

3D Printing Prusa Handbook

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Welcome 3D Printing Enthusiasts

Welcome to the Library 3D Printing Handbook! At our library, we offer self-service 3D printing using the latest technology. Our 3D Printing Zones are equipped with the Prusa i3 MK3S+. Best of all, these services are free—allowing you to bring your 3D projects to life without any cost.

The purpose of this handbook is to guide you through the process of using the library's 3D printing services safely and effectively. In this handbook, you'll find:

- Safety guidelines to help ensure a secure and safe printing experience.
- Detailed instructions on how to modify, slice, and print your models.

Effective Date: 07/31/2025	<input type="checkbox"/> New <input checked="" type="checkbox"/> Revised	Index Code: LO 200-27-PRO.2.I
Originating Department: Library Operations, IT		

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- Troubleshooting tips to help resolve any issues that may arise during the printing process.

After reading this guide, you'll need to complete an online or in-person quiz. A score of 100% is required to pass, and all the answers to the quiz can be found within the handbook. Don't worry—you can retake the quiz as needed. Once you pass, simply see a staff member to finalize the process and start your 3D printing journey.

Good luck and happy printing!

3D Printing Zone Guidelines

To ensure a safe, enjoyable, and fair experience for all customers, we've outlined the following guidelines and conditions for using our 3D printers. Please review this information carefully:

Getting Started:

- Customers must have a valid library card in good standing.
- Complete required training (online or in-person).
- 3D printing is available for customers aged 10 and older. Children under 10 are not allowed to operate the printers.

Using the 3D Printer:

- The 3D printer can be used for up to 4 hours per day, depending on branch operating hours. Reservations can be made on a same-day, first-come, first-served basis.
- Always follow safety guidelines. Do not touch heated parts during or after printing.

Printing Limitations:

- Prints must be completed during library hours.
- Maximum print size: 25×21×21 cm (9.84"×8.3"×8.3").
- Single-color prints only.

Customer Responsibilities:

- Customers are responsible for downloading, designing, preparing, and troubleshooting their own 3D models.
- Library staff and volunteers are available to provide basic guidance.
- Follow all library-approved print content guidelines (no unsafe, harmful, or copyrighted designs).
- Misuse of equipment can lead to loss of privileges or financial responsibility for damages.

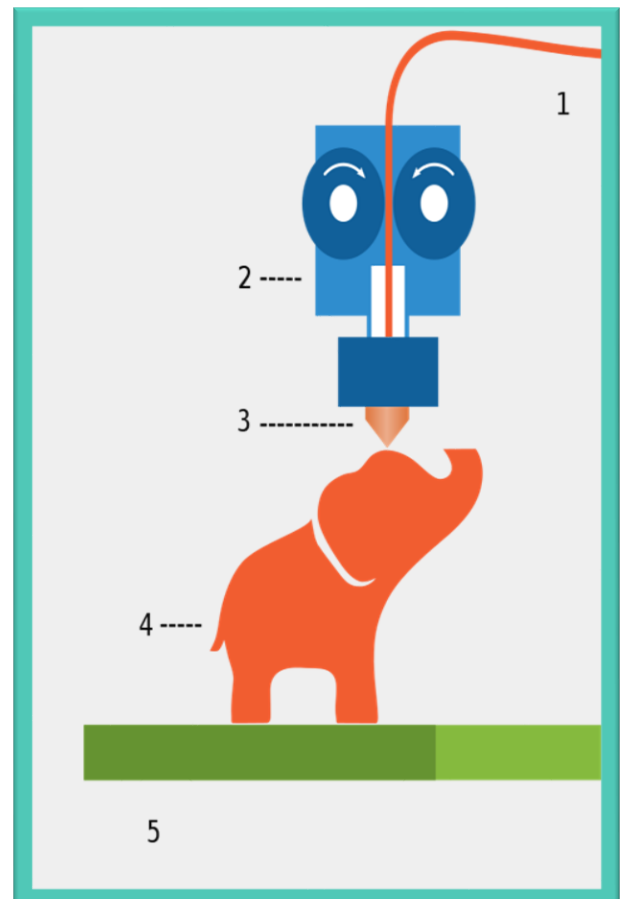
District is not responsible for any object created with the use of the equipment, including any harm or injury incurred as a result of any usage of the equipment. For the full guidelines, visit thelibrarydistrict.org/3DPrinting/.

What is 3D Printing?

3D printing is a process that transforms a digital model into a tangible, three-dimensional object. This involves using software to slice the digital model into layers that the printer can understand. More details will be provided in the handbook. Below is an image along with an explanation of how the process works.

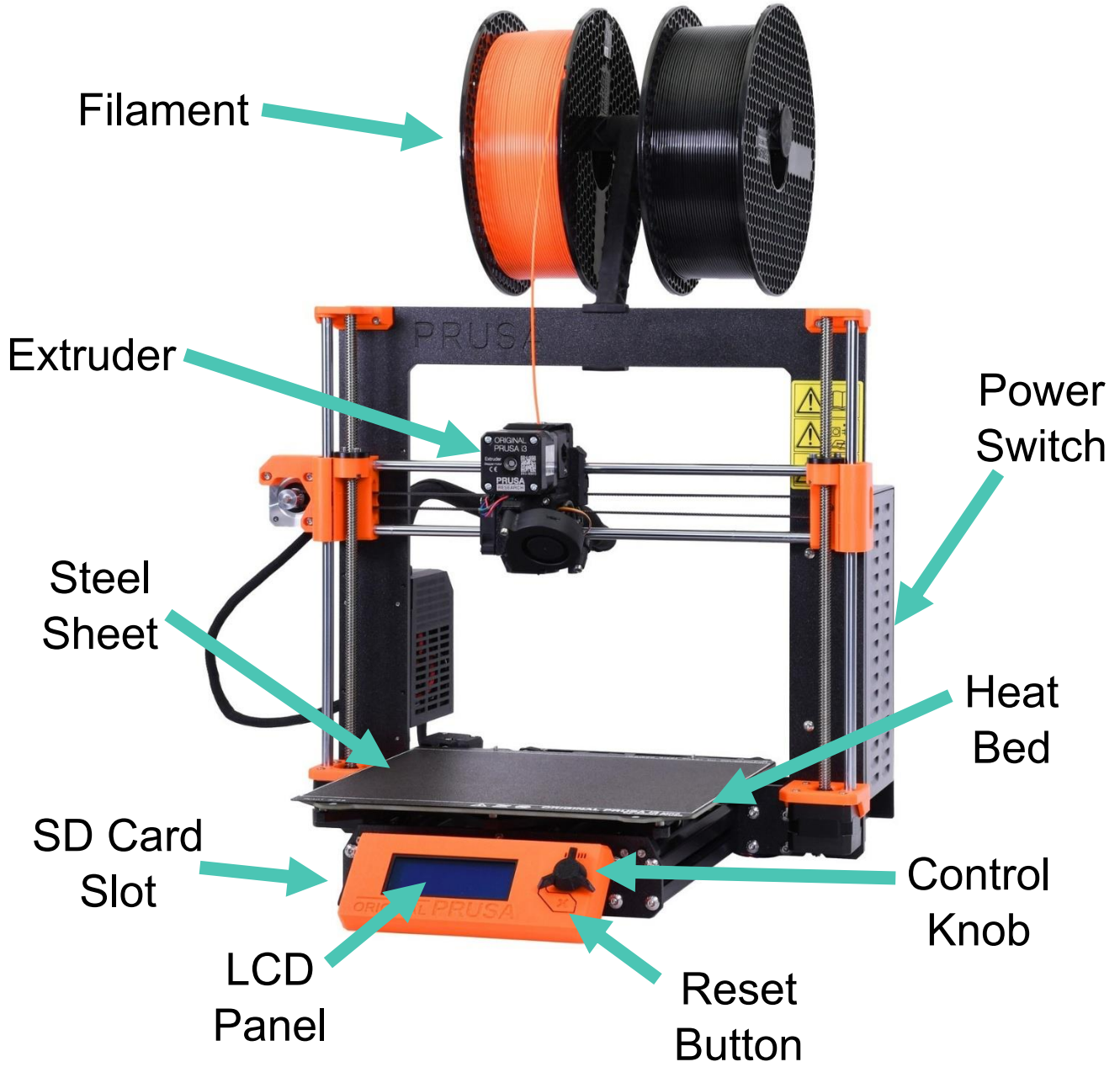
The Process of 3D Printing

1. **Filament Insertion:** The printing material (filament) is inserted from above through a small hole.
2. **Melting:** The filament travels through drive gears and is melted in a heater block.
3. **Extrusion:** The melted filament is extruded by an extrusion head onto the build plate, where it cools and solidifies.
4. **Layer-by-Layer Building:** The process repeats continuously, building up layers to create the final model.
5. **Platform Heating:** The build plate is heated to help secure the model in place during printing.



Anatomy of the 3D Printer

Prusa i3 MK3S



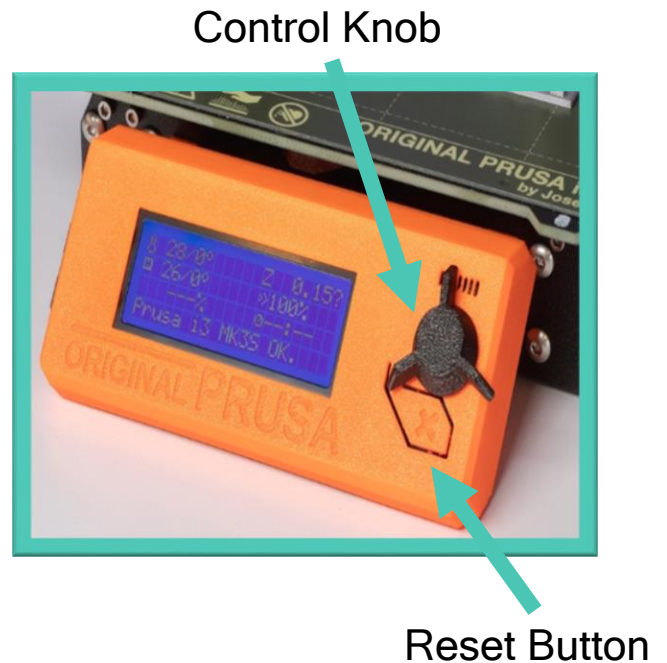
LCD Panel

Controlling the LCD Screen

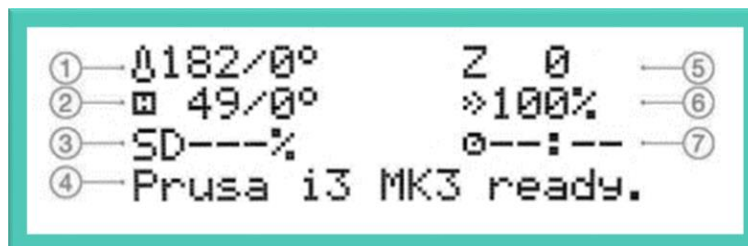
The LCD screen is controlled using the rotational knob. Press the knob to confirm your selection.

Reset Button

The reset button (X button) is located directly below the control knob. It's useful for canceling a print job or resetting the printer if you encounter any unusual behavior or a failed print.



Information Screen (Main Menu)



1. Nozzle temperature (actual / desired temperature)
2. Heat bed temperature (actual / desired temperature)
3. Progress of printing in % (shown only during the printing)
4. Status Bar (*i.e. Prusa i3 MK3 ready / Heating / file_name.gcode, etc.*)
5. Z-axis position
6. Printing speed
7. Remaining time estimation (shown only during the printing)

Filament (PLA)

Filament is the material used in 3D printers. It consists of a continuous thread spooled onto a reel. While many types of filament exist, only PLA filament supplied by the Library District is allowed for use on our 3D printers. The Library



District provides a selection of filament colors, which may differ between branches based on availability.

Build Plate (Heat Bed and Steel Sheet)

The build plate is where your 3D model is printed. It heats up to help the print stick to the surface. The Prusa i3 MK3S+ uses a steel sheet with a textured surface that improves adhesion and makes it easier to remove your print once it's finished.

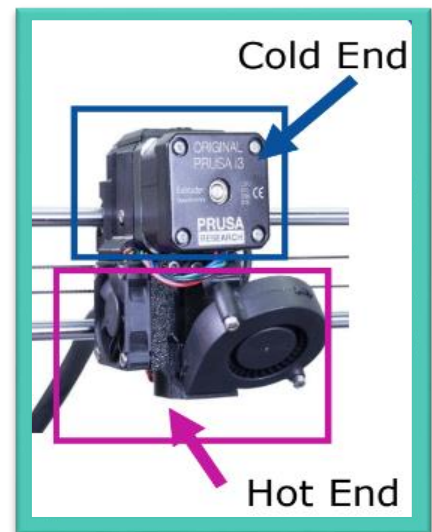


Extruder

The extruder is one of the most important parts of a 3D printer. It transfers heated filament onto the build plate, layer by layer, to create your print. The extruder consists of two main parts:

Cold End: The upper portion of the extruder system where the filament is fed into the hot end.

Hot End: The lower portion where the filament is heated and melted before being extruded onto the build plate.

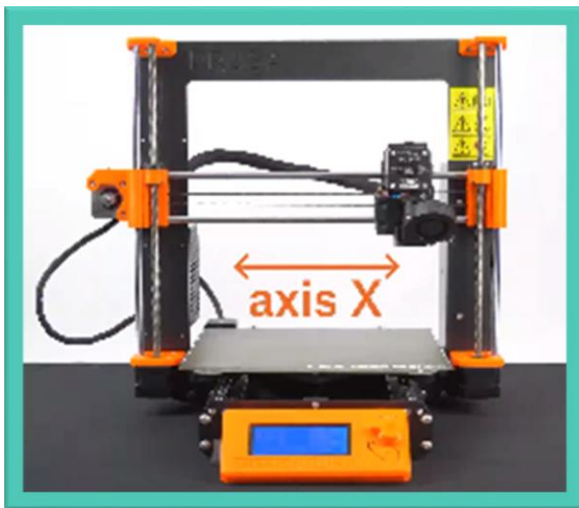


⚠ Important: For PLA filament, the hot end must reach a temperature of 215°C to melt the filament properly. This temperature ensures that the PLA flows smoothly onto the build plate for accurate and high-quality prints.

Stepper Motors (X – Y – Z Axis)

The extruder houses the stepper motors located in the cold end. These motors are responsible for driving the movement of the printer's parts. They control the movement of the:

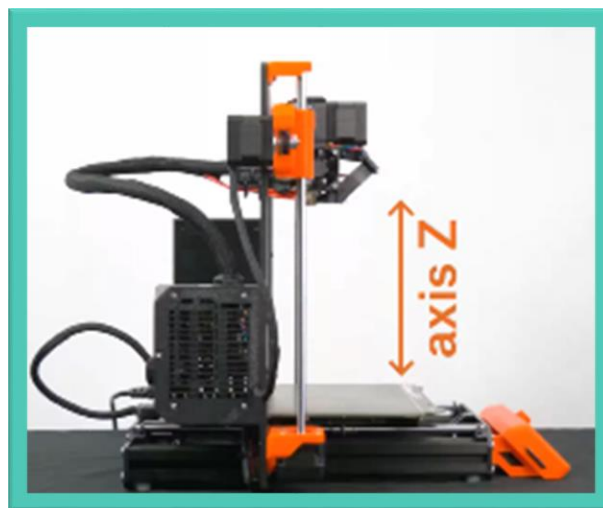
- **X-axis:** Moves the extruder (the part that melts the filament) from side to side.
- **Y-axis:** Moves the build plate (where the print sits) from front to back.
- **Z-axis:** Moves the extruder up and down, controlling the height of each printed layer.



Left and Right



Front and Back

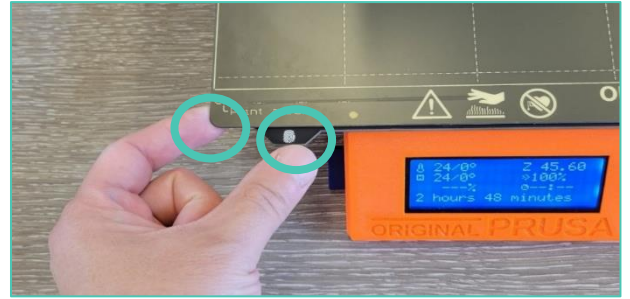


Up and Down

Setting Up the Printer

Steel Sheet Detaching

1. Place your index fingers under the corners of the steel sheet and your thumbs on top of the thumbprint images.



2. Using both hands, lift the corners of the magnetic steel sheet and detach it from the heat bed.



Steel Sheet Cleaning

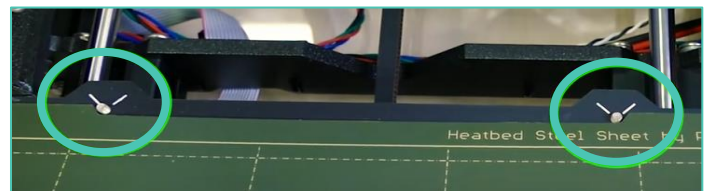
Take an alcohol wipe and gently clean the steel sheet. Be careful not to leave any fingerprints.



⚠ Important: The steel sheet should be completely clean for the first print layer to stick properly. Dust and fingerprints can compromise the adhesion.

Steel Sheet Attaching

1. Make sure the heat bed is clean and free of any filament debris. Carefully slide the back edge of the steel sheet onto the heat bed. Make sure the small pins on the heat bed fit into the notches on the side of the steel sheet.



2. Lower the steel sheet slowly and gently onto the magnetic heat bed until it lays flat.

⚠ Important: Always use both hands when handling the steel sheet, and be gentle. Hold the corners with your fingers to avoid pinching them.

Unloading Filament

1. Press the control knob to enter the main menu. Turn the knob to find and select 'Unload filament', then confirm by pressing the control knob.
2. Select 'PLA' and confirm by pressing the control knob. The extruder will begin to heat.

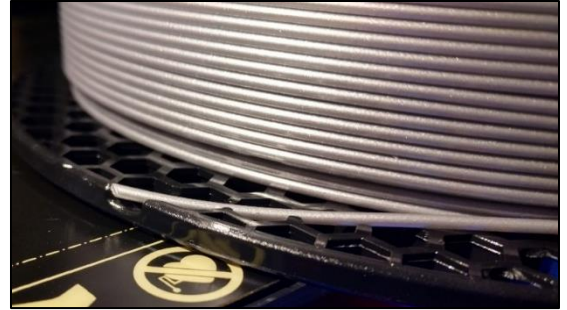


⚠ Important: Filament should never be removed from the extruder while the nozzle is cold.

3. Once the printer reaches the target temperature, you will be prompted to press the control knob to unload the filament.
4. After pressing the knob as prompted, the extruder will begin to unload the filament by pushing it out from the top. You will then be prompted to fully remove the filament by pulling it out gently.



5. Secure the end of the filament by tucking it into a slot on the outer edge of the spool. This will prevent the filament from loosening or tangling during storage.



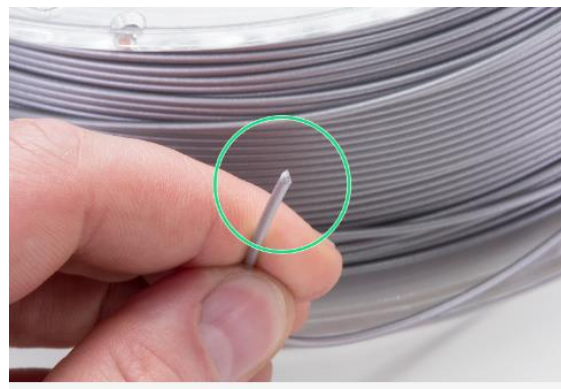
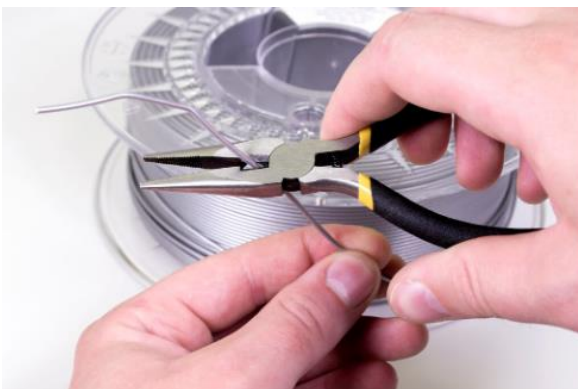
Loading Filament

Checklist before you start:

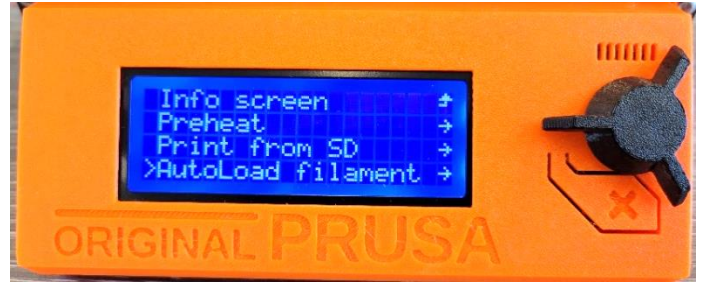
- If there is existing filament in the extruder, refer to the **Unloading filament** section before proceeding.
- Place the filament spool on the spool holder above the printer. Ensure the filament end is at the top and facing the front, as shown below.



- Make sure the end of the filament is sharp. Use a side or flush cutter to trim it at an angle. Ask staff for assistance if needed.



1. Press the control knob to enter the main menu. Turn the knob to find and select 'AutoLoad filament', then confirm by pressing the control knob.



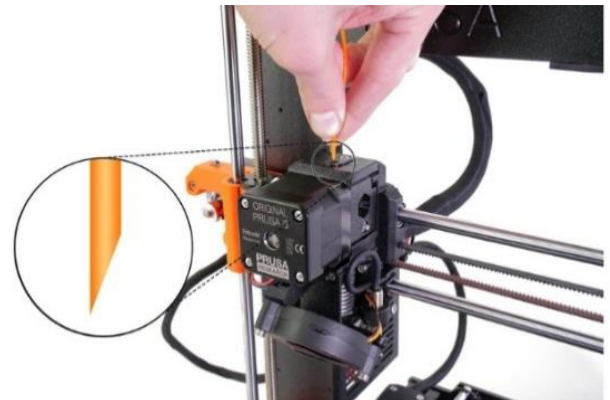
2. Select 'PLA' and confirm by pressing the control knob. The extruder will begin to heat up.



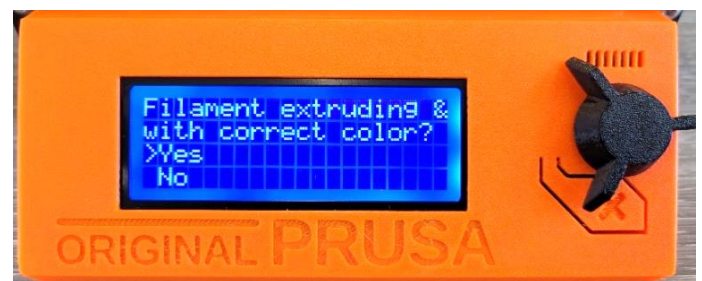
3. Once the printer reaches the target temperature, a prompt will appear. Press the knob to begin the loading process.



4. Carefully push the filament into the hole at the top of the extruder. You will feel the motor begin to pull the filament in, and you can release the filament.



5. The filament should soon start extruding from the nozzle. If you see the filament change from the old color to the new color, select "Yes" when prompted. If the color does not change, select "No," and the machine will continue extruding filament.



6. Remove any extruded filament from the build plate.

⚠ Important: The extruder and heat bed will still be hot. Be careful not to directly touch the nozzle or the heat bed when removing filament.



Preparing Your Print

To get started with 3D printing, you can either download a pre-made model or create your own. These models are usually in .STL format, which is a special type of file that describes the shape of a 3D model.

Once you have your .STL file, the next step is to load it into PrusaSlicer. This program will convert your model into a .GCODE file, which provides the instructions that tell the 3D printer how to create the model. You can also make adjustments to your model in PrusaSlicer before preparing it for printing.

The following steps will guide you through this process and help get your print ready:

OctoPrint

OctoPrint is a web-based dashboard that communicates between the computer and the 3D printer. We will talk more about this in the next section.

Please note that once you log onto the computer, after maybe 30 seconds, OctoPrint will automatically open. Your screen should look like this:

The screenshot shows the OctoPrint web interface. On the left, a sidebar contains a 'State' section (marked with a circled '1') showing the printer is 'Operational' and a 'Files' section (marked with a circled '3') listing uploaded GCODE files. The main area (marked with a circled '2') displays a temperature control panel with a graph and a table of current and target temperatures for the tool and bed.

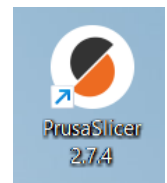
	Actual	Target	Offset
Tool	24.4°C	off °C	0 °C
Bed	24.0°C	off °C	0 °C

1. Current print .GCODE file
2. Current 3D printer temperature
3. .GCODE Files from SD card and PrusaSlicer

PrusaSlicer

1. Find or Create a 3D Model

You can either download a pre-made model or create your own.

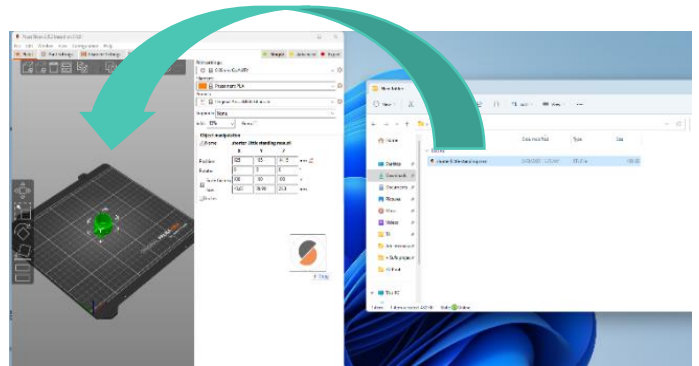
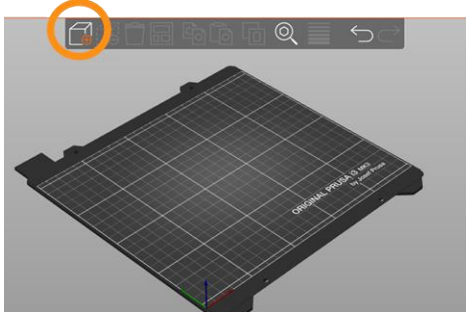


- Download a Pre-made Model: Websites like Thingiverse.com or Printables.com offer a wide range of free models. Simply search for the model you want, and make sure it's in one of these supported file types.
- Create Your Own Model: If you prefer, you can create a 3D model using a program like Tinkercad.com. These tools allow you to design your own creations from scratch.

2. Open the Model in PrusaSlicer

Load the model into PrusaSlicer either by:

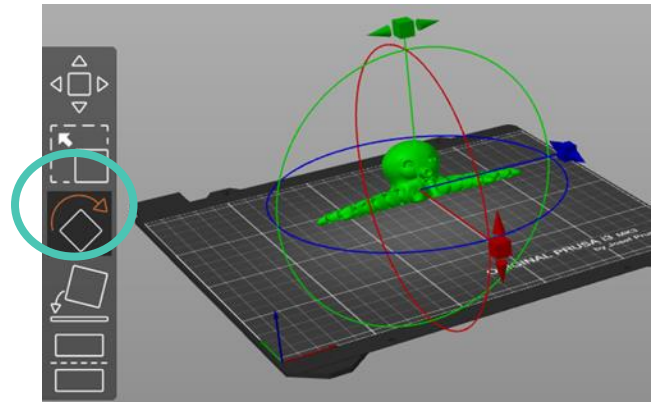
- Use the Add button and locate the file.
- Drag and Drop your file directly from a folder to the PrusaSlicer window.



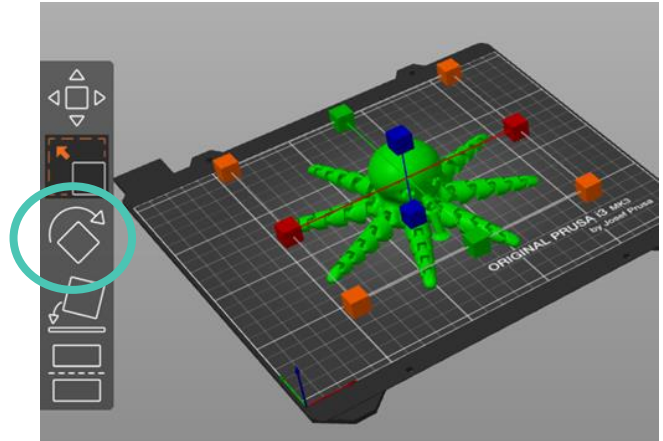
3. Adjusting the Model for Printing

⚠ Important: The Library District provides up to four hours per 3D print session, so it's important to make adjustments that help ensure the best possible print within that timeframe.

- **Model Orientation:** The way your model is oriented on the print bed can affect both print quality and time. You can use the "Rotate" tool to adjust your model's orientation. The best orientation for printing usually has the largest flat surface on the print bed. This helps to improve stability during printing and minimizes the need for support structures.

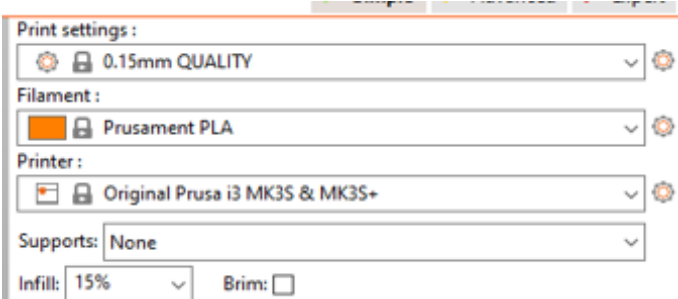


- Model Sizing:** The "Scale" tool allows you to change the size of your model. You can increase or decrease the model's dimensions, either manually or by percentage. Keep in mind that scaling your model larger will increase print time significantly, while scaling it smaller will reduce the print time. Be sure to keep your time limit in mind when adjusting size.

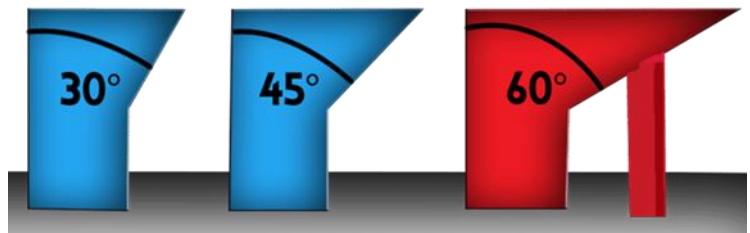


4. Choose Your Print Settings

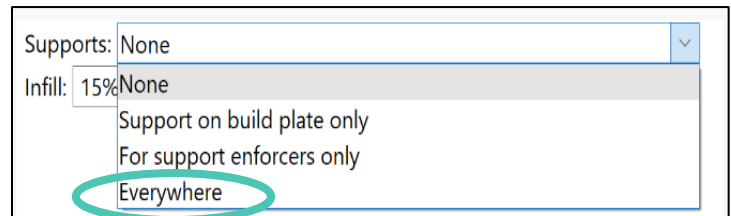
⚠ Important: The printer settings are already preset to default for the Prusa i3 MK3S+. Typically, you only need to adjust the following settings:



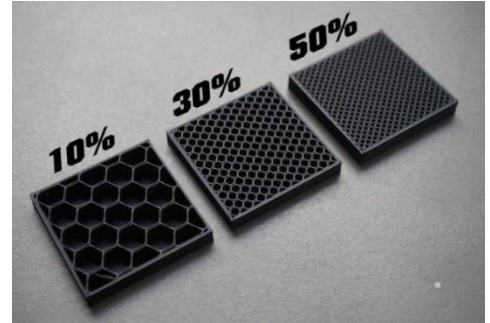
Supports: Many models have parts that stick out further than the part of the object below it. This is called an overhang. Most 3D printers can successfully print overhangs of 45°, but the greater the angle the more likely a print is to deform or fail as gravity will start to pull it down. Supports should be used for any object that has overhangs of 50° or greater for best results.



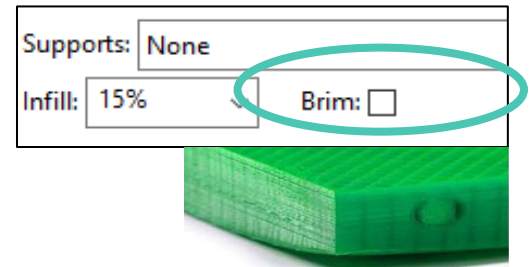
PrusaSlicer can automatically detect and generate supports. You can toggle supports on and off, and specify whether you want them to appear everywhere or only on the build plate. "Everywhere" is recommended in order to avoid unsupported parts of your model causing the print to fail.



Infill: Infill is the internal structure of a 3D print model and indicates what percentage of the inside of a model is solid material, with 0% making a part hollow and 100% completely solid. Weight, print time, material consumption, and buoyancy are impacted by infill density. Our printer has it set to 15% as default.



Brims: While optional, brims are recommended on all prints and necessary on models that have a small surface area touching the build plate. Brims are used to hold down the edges of your print, which can prevent warping and help with bed adhesion.

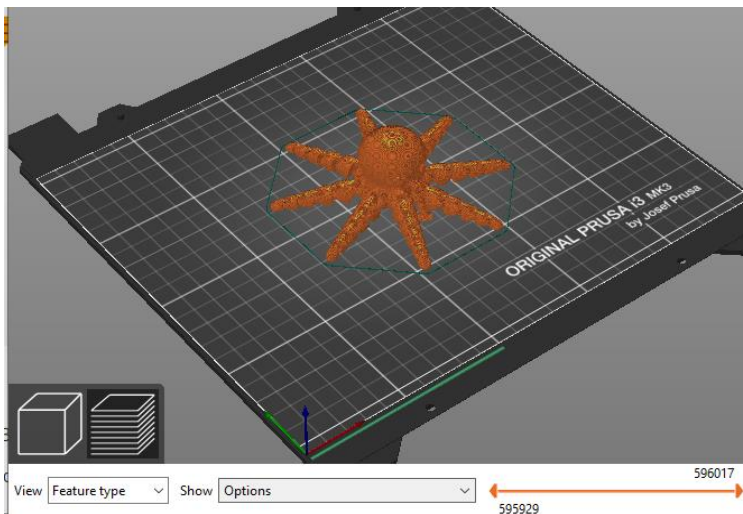


Example of Warping

5. Slice Your Model

Once your model is ready and your settings are adjusted, the next step is to convert it into a .GCODE file. This file contains all the instructions the printer needs, such as how to move the extruder, when to heat the print bed, and more.

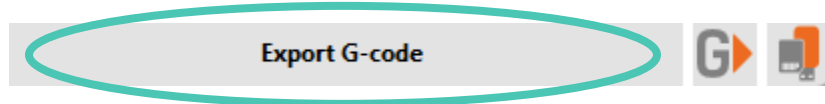
- Click on the ‘Slice Now’ button located at the bottom right.
- After slicing, PrusaSlicer automatically switches to Preview Mode.
- At the bottom right corner of the screen, you’ll find the Sliced Info panel. This includes key details such as estimated printing time: helps you ensure your print fits within the Library District’s four-hour limit.



Sliced Info	
Used Filament (g) (including spool)	21.56 (222.56)
Used Filament (m)	7.23
Used Filament (mm ³)	17383.20
Cost	0.78
Estimated printing time:	
- normal mode	4h13m
- stealth mode	4h14m
Export G-code	

6. Save the .GCODE File

After slicing your model, the next step is to save the .GCODE file. In the Print Preview mode of PrusaSlicer, click the "Export G-code" button and save the file to your computer.

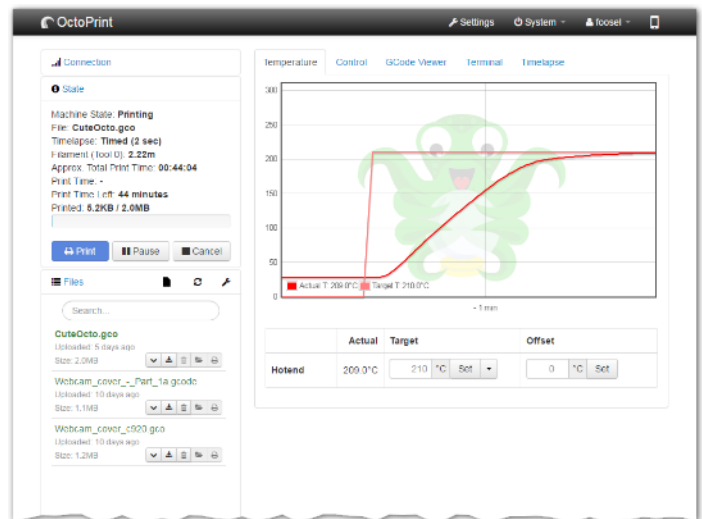


Printing Your Model

Checklist before you start:

- Compare the estimated print time with the time left in your computer session to ensure it will complete in time.
- Make sure the filament is the color you want and is loaded correctly.
- Ensure that the build plate is clean and clear of debris.

1. Now that the G-CODE file is ready, it's time to send it to the printer. Open OctoPrint in your web browser, navigate to the "Files" section, and click the "Upload" button.
2. Select your G-CODE file from the saved location on your computer and upload it to OctoPrint.
3. Click the "Load and Print" button. This sends the file to the printer and positions it for printing.
4. Once the printer is ready, click the "Start" button in OctoPrint.
5. The printer will begin following the instructions in the .GCODE file to create your model.



Tips and Tricks

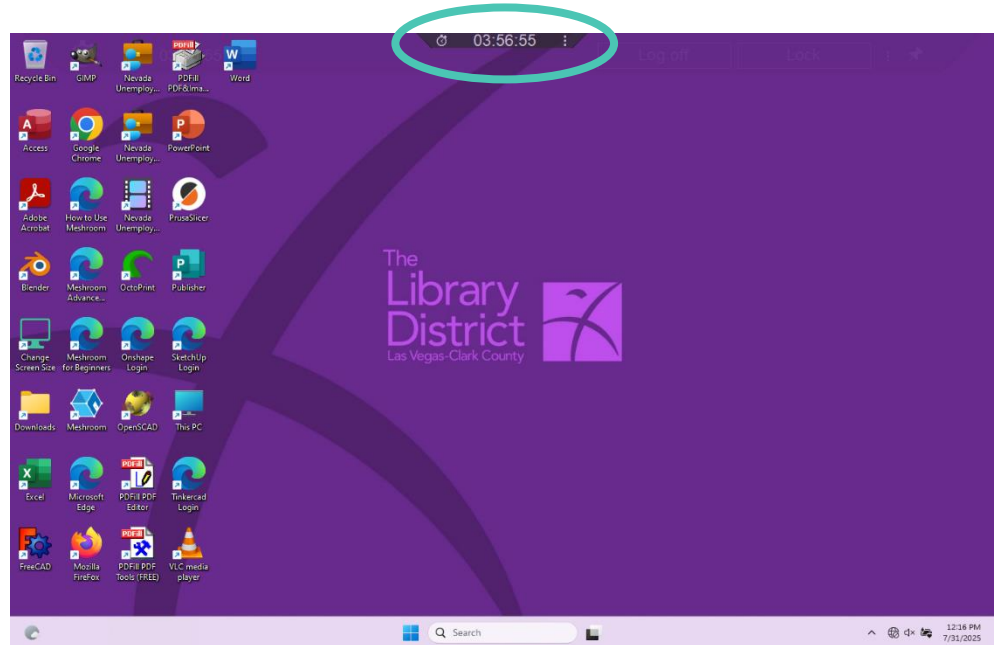
- While the printer is running, press the control knob for options: such as pausing and resuming your print job, and canceling.
- If you need to have an emergency stop, press the reset button on the printer (X button) to stop the printer immediately.
- Do not log out of the computer while your 3D model is printing! It will cancel your print.

- When you need to leave your station or aren't using the computer, use the 'Lock My Screen' option.

Lock My Screen

If you choose to leave the area while your print is running, please lock your screen. This will prevent other customers from using the computer while it is signed into your account.

1. Locate the rectangular box that indicates the laptop timer (usually located on the top center of the screen). Click the timer.



2. Select "Lock".



Removing Your Print

Checklist before you start:

- Make sure the extruder is not moving and is back to its home position.
- Heat bead temperature is low.
- Do not directly touch the nozzle throughout this section.



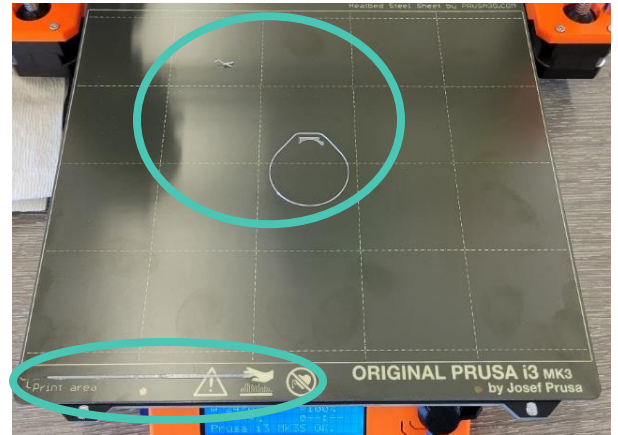
1. Using both hands, lift the corners of the magnetic steel sheet and detach it from the heat bed (see page 8).

2. Flex the steel sheet slightly on all sides and corners.



Don't flex the steel sheet too hard as you can permanently deform it.

3. Grip your model and lift or slide to remove it. The filament skirt surrounding the print and nozzle wipe at the front of the sheet can be scraped off with your fingernails. Make sure there is no remaining filament on the steel sheet or the nozzle.



Don't use a tool such as scraper to remove your 3D model. Ask staff for assistance if you are having trouble.

4. When you are finished, remember to clean up your station, log off of your computer, and return any tools used to staff.

Final Reminders

1. No drinks, foods, or snacks are allowed in the 3D Printing Zones.
2. Please do not attempt to move the printer.
3. Do not touch the nozzle or heat bed when the printer is printing or warming up. Build plate temperatures may get above 60°C (140°F) which can cause harm to the human body.
4. Do not reach inside the printer while it is still in operation. You may be injured by the moving parts.
5. Listen to staff instruction when given.
6. Be aware that if you don't return to the printer as soon as your print has finished, others may remove your print for you and may accidentally damage your print in the process.
7. High electrical currents are being switched on and off in the immediate proximity of parts marked like this. Persons with an implanted cardiac stimulator or other devices for controlling and regulating heart functions must take extra care and consult their doctor before using the 3D printer.

Any misuse or failure to follow 3D Printing Zone Guidelines will result in the loss of 3D printer privileges!

Safety Symbols and Their Meaning



Careful: strong magnetic fields



Careful: mechanical parts. Take care to avoid injury to hands when in close proximity to the device with mechanical parts.



Further information regarding function and service can be found in this user (service) manual or online at help.prusa3d.com.



Before any service intervention, it is necessary to first disconnect the 3D printer from the power source and familiarize yourself with the instructions.



Take extra care when handling or touching parts marked with this symbol, and avoid further risks specified by specific symbols, such as hot surface hazards — burns may occur.



Hot surface! The marked object may be hot and extra care should be taken when touching it.



Unprotected moving mechanical parts can cause injuries, please take extra care.



Do not print directly on this surface.



High electrical currents are being switched on and off in the immediate proximity of parts marked like this. Persons with an implanted cardiac stimulator or other devices for controlling and regulating heart functions must take extra care and consult their doctor before using the 3D printer.



This device is composed of components that must be disposed of in accordance with the Directive on Waste Electrical and Electronic Equipment.