



**WHERE  
PRECISION  
DRIVES  
PRODUCTION**

**Emergence PRO™ 3D Printer  
Operation Manual  
Revision A**

Precision Valve & Automation  
One Mustang Drive  
Cohoes, NY 12047





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# 1. Introduction

Before you operate this system, read the operation and setup manual. This will help you to become familiar with the product and ensure successful operation.

If any questions or problems arise, contact PVA's Technical Support department.

## 1.1 PVA Contact Information

### Main Office

**PVA**

**One Mustang Drive**

**Cohoes, NY 12047**

**Tel +1-518-371-2684**

**Fax +1-518-371-2688**

**Website: <https://.pva.net>**

**Email: [info@pva.net](mailto:info@pva.net)**

### Technical Support

**Tel +1-844-734-0209**

**Email: [cs@pva.net](mailto:cs@pva.net)**

## 1.2 Document History

Revision	Revision Date	Reason for Changes
REV A	December 2019	Initial Release

**Note: All photographs and CAD model representations in this document are a “general representation” of the system and its components. The actual appearance of the system and its components can differ based upon customer specific configuration.**

## 1.3 Safety

Certain warning symbols are affixed to the machine and correspond to notations in this manual. Before operating the system, identify these warning labels and read the notices described below. Not all labels may be used on any specific system.



Always wear approved safety glasses when you operate or work near the workcell.



Before you operate the system, read and understand the manuals provided with the unit.



Never put hands or tools in areas with this symbol when the machine is in operation. A dangerous condition may exist.



Read and understand the manuals provided with the unit before any repairs or maintenance is done. Only a qualified individual should do service.



Use caution when there are pressurized vessels. Find and repair any leaks immediately. Always wear appropriate safety equipment when you work with pressurized vessels or vessels that contain chemicals.



Shear hazard from moving parts. Avoid contact.



Do not remove protective guarding.



In situations where inattention could cause either personal injury or damage to equipment, a warning notice is used.



Do not smoke near the PVA UV cure machine. Always have a fire extinguisher available for emergency use.



Before performing any repairs or maintenance to the system, turn off power and lock out the power disconnect switch.



Warning notices are used to emphasize that hazardous voltages, current, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use. Only qualified personnel should enter areas designated with this symbol.



Laser light source present. Do not stare directly into the beam. Do not use in the presence of highly reflective surfaces



Pinch hazard from moving parts. Avoid contact.



Hot surface. Avoid contact.



Warning, Ultraviolet (UV) light hazard. Do not look directly at the UV light source.

## 2. Getting Started

### 2.1 Unboxing

- Remove the packaging straps from the shipping crate.
- Open the shipping crate by first taking the lid off and then removing the sides.
- Remove plastic wrapping around the metal ramp and any additional items that may be included.



**Figure 1: Remove Plastic Wrapping**

- Remove the four metal plates around each of the wheels by removing the lag screws using a 9/16" socket wrench.



**Figure 2: Remove Metal Plates**

- Secure the metal ramp to the wooden pallet with lag screws from prior step.



**Figure 3: Secure Metal Ramp to Wooden Pallet**

- Offload the 3D printer using the metal ramp with two people -- one person in front of the printer and one person in the back.
- Move the printer to its location and position the printer on level ground.
- To level the printer, lower the feet by turning the red knob on each leg to stabilize the 3D printer. Turning the knob to the left lowers the foot and turning the knob to the right raises the foot.

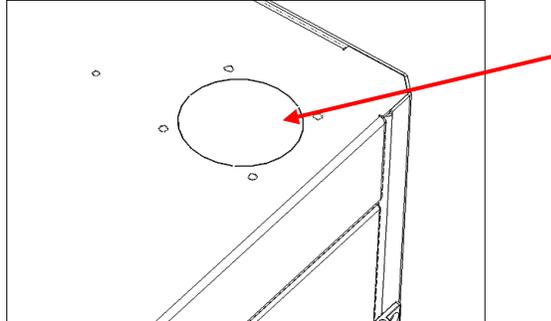
## 2.2 Local Ventilation Disclaimer

**IMPORTANT: End user should consult manufacturer safety data sheets to identify if local ventilation is required for their application and proceed as recommended. For composite materials please consult local regulations (OSHA PELs, NIOSH RELs, and/or ACGIH) for the particular materials being used and monitor locally to identify if local ventilation is required.**

### 2.2.1 Exhaust Flange Installation

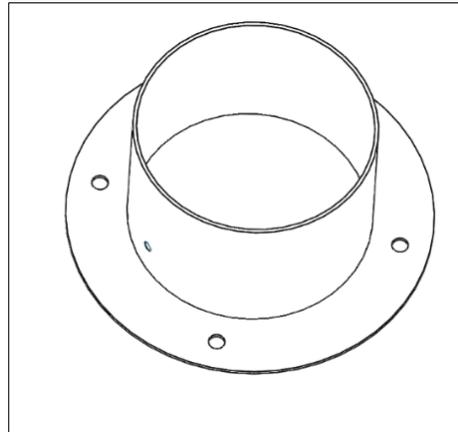
If local ventilation is required, follow the steps below to install the exhaust flange.

Remove cover from exhaust flange mount in the top rear corner of the machine.



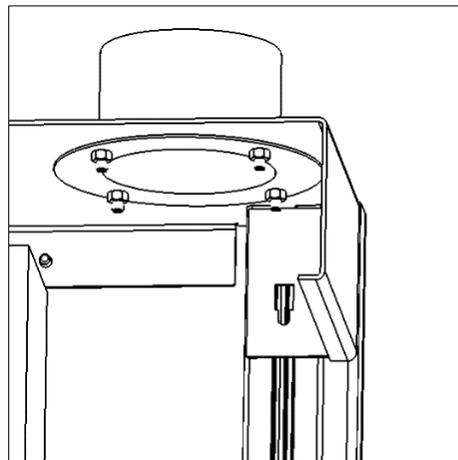
**Figure 4: Remove Exhaust Flange Cover**

Locate the 4-inch exhaust flange provided with the machine.



**Figure 5: Exhaust Flange**

Install exhaust flange through top hole and secure with 4 M6X1 hex nuts.



**Figure 6: Secure Exhaust Flange**

## 2.3 Initial Setup

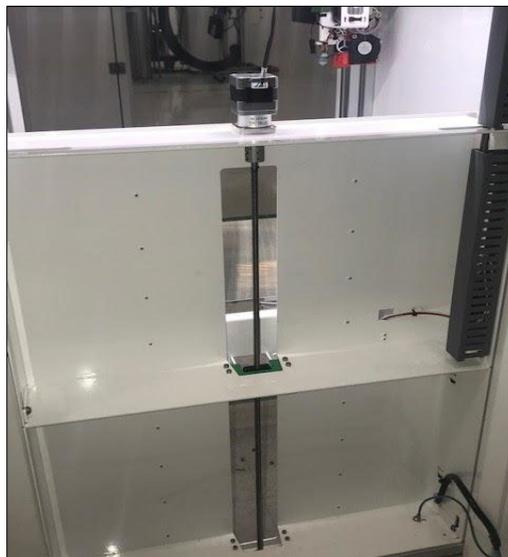
### 2.3.1 Setting Up the Printer

- Remove additional packing material from the outside of the printer.
- Remove the key tied to the handle on the front door. The key is for the back door.
- Open the front door and remove the green metal bracket holding the extruder in place by removing the mounting screws.



**Figure 7: Remove Bracket from Front Door**

- Open the back door using the key and remove the green metal bracket holding the Z-bed in place by removing the mounting screws.



**Figure 8: Remove Bracket from Back Door**

- Connect the power cord in the back of the printer and plug the power cord into the 120/220V\* power supply. \*Refer to the machine serial tag.



Figure 9: Connect Power Cord

### 2.3.2 Setting Up the Emergence PRO™ Wireless Connection

The Emergence PRO™ has 2.4GHz wireless network connection capability that allows you to use the printer remotely with a computer. For the initial setup of the printer, you will need to use this feature.

- Turn on the printer using the on/off switch located near the power cord connection.
- The printer control screen will start up on its own.
- Using a computer, connect to the network matching your printer serial number. The serial number is listed on the label located on the upper right corner of the back panel on the printer.
- The network password is "PVA12345".
- Once connected to the network, access the computer interface by typing "11.22.33.44" into a web browser address bar.

## 2.3.3 Setting Up the Print Bed

It is possible for the print bed to move during shipment, resulting in a need to level and calibrate the bed as part of the initial set up.

- Double check that all green securing devices have been removed (see Section 2.3.1).
- Using a computer, connect to the printer (see Section 2.3.2).
- Auto-home the print bed.
- Run the Auto Bed Compensation from the web interface.
- The printer will display a topographical map of the print bed. The arrow in the picture points to the front left corner of the bed.
- Using the resulting map, adjust the printer bed screws to adjust the bed.
  - Loosen or tighten one bed screw at a time as a single revolution may create a large change. The bed screws are marked on the Z-Assembly page. The “Top View” is a useful tool for adjusting the bed.
- Run the Auto Bed Compensation to check the adjusted print bed.
- Continue screw adjustments until the bed is within  $\pm 0.5$  mm.

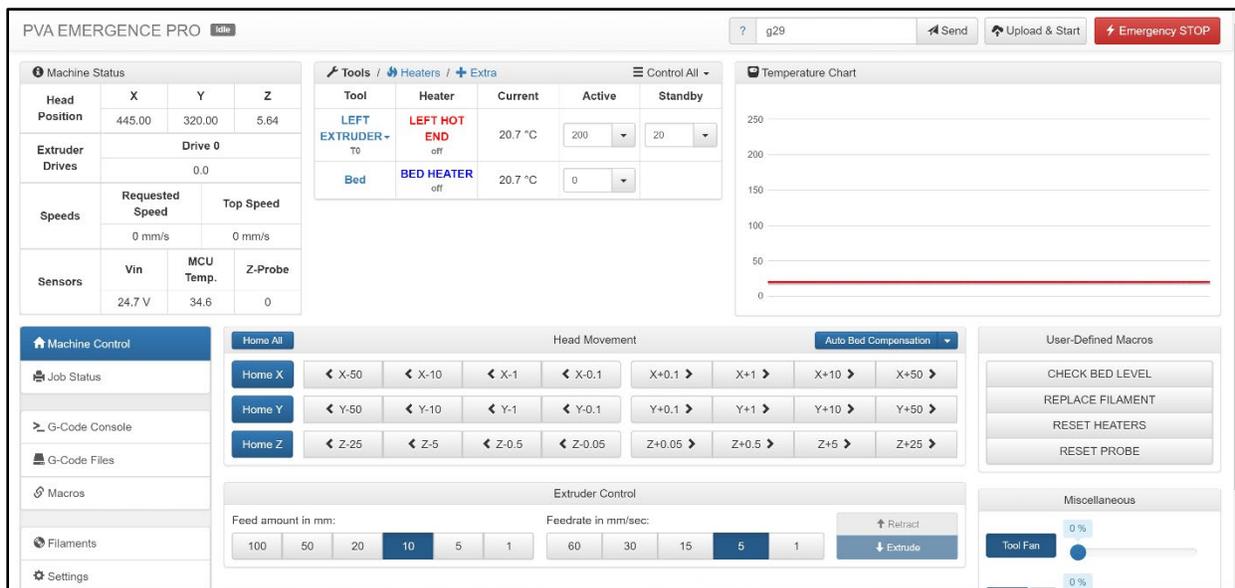
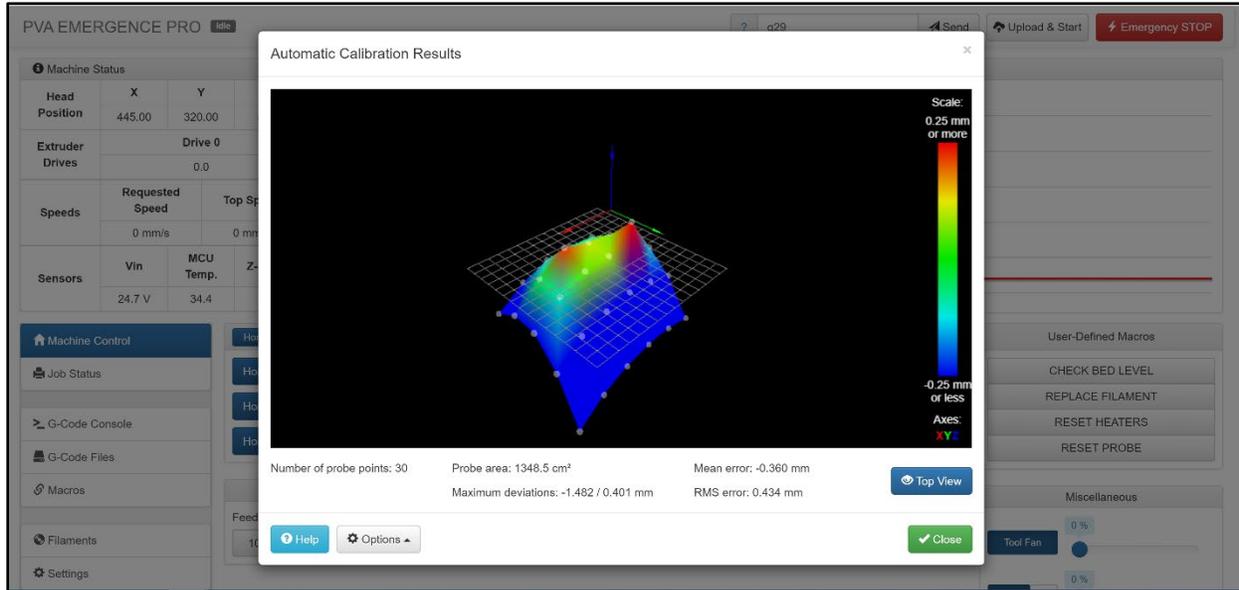


Figure 10: Auto-Home the Print Bed



**Figure 11: Top View**

**More information about leveling and calibrating can be found in Section 3.3.1.**

### 2.3.4 Test Printing

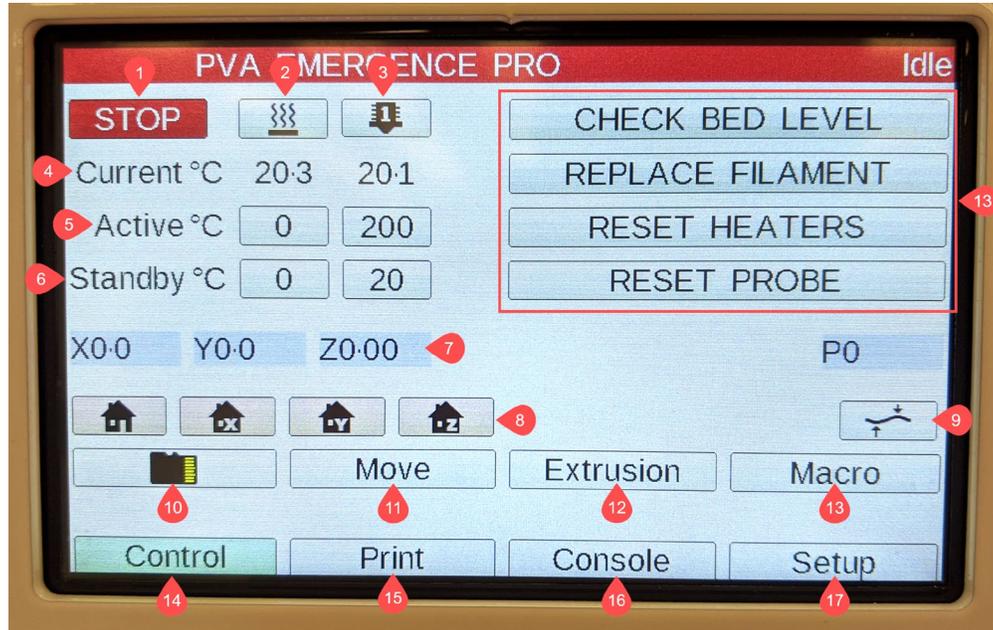
Before you begin to print your own devices, we recommend that you test the printer with a preloaded print. Select the file appropriate for the hot end installed in your machine upon delivery by selecting File Selection on the Emergence PRO™ Control screen). For questions regarding the use of the printer, refer to Section 3. If the printer experiences issues like those outlined below, refer to the listed solution. If the issue persists, please contact us for additional assistance.

- **Under Extrusion** (Little to no filament is coming out from the hot end).
  - **Solution:** Loosen or tighten the tension screw.
- **Hot End Running into the Print:** Hot end is off course or is getting stuck on the print.
  - **Solution:** Check the bed level as well as the distance between the bed and the hot end nozzle.
- **Touch Probe Failing to Drop Pin:** The pin fails to drop when attempting to home the print bed.
  - **Solution:** Reset the probe from the display via the Reset Probe button. Restart the printer.

## 2.4 Printer Control Screen

The printer control screen is a touch screen controller consisting of four screens: Control, Print, Console, and Setup. See Figure 12 on next page.

<b>1 Stop Button</b>	Stops and reboots printer.
<b>2 Bed Button</b>	Sets bed to active state or standby.
<b>3 Hot End Button</b>	Sets hot end to active state or standby.
<b>4 Current Temperature</b>	Displays current tool temperature.
<b>5 Active Temperature</b>	Set point for active tool temperature.
<b>6 Standby Temperature</b>	Set point for standby tool temperature.
<b>7 Print Head Position</b>	Displays position of print head.
<b>8 Axes Homing Buttons</b>	Homes the print head in all axes or in an individual axis. <ul style="list-style-type: none"><li>• Auto homing -- button on the far left</li><li>• X-axis -- button in the middle left</li><li>• Y-axis -- button in the middle right</li><li>• Z-axis -- button on the far right</li></ul>
<b>9 Bed Probe</b>	Probes bed and creates bed level profile.
<b>10 File Selection</b>	Displays available prints.
<b>11 Move Selection</b>	Allows movement of print head <ul style="list-style-type: none"><li>• X-axis -- negative moves left, positive moves right</li><li>• Y-axis -- negative moves towards front of the machine, positive moves towards rear of the machine</li><li>• Z-axis -- negative moves up, positive moves down</li></ul>
<b>12 Extrusion Selection</b>	Allows for extrusion of filament when hot end is at temperature.
<b>13 Macro Selection</b>	Allows for selection of macros. Four macros are found on the right side of the Control Screen: Check bed level, replace filament, reset heaters, and reset probe.
<b>14 Control Screen</b>	Main menu for the control screen.
<b>15 Print Screen</b>	Similar to the control screen and only used when printing. Allows for pause, resume, and cancel commands.
<b>16 Console Screen</b>	Displays codes and commands recently entered into the printer.
<b>17 Setup Screen</b>	Options for adjusting the touchscreen display settings.


**Figure 12: Printer Control Screen**

## 3. Print

### 3.1 Hot End

PVA offers a variety of hot ends to fit individual application needs. Please refer to Appendix B for a breakdown of the hot end and print head.

#### 3.1.1 Changing the Hot End

- Unload filament from the hot end (see Section 3.2.2 for details).
- Let the hot end cool to a safe temperature (maximum of 35°C).
- Disconnect the heater cartridge and the thermistor cartridge.
- While supporting the hot end, loosen the hot end screw on the right side of the hot end clamp.
- Carefully remove the hot end and insert the new hot end.
- Tighten the hot end screw.
- Connect the heater cartridge and the thermistor cartridge.
- Load the proper filament into the hot end (see Section 3.2.1 for details).

**Note: You will change the hot end, not the nozzle.**

## 3.2 Filament

### 3.2.1 Loading Filament

- On the display, set the hot end temperature. Please refer to the filament manufacturer's recommended print temperature.
- Once the hot end has reached temperature, depress the extruder lever.
- While holding the lever, feed the filament through the extruder and into the hot end.
- Continue to feed filament until it begins to extrude out of the hot end nozzle.
- Release the extruder level and tighten the tension screw.
- Extrude filament using the display to ensure sufficient tension in the extruder lever.
- If extrusion is inconsistent, tighten the tension screw until filament extrusion is consistent.

### 3.2.2 Unloading Filament

- On the display, set the hot end to the filament manufacturer's recommended temperature.
- Once the hot end has reached temperature, retract 200 mm via the display.
- Carefully pull the filament out.

## 3.3 Print Bed

The print bed is the foundation of a successful print. A properly leveled and calibrated bed will ensure that your print is successful the first time. An improperly leveled and calibrated bed will lead to poor first layer adhesion, an uneven finish on the bottom of the print, and early print failures. Before shipment, each printer is checked to ensure that the print bed is level and calibrated to the nozzle. The print bed should be checked before starting a print.

### 3.3.1 Leveling and Calibrating

In the initial setup, you checked and adjusted the print bed. Once you have leveled and calibrated the print bed, it will be properly set for several prints. If you begin to experience any of the aforementioned issues, check the print bed using the technique found in Section 2.3.3. If you continue to have issues or are unable to level the bed, follow the instructions on the next page.

- Auto-home all axes.
- Lower the bed for comfortable access.
- Remove filament and tape from the print bed.
- Clean the print bed of excess adhesive residue (using isopropyl alcohol is recommended).
- Apply a new layer of tape to the print bed.
- Completely remove filament from the extruder.
- Carefully remove excess filament on the hot end nozzle.

**Warning: If you need to heat up the hot end to remove excess filament, be careful not to burn yourself.**

- Depending on the material, begin heating to the manufacturer recommended temperature.
- Once the jam nuts located on the screws on the underside of the print bed are loosened, use a 2.5 mm hex wrench and tighten each of them three revolutions.
- Raise the print bed until the Z-axis reads "0.00".
- Move the nozzle next to one of the screws.
- Adjust the gap between the nozzle and bed using a 0.2 mm shim as your reference.
- Perform the previous two steps at each screw.
- Perform a double check at each screw and adjust accordingly.
- Lower the print bed, auto-home all axes, then raise the print bed until the Z-axis reads "0.00".
- Adjust the gap between the nozzle and bed using a 0.2 mm shim as your reference.
- Loosen the screws of the block holding the hot end with a 3 mm hex wrench to adjust the gap.
- Auto-home all axes, then probe the print bed.
- Run a test for first layer adhesion.

### 3.3.2 Preparing for Printing

The print bed should always be layered with blue painter's tape. This layer will help preserve the print bed and provide a smooth finish to the bottom of your prints. When preparing to print, ensure that the tape is tight against the print bed. Avoid large overlaps between the strips of tape. Depending on the print material, a thin layer of adhesive may be required to help with print stability.

## 3.4 Starting the Print

The Emergence PRO™ allows for a G-code to be loaded through a MicroSD card or through a network upload. Once you have acquired your G-code, you can use either option.

### 3.4.1 MicroSD

The MicroSD reader is found on top of the printer in the back-right corner. Push the MicroSD card into the reader until you feel a small click. On the touchscreen, navigate to the "Control" screen and press the button with an SD card symbol (see bullet 10 in Section 2.4). A secondary screen will pop up on the display. Another button with an SD card symbol will be in the top left corner of the secondary screen. Press the button and the page will bring up the files from the MicroSD card. Press the button with your desired file's name and press the "OK" button on the following information page.

### 3.4.2 Internet Upload

Connect to the Emergence PRO™ network and access the online control screen (see Section 2.3.2 for details). On the left side of the screen, click the blue button labelled "G-code Files". The bottom half of the page will change to G-codes that have been uploaded to the printer's control board. On the right side of the screen, click on the blue button labelled "Upload G-code File(s)". Your computer's file system will appear for you to choose which G-code(s) you would like to upload to the printer. A progress screen will pop up to show you when the printer has uploaded the G-code(s).

## 3.5 Monitoring the Print Process

While it is easy to start a print and walk away, it is recommended that you check in at regular intervals.

### 3.5.1 First Layer

The first layer should have a smooth and even finish. A good first layer will feel like a smooth and flat bump with little difference in height between the layer and the print bed. If filament is extruding, but not sticking, try applying each of the following suggestions alone, then together consecutively:

- Replace the print surface.
- Calibrate the print bed (see Section 3.3.1 for reference).
- Decrease the print speed (see Section 4.2.1 for reference).
- Increase the flow rate (see Section 4.2.2 for reference).

### 3.5.2 Next Layers

A first layer can indicate that a print is off to a good start, but it will not guarantee a print without issues. The following layers will be important in determining the quality of your print. For example, if you notice that filament is not being extruded consistently or that the printed filament is cloudy, it may indicate that you have improper tension on the extruder or that the filament is saturated with moisture. Paying attention to the next layers will help you save filament and identify any issues with your print.

### 3.5.3 Opening the Door and Pausing the Print

If you need to access the print, you should always pause the print before opening the door. The Emergence PRO™ also includes a door sensor that will pause an active print when opening the front door. This functions as an added layer of protection for the printer and operators.

### 3.5.4 Filament Break Detection System

The Emergence PRO™ offers a filament break detection system that will pause your print when the roll runs out of filament. While the printer is paused, you can replace the filament without losing your print.

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## 4. Helpful Recommendations

### 4.1 Best Practices

In order to increase your familiarity and comfort with the Emergence PRO™, we have included a few best practices.

#### 4.1.1 Filament

Filament spools, both new and used, should be stored in a filament storage container with desiccant. A relative humidity level of 10% is ideal for storing filament, however, anything under 30% is acceptable. Filament may also be left in the top of the Emergence PRO™ with the dehumidifier for a short period of time. Filament should be stored in the aforementioned container for long term storage.

#### 4.1.2 Hot End

The hot ends are completely made of metal which makes them resilient to the heating and cooling of multiple prints. However, in order to extend the life of the hot end, heat the hot end only when working on the printer or when the printer is fabricating a print.

Filament should not be left in the hot end when the printer is not in use. Leaving filament in the hot end can lead to clogs and jams. In addition, leaving filament in the hot end may expose the filament to humid air which will affect the quality of the print.

#### 4.1.3 Print Bed

Tape should be laid tight against the print bed and provide a solid, single layer. Overlapping between strips of tape will not cause a print to fail but limiting the size of these overlaps will help with first layer adhesion. Tape should be replaced as needed after prints are removed from the bed.

Before each print, it is recommended to calibrate the print bed with the probe. This calibration is as simple as homing the axes and probing the print bed with the probe. Most G-codes received from PVA will already contain a command to run a bed probe before beginning a print.

#### 4.1.4 Printer

In order to keep the printer working in excellent condition, it is recommended to adhere to these best practices and to regularly clean the printer (see Section 4.3 for details). In addition, it is recommended that the front door remain shut during printing, the back door remain locked, and the printer turned off when not in use for extended periods of time.

## 4.2 Troubleshooting

As you gain more experience, you will be able to judge how to best address issues with prints. To get you started, here are some tips.

- Printing slower (5% to 10%) and colder (5° to 10°) will help with print quality.
- Prints containing overhangs with angles greater than 45° should have support structures.
- Clean the hot end if you observe consistent under-extrusion (see Section 4.3.1 for details).

### 4.2.1 Changing Print Speed

Slowing down the print speed may help improve print quality and improve first layer adhesion. However, slowing down too much may introduce new problems, such as drooping. Slowing down the print speed by 5% or 10% is a good start (remember that the speed is listed as a percentage).

### 4.2.2 Changing Flow Rate

The flow is the amount of extruded material and is dictated by several factors. Increasing the flow rate may help with first layer adhesion or in cases where slight under-extrusion is observed. The hot end should be cleaned using the Cold Pull method after any print where the flow is increased. The printer will also remember the last flow rate. Set the flow rate back to 100% before the next print.

## 4.3 Cleaning and Maintenance

### 4.3.1 Hot End Cleaning and Maintenance

It is highly recommended that a new hot end is installed every 3 to 6 months when under heavy use. This window may be shorter if using abrasive filaments like carbon fiber. It is recommended that the hot end be cleaned after five prints. Regular cleaning will reduce the occurrence of clogs.

The “Cold Pull Method” is recommended for cleaning the hot ends. Follow the process below.

- Lower the print bed for comfortable access.
- Set “Active” temperature to 230°C and begin heating the hot end.
  - Set “Standby” temperature to 40°C.
- Loosen the tension screw and depress the extruder lever.
- Manually feed FlexyFit™ filament through the hot end or until you reach a clog.
  - If other filament is present in the hot end, continue to manually feed filament until new filament is extruding from the hot end.
- Switch the temperature from “Active” to “Standby”.
- Manually feed filament until the filament is no longer extruding from hot end.
- Once the temperature reaches 40°C, switch the temperature from “Standby” to “Active”.
- While heating the hot end, depress the extruder lever and pull out the filament.
- Inspect the filament for debris and discoloration and then remove the affected filament.
- Repeat the process until the filament is clear of debris and discoloration.

#### 4.3.2 Rail Maintenance

The Emergence PRO™ uses linear guide rails for all axes. Maintaining these rails takes a small amount of synthetic lubricant applied once per month. In the printer kit is a small bottle of synthetic lubricant. To lubricate the rails:

- Dust the rails and remove any excessive buildups of dirt or grime.
- Apply a small amount of lubricant directly to the grooves in the rails.
- Use the control screen to move the extruder assembly along the entire length of each axis.

### 4.3.3 Belt Maintenance

The Emergence PRO™ uses a single belt for moving along the X-/Y-axis. While testing is performed on the Emergence PRO™ before shipping, it is recommended that the belt be examined before use in case of looseness developed during shipping. In addition, it is recommended that the belt be checked weekly for the first few weeks as the printer is used more frequently. Eventually, the belt may be checked once a month, or as determined necessary, as the printer is used on a more regular basis.

- Check the belt by plucking it.
  - The belt should resonate with a low noise and should feel taut but not tight.
- To tighten the belt, locate the tensioning screws (located on the gantry).
  - Use a 2.5 mm hex wrench to tighten the tensioning screws.
- Check the belt by plucking it.
  - Adjust the belt as necessary.

**Please refer to Appendix B for a breakdown of the X-/Y-assembly.**

### 4.3.4 Bed Maintenance

The Emergence PRO™ print bed is fabricated from aluminum to provide a sturdy and resilient base. Maintenance on the print bed is simple, yet it should be performed regularly to ensure that prints do not tip and that tape sticks well and uniformly to the print bed. To clean the print bed:

- Remove tape and additional artifacts from the print bed.
- Apply isopropyl alcohol to the bed.
- Wipe the isopropyl alcohol across the bed using a paper towel or cloth.
  - It is best to use a material that will not leave behind fibers.
- Perform the last two steps for any areas that still contain buildups of tape residue and artifacts.
- Add another layer of tape to the print bed.

## 4.4 Check for Quality

Many print quality issues associated with 3D printing are a result of incorrect slicer settings or variance in filament from manufacturer to manufacturer. However, if you continue to experience the same issues with different slicer settings, there may be a mechanical issue.

The quality checklist below can be used as a guide to assist you in diagnosing an issue. Please call us or submit a support request if you need assistance diagnosing or fixing an on-going issue.

### 4.4.1 Quality Checklist

**Under-extrusion:** This occurs when too little filament is extruded, or it is unable to lay down properly. Small amounts of under-extrusion can manifest as delamination. More severe under-extrusion will appear as inconsistent extrusion. To remedy this issue, we recommend loosening or tightening the tension screw.

**Over-extrusion:** This occurs when too much filament is extruded and can potentially damage the printer. The printed part will appear as if it is oozing filament and create extremely textured walls. Minimal amounts of over-extrusion will create thick walls and slight discoloration; however, it will have minimal effect on the overall print quality.

**Delamination:** This is a specific type of under-extrusion. The outer shell looks good visually; however, it feels like it is not well-adhered to the rest of the model. This is a structural concern and indicative of future complications with prints. Any time the printer creates a print with delamination, it should be thoroughly cleaned.

**Missing layers:** This is an example of temporary under-extrusion and will be considered a weak layer. This can be a result of mechanical or filament issues. If this appears on the print, you should perform a thorough mechanical check of the printer, which includes checking for: z-axis screw alignment, movement of axis carriages, and rail lubrication. If these appear to be in working order, the issue was probably a mishap related to the filament. For example, this happens if the filament diameter varies too much or experiences a moment of increased friction. A missing layer may occur if the filament is changed mid print.

**Gaps in thin walls:** This occurs when there is a spot in the STL that is too thin to print. The STL appears normal but the layer view in the slicer, and resulting print, will have a hole. This cannot be salvaged and requires the STL or printing profile to be modified. This issue is sometimes hard to diagnose without looking at the slicer. This issue may be remedied by using a smaller nozzle and reslicing.

**Layer Shifting and Separation:** This is a result of the profile settings when two consecutive layers do not adhere. To manually fix this, try increasing the temperature by 5°. Layer shifting and separation causes significantly weaker layers which would deem a device unacceptable for patient use.

**Inconsistent texture:** Inconsistent texture can be a sign of moist filament, under extrusion, and poor layer adhesion. If the filament finish is not as expected, moisture within the filament is likely the reason.

**Overheating:** This can cause drooping, poor layer adhesion, and gaps in the print. To solve this, first check if the fans are on. If they are not, it is worth stopping the print and fixing them. The cooling that the fans offer allow higher print speeds. Without fans, the print does not have enough time to cool before the next layer is extruded.

**Blobs and Zits:** These are small amounts of extra filament melted onto the product. They are not a sign of structural damage and can be removed using a razor blade or grinder. Be careful not to remove too much material, which would sacrifice some structural integrity. If this happens in excess, it is a sign that the nozzle must be cleaned.

**Poor First Layer Adhesion:** This is a sign that the print bed needs to be recalibrated. The first layer is essential in providing a sturdy base for the rest of the print. If the first layer does not lay down smoothly and adhere to the bed well, stop the print and recalibrate the bed before trying to print again.

**Dimensional Accuracy:** Is an important factor to consider when printing. Some materials are more likely to shrink than others. Prints should be checked for dimensional accuracy before fitting to the patient.

## 4.5 Warranties

Please refer to the terms and conditions located on our website at <https://pva.net/terms>.

## 5. APPENDIX A

### 5.1 Printing Terminology

<b>3D Model</b>	Any digital shape occupying three dimensions.
<b>Extruder</b>	Allows for filament to be extruded; includes the hot end.
<b>Feed Rate</b>	The speed at which the extruder moves filament.
<b>Flow Rate</b>	The volume of filament extruded per unit time.
<b>G-code</b>	The file type that the printer will use to print the model. This file contains all the printer settings and model information needed to print.
<b>Printer File</b>	Has a .gcode file extension.
<b>Print Speed</b>	Defines at which speed (in millimeters/second) the print head moves while printing.
<b>Profile</b>	The saved settings applied to the 3D model when slicing in a slicing software.
<b>Slicer</b>	The software used to generate the toolpath and convert a 3D model into a .gcode.
<b>STL</b>	A file type common for 3D models. Has the file extension “.stl”.

## 6.APPENDIX B

### 6.1 Printer Dimensions and Parts

NOTE:  
SEE MACHINE SPEC FOR UTILITY  
REQUIREMENTS.

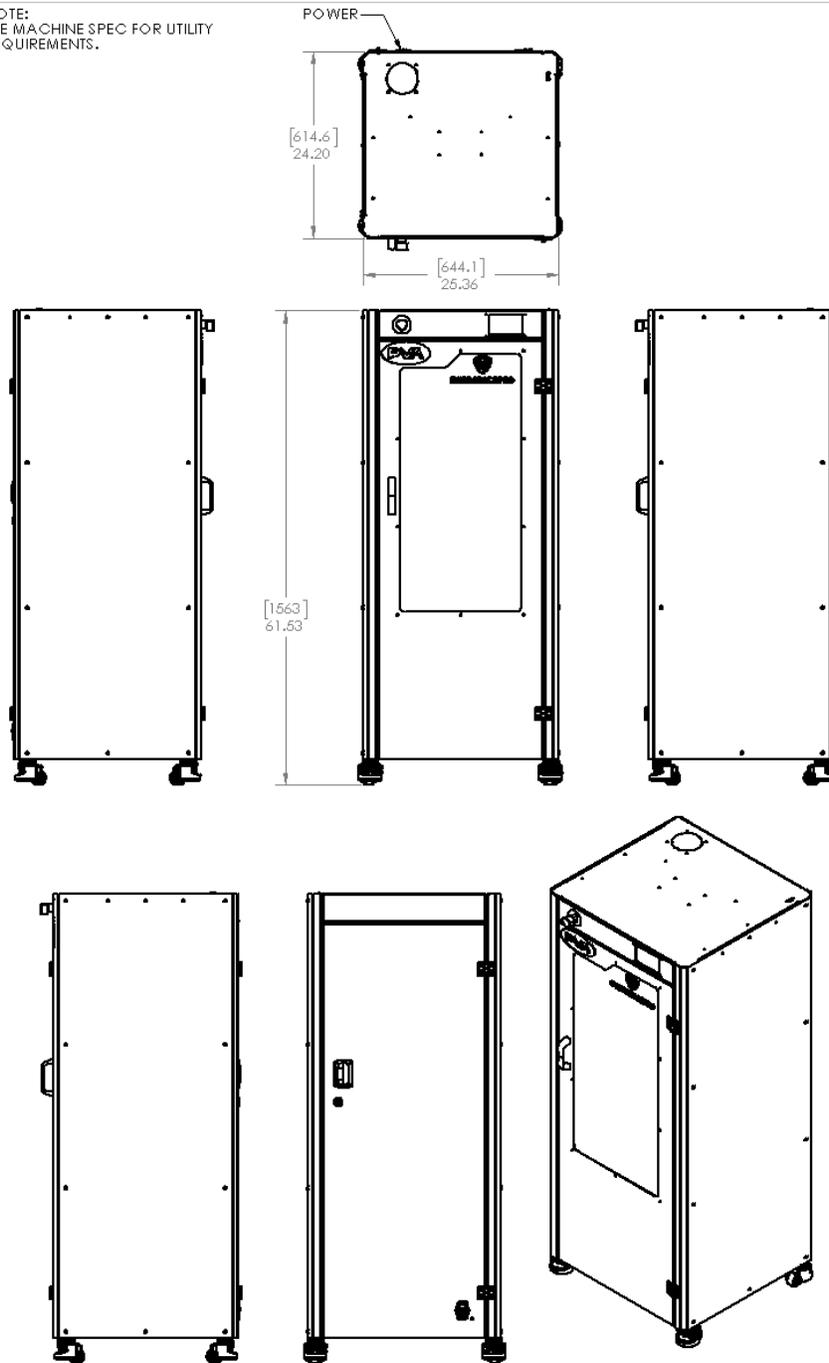


Figure 13: Printer Dimensions

## 6.1.1 X-/Y-Assembly

A breakdown of the X-/Y-assembly.

1. Belt
2. Y-axis Rail
3. Y-axis Carriage
4. X-axis Rail
5. Print Head Carriage/Tension Screws
6. E-Chain

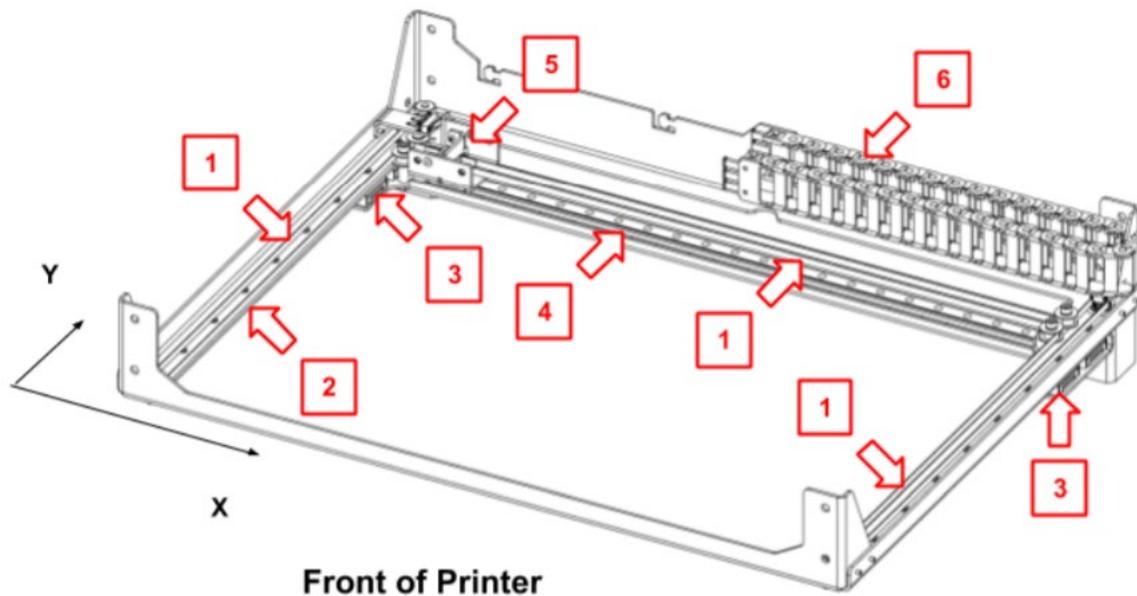
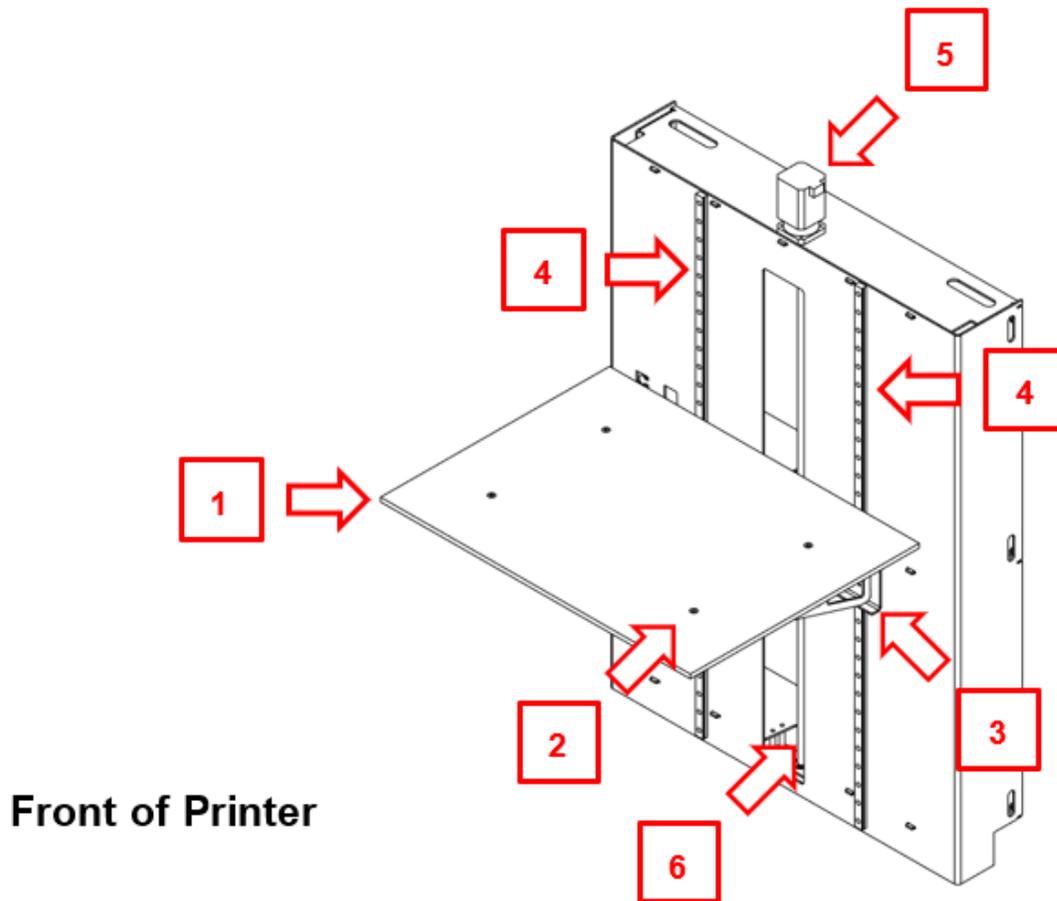


Figure 14: X-/Y- Assembly

### 6.1.2 Z Assembly

A breakdown of the Z-assembly.

1. Print Bed
2. Bed Screws
3. Print Bed Gantry
4. Z-axis Rail
5. Z-axis Stepper Motor
6. Z-axis Screw



Front of Printer

Figure 15: Z Assembly

## 6.1.3 Print Head

A breakdown of the print head.

- |                                |                                     |
|--------------------------------|-------------------------------------|
| 1. Extruder Lever              | 2. Tension Screw                    |
| 3. Filament Guide Tube         | 4. Guide Tube Collet                |
| 5. Extruder                    | 6. Hot End Clamp                    |
| 7. Fan Shroud                  | 8. Fan                              |
| 9. Heater Cartridge Connection | 10. Hot End Fan                     |
| 11. Hot End                    | 12. Hot End Nozzle                  |
| 13. Touch Probe                | 14. Thermistor Cartridge Connection |
| 15. Hot End Screw              | 16. Clamp Screws                    |

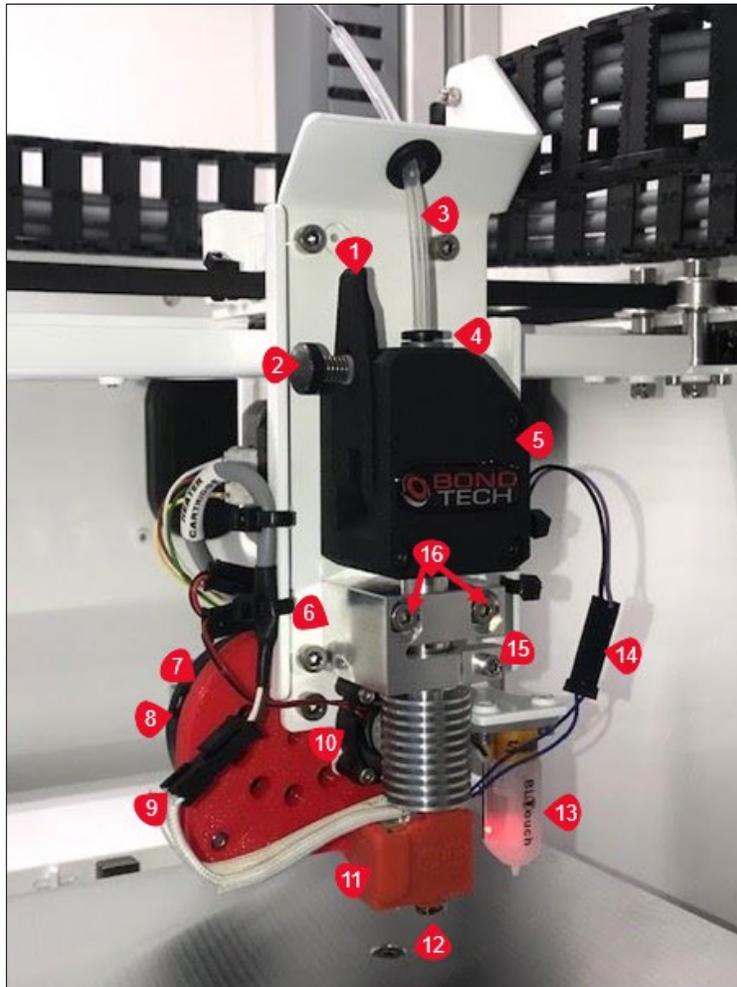


Figure 16: Print Head

## 6.2 Technical Specifications and Warnings

<b>Build Volume</b>	480 mm X 330 mm X 635 mm (19 in x 13 in x 25 in)
<b>Power Requirements</b>	Volts: 120/220V (Refer to machine serial tag) Amps: 10A Frequency: 50/60Hz
<b>Hot End Temperature Limit</b>	Up to 285°C (518°F)
<b>Heated Print Surface Temperature Limit</b>	Up to 100°C (212°F)
<b>Layer Height</b>	100 - 1000 microns
<b>Print Head Speed</b>	Up to 400 mm/sec (16 in/sec)
<b>Available Nozzle Diameter</b>	0.4 - 3 mm (0.02 - 0.12 in)
<ul style="list-style-type: none"> <li>• Compatible with multiple print materials</li> <li>• Heated build platform</li> <li>• Rigid metal frame</li> <li>• Mesh bed leveling</li> <li>• Made in the USA</li> </ul>	<ul style="list-style-type: none"> <li>• Front-loading, multi-roll enclosed material storage</li> <li>• Precision Aluminum build plate</li> <li>• 5-inch touch interface with Wi-Fi connectivity</li> <li>• Filament break detection</li> </ul>

### 6.2.1 Warnings

- Do not use if wires are frayed, connections are loose, or you detect unusual conditions that could indicate a short.
- Do not use hot end in or around water.
- This product is designed to melt plastic. During and after use, parts of the hot end and printer may burn or ignite items that touch it. Do not touch or allow any item to touch the hot end until it has completely cooled.
- Do not use near volatile or flammable substances.
- This machine is made of machined metal which may retain sharp edges. Improper handling may result in property damage or personal injury.
- Supervise any children who are near or using this product.



## 7. APPENDIX E

### 7.1 Recommended Maintenance Schedule

Task	Frequency	Date Last Performed					
Recharge Dehumidifier	Once per						
	Week						
Check Belt Tension	Once per						
	Month						
Clean Hot End	Every 5						
	prints						
Lubricate Rails	Once per						
	Month						
Replace Hot End	Every 3 to 6						
	Months						

Task	Frequency	Date Last Performed					
Recharge Dehumidifier	Once per						
	Week						
Check Belt Tension	Once per						
	Month						
Clean Hot End	Every 5						
	prints						
Lubricate Rails	Once per						
	Month						
Replace Hot End	Every 3 to 6						
	Months						

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## 9. Warranty

### 9.1 PVA Warranty Policy

PVA warrants the enclosed product against defects in material or workmanship on all components for one year from the date of shipment.

The warranty does not extend to components damaged due to misuse, negligence, or installation and operation that are not in accordance with the recommended factory instructions. Unauthorized repair or modification of the enclosed product, and/or the use of spare parts not directly obtained from PVA (or from factory authorized dealers) will void all warranties.

All PVA warranties extend only to the original purchaser. Third-party warranty claims will not be honored at any time.

Prior to returning a product for a warranty claim, a return authorization must be obtained from PVA's customer service department. Authorization will be issued either via the telephone, facsimile, or in writing upon your request.

To qualify as a valid warranty claim, the defective product must be returned to the factory during the warranty period. Upon return, PVA will repair (or replace) all components found to be defective in material or workmanship.

(Retain this for your records)

Product Information

PRODUCT:

---

SERIAL NUMBER:

---

DATE OF PURCHASE:

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