may be increased part warping. If using blue painters tape, try to re-level the print board to move the hot end slightly closer to the tape, although this may not completely correct problem. It is recommended that BuildTak be used to improve part quality.

**Probable Cause 3:** Print board not level.

- **Remedy:** If a part is warping in one particular place, the print board may not be level. Stop the print, remove the part, and allow the hot end to cool down, then level the board. Initiate a print to verify that the problem has been corrected.

**Problem:** *Print is stringy and/or messy*

**Probable Cause 1:** Filament is poor quality.

- **Remedy:** Verify that high quality filament from a recommended supplier is being used. Cheap filament is very stringy and does not retract well as compared to high quality filament.

**Probable Cause 2:** Hot end temperature too high

- **Remedy:** The hot end temperature may be set too high. It is not recommended to print at a temperature greater than 225°C. If this does not remedy the problem, the thermistor may be faulty.

**Probable Cause 3:** Hot end needs replaced.

- **Remedy:** Submit a Support Ticket to order a new hot end.

**Problem:** *Print quality is not good*

**Probable Cause 1:** Improper slicing.

- **Remedy:** The printer part may have been improperly sliced. Re-slice the part using the pre-programmed, default settings which can be found at [www.inventorcloud.net](http://www.inventorcloud.net) and re-attempt the print.

**Probable Cause 2:** Part geometry not conducive to 3D printing.

- **Remedy:** Certain part geometries result in poor quality when 3D printed. Verify that part geometry is conducive to 3D printing. Many designs downloaded from the Internet will not print properly and should not be used. If unsure if the part geometry can be 3D printed, submit a Support Ticket for assistance.

## **LCD**

**Problem:** *LCD displays only blue screen*

**Probable Cause:** Wiring backwards from LCD to RAMBO board.

- **Remedy:** Disconnect power from the printer and remove the top cover to access the RAMBo board. Ensure that the LCD wires are plugged into the correct ports on the RAMBo board. The LCD wires should cross once if properly plugged in, meaning that the right wire plugs into the left port on the RAMBo board and vice versa. Check that the wires are plugged into

the RAMBo in the correct direction - the side of the wire with the red line should be on the side closest to the front of the printer. Return power to the printer and verify that the LCD screen is working properly.

**Problem:** *LCD displays nonsensical characters*

**Probable Cause:** Static charge to LCD.

- **Remedy;** Disconnecting and reconnecting the printer power supply will cause the LCD to reset and function normally. If the LCD displays senseless characters during a print, let the print finish and the hot end cool down. Then, disconnecting and reconnecting power to the printer will reset the LCD screen. This will not affect the quality of the print. If necessary to stop the print, disconnect the power and reconnect the power, and then remove the part and start the print again.

## **POWER ISSUES**

**Problem:** *No power to the printer*

**Probable Cause 1:** Plug not completely inserted.

- **Remedy:** Make sure power cord is plugged into appropriate power source. Check the back of the printer to ensure that the power adaptor is connected properly to the power plug breakout board. Remove the top cover of the printer and check the power plug breakout board connector cable. Ensure that one end of this cable is inserted completely in the 6 pin connector in the breakout board, and ensure that the other end is plugged into the appropriate port on the RAMBo board.

**Probable Cause 2:** Fuse burnt out.

- **Remedy:** If above remedy does not resolve issue, there may be a burnt out fuse on the RAMBo board. Replace the fuses on the RAMBo board with the appropriate new fuse. Submit Support Ticket if unsure of necessary fuse.

## **PRINT BOARD**

**Problem:** *Print board will not level*

**Probable Cause 1:** Red thumb screws too far out of adjustment.

- **Remedy:** If unable to level the print board due to not having enough room to turn the red thumbscrew (either all the way tightened or too loose and falling out of the threads), the height of the Z-axis end stop may not be set properly. If the red thumbscrews can be tightened no further, lower the Z-axis end stop to create more space between the hot end and print board. If the red thumbscrews can be loosened no further, raise the Z-axis end stop to create less space between the hot end and print surface. Re-level the print board.

**Probable Cause 2:** Wave springs missing or not properly seated.

- **Remedy:** If it appears that the Z-axis end stop is at the appropriate height and are experiencing a problem with just one of the thumbscrews, review that each of the red thumbscrews are compressing a wave spring on top of a spacer. Review that the springs are

completely seated into the cutout on the spacer. If missing a wave spring or spacer and cannot locate the parts, submit a Support Ticket.

**Probable Cause 3:** Improper setting of Z-axis end stop.

- **Remedy:** Improper setting of the Z-axis end stop could prevent achieving a level board due to not having enough range of movement of the red thumbscrews. Follow the procedure to reset the Z-axis end stop height and re-attempt board leveling.

**Probable Cause 4:** Print board is bowed.

- **Remedy:** If the print board has been aggressively clamped over a long period of time it can bow in the center, making it impossible to level. If print board is bowed, submit a Support Ticket to order a new print board.

**Problem:** Board does not lift high enough to print

**Probable Cause:** Z-axis limit switch adjustment screw not set properly

- **Remedy:** If the print board is not lifting close enough to the hot end to print properly, the Z-axis limit switch end stop may be over tightened and created too much space between the hot end and print board plate. Allow the hot end to cool and perform the procedure to set the Z-axis limit switch end stop described in the operating instructions for setting the print gap.

## **HOT END**

**Problem:** Hot end is leaking melted filament from heater cartridge onto the cooling fans

**Probable Cause:** Hot end needs replaced.

- **Remedy:** Leaking filament from the hot end nozzle is common and not an indication of a problem. However, if melted filament is leaking around the top of the nozzle of the hot end or from the top of the heater and onto the cooling fans, the hot end needs replaced. Submit a Support Ticket to order a new hot end.

**Problem:** Hot end does not maintain temperature

**Probable Cause:** Failure of hot end thermistor.

- **Remedy:** If the hot end does not maintain a constant temperature and the temperature is fluctuating significantly on the LCD display, the thermistor in the hot end is defective, and the hot end will need to be replaced. Submit a Support Ticket to order a new hot end.

## **LIMIT SWITCH WIRES**

**Problem:** Limit switch wires are broken

**Probable Cause:** Excessive tension or repeated over-flexing of limit switch wire

- **Remedy:** If the limit switch wires are broken, they will need to be replaced. Submit a Support Ticket to place order. When the replacement wire is received, remove the broken wires from the wire sleeve, removing the appropriate side cover and zip ties as needed, and disconnect it from the RAMBo board. Ensure that there is no power to the printer when replacing the

wires. Attach the replacement wire to the appropriate limit switch, exactly as they were. Connecting the wires to the wrong pins or in the wrong order will result in a non-operating limit switch. Run the wire through the wire sleeve, and plug into the appropriate port on the RAMBo board. Replace the zip ties as needed. Ensure that there is sufficient slack in the limit switch wire between the limit switch and wire sleeve such tension is not placed on the wire due to either the horizontal motion of the hot end or vertical motion of the Y-axis plate. Hold the slack in place using a zip tie.

## **Y-AXIS GRINDING**

***Problem:*** Grinding when raising the y-axis subassembly on the lead screw

**Probable Cause 1:** Z-axis lock engaged

- **Remedy:** If there is a loud grinding noise as the Y-axis subassembly is being raised on the lead screw when starting a print, the Z-axis lock may be engaged. Disconnect the power to the printer and loosen the yellow thumbscrew on the Z-axis lock so that the lead screw knob can spin freely. Re-connect the power and attempt to print again.

**Probable Cause 2:** Improper alignment of lead screw and/or ACME nut.

- **Remedy:** Repeat the process to align the z-axis lead screw and embedded ACME nut.

**Probable Cause 3:** The Z-axis knob is grinding on top plate or Z-axis bearing is not properly seated.

- **Remedy:** Loosen the screw in the knob, then reset the bearing and height of knob.