FUSED FORM

FF P1000 USER MANUAL

For technical support, contact us:

soporte@fusedformcorp.com

Include Photos and videos in your description

We recommend to begin your 3D printing learning process with simple prints.

You can download models on: thingiverse.com

Dominating 3D printing will require experience and a good following of this instruction manual. Please read it carefully and completely.

Contents

A. General Aspects

Please read and understand entirely this user´s manual before operating your machine. Inside this manual are described safety instructions and manipulation procedures that are very important that you understand.

A.1 Safety Instructions

- Adapt the location where your 3D printer will be in operation:
  - Without direct air currents.
  - With a power supply nearby and preferably regulated.
  - Locate your printer in a flat, stable surface
  - Check your power supply capacity with the machine power requirement.
  - Verify that the power supply of your location has an adequate grounded connection. The machine will require a grounded connection for safety.
- Children should not be allowed to operate this type of equipment or unsupervised if nearby.
- This is an industrial equipment. Only qualified personnel should operate it.
- Keep liquids away from the printer, specially from electronics.
- Keep away flammable liquids or solids from the printer.
- DO NOT TOUCH the extruder elements or heat bed while turned on. They can remain hot even after turned off.
- Do not touch electric terminals of the machine or machine components
- Ask the manufacturer before making any modification in the machine or in power supply characteristics.
- Do not insert your hands inside the machine or any part of your body while printing. This machine has high power motors that can harm you.
- Do not insert any object on any of the printer fans.
- This machine contains moving and rotating parts. Please keep your hair tied, and your hands away from the moving parts. Also remove from you any accessory that can get tangled in the machine components.
- Keep your hands or any element away from the rotating shaft of the extruder screw.
- Maintain the floor of your workplace free of pellets. Pellets will make the floor very slippery.
- Maintain your machine free of dust and plastic remaining, especially linear guideways, bearings and screws.
- Never remove the extruder nozzle while the screw is rotating or if it is possible that there is pressure accumulated inside. The extruder screw can

build high pressure of overheated plastic, this pressurized melted plastic may burst if the nozzle is removed under these conditions.

A.1 Personal Protection Equipment

The main hazards present in the operation of this machine are:

- Electric shock hazards
- Moving and rotating parts
- Hot elements
- High noise pneumatic components
- Slippery surfaces caused by loose pellets
- Sharp surfaces on prints and glass surface
- High pressure of overheated plastic

Extruder screws can build high pressure of overheated plastic and be very dangerous of producing burns.
Extruder components and heated bed platform reach high temperatures,

The following personal protection equipment is required for a safe operation or manipulation:

When manipulating the extruder system:

- Long sleeve thick shirt of non-synthetic cloth.
- Heat resistant gloves
- Eye protection goggles
- Face shield

When operating the printer:

- Eye protection goggles
- Long Sleeve shirt
- Ear protection devices

When operating the pellet feeder system / pneumatic system

- Face shield
- Eye protection goggles
- Ear protection devices

When removing prints from printed bed, or removing support material from the printed parts:

- Protection gloves
- Eye protection goggles with side protective cover
- Face shield

B. Know your 3D printer

This 3D printer works under the same principles of a traditional FFF 3D printing technology, with the variation that the extruder works with pellets instead of filament: a pellet screw extruder is moved by a cartesian type robot along the X and Y axes. The build platform is moved along the Z axis. The addition of the extruder screw brings advantages and complexities of both 3D printing and pellet extrusion technologies.

Using pellets instead of filament broadens the range of the possible materials that can be printed: it is possible to make blends of materials, on-demand coloring, material gradients, etc.

This type of extrusion also brings some complexities: 3 zones of temperature control in the extruder screw, as well as other typical complexities of screw extrusion of polymers. We encourage the end user to have screw extrusion technology bibliography on hand, to understand in depth the nature of the screw extrusion process. One very valuable book is: “Extrusion: The Definitive Processing Guide and handbook” by Harlod F. Giles, Jr., John R. Wagner, Jr., Eldridge, ISBN: 978-1-4377-3481-2

General Specs

- Printing technology: pellet extrusion 3D printing, fused granular fabrication (FGF)

- Printing Materials

    - HIPS, ABS, PC, PP, PETG, PBT, and others.

    - The suitability of a material will depend on different factors such as:

        - Screw geometry characteristics (compression ratio, screw channel depth, screw profile, etc)
        - Degradation time of the material (e.g. PLA degrades rapidly, hence PLA pellet 3D printing must ensure a high flow rate of material)
        - Available torque of the extruder gearmotor (excessively viscous materials will require too much torque for pellets to be extruded).

- This machine has an automatic pneumatic pellet feeding system

- Printing Volume (width, depth, height): 1100x1100x1300 mm (43.3x43.3x51.2 in)

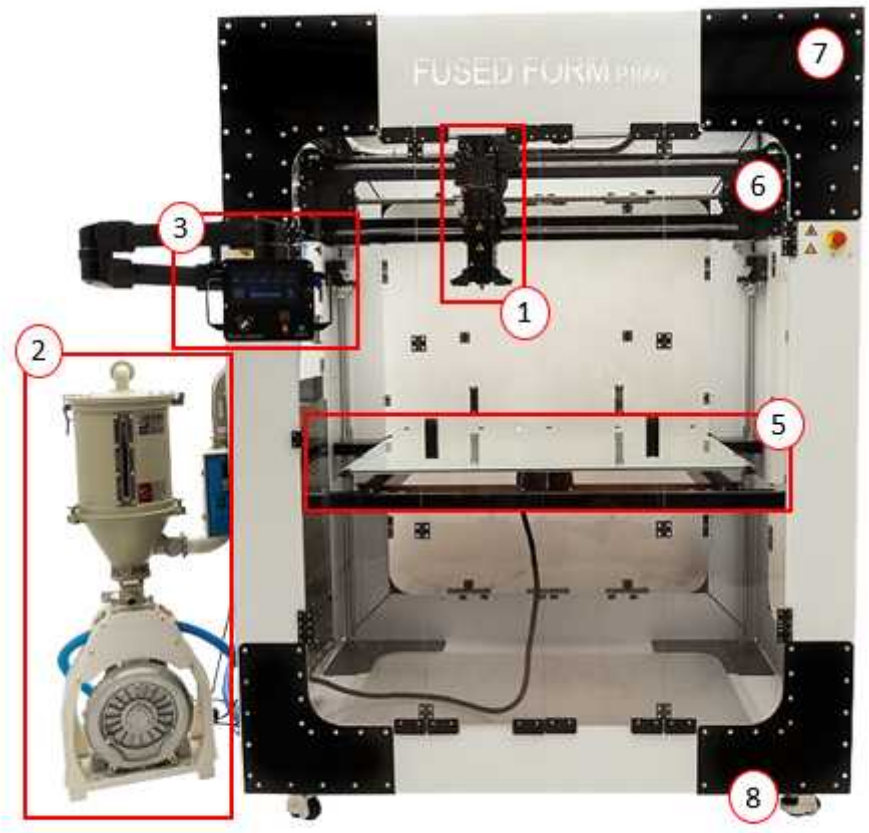
- Minimum Layer Height**:** 0.1mm (100 microns). Maximum layer height: 80% of nozzle diameter. The minimum layer height must consider degradation times of the material to be printed because a small layer height will probably imply a smaller material flow (higher residency time of the material in the extruder causing degradation)

- Power requirements:

    - Main power: 220V AC, 60/50 Hz: 4500W max. Grounded connection is required.
    - Hopper Dryer: 220VAC 60/50 Hz 1900W max. Grounded connection is required.

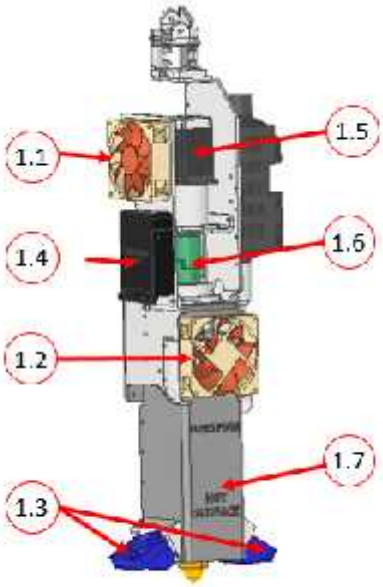
B. Machine components

The main components of the machine are:



1. Extruder System
2. Pellet feeding/drying system
3. Control screen
4. On/Off and emergency switch
5. Bed / Z axis
6. X Axis Gantry
7. Chassis
8. Leveling casters

B.1 Extruder System



ISOMETRIC-LEFT VIEW

1.1 Extruder gearmotor cooling fan (24V)

1.2 Cooling fan for extruder feeder zone (24V)

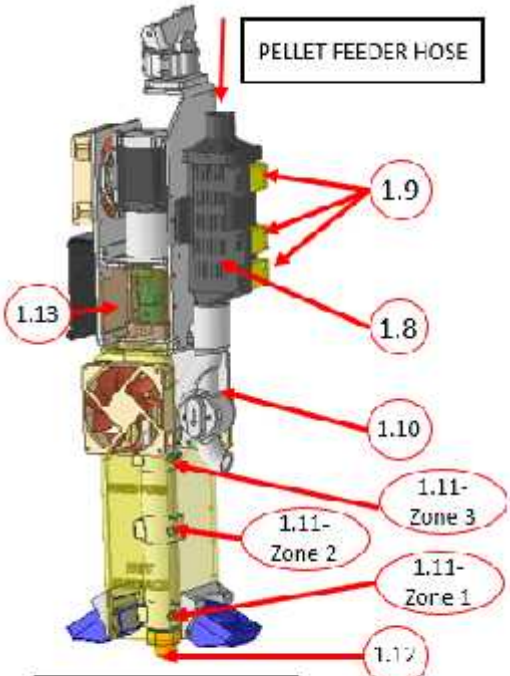
1.3 Printing cooling fan (12V)

1.4 Connector box

1.5 Extruder Gearmotor

1.6 Extruder flexible coupling

1.7 Extruder screw cover



ISOMETRIC-RIGHT VIEW

1.8 Reservoir body

1.9 Pellet level sensors

1.10 Feeding duct and pellet purge valve

1.11 Extruder heaters (3 zones, 220V supply each)

1.12 Nozzle main body and nozzle outlet (interchangeable nozzles)

1.13 Extruder coupling cover

B.2 Pellet feeding system

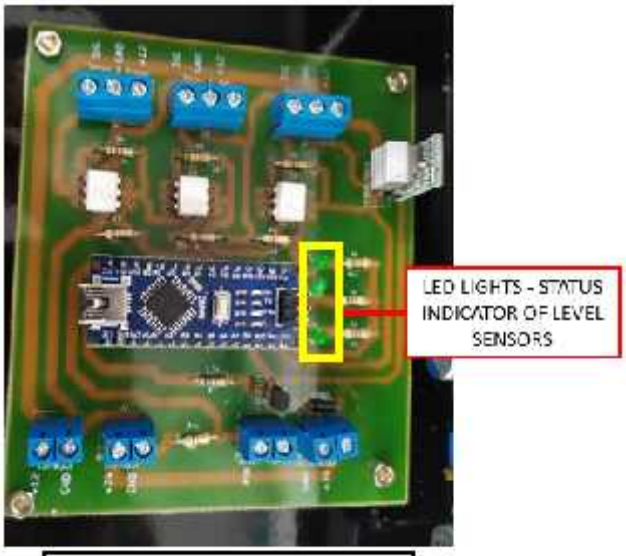
The components of the pellet feeding system are shown in the following image:

2.1 Pellet hopper
2.2 Pellet hopper lid
2.3 Pellet feeder hose
2.4 Hopper pellet sender duct
2.5 Pellet dryer system
2.6 Air Blower

The command buttons in the screen:

2.7 Feeder manual activate pulsator
2.8 Pellet supply system and pellet runout sensor on/off switch

The feeding system is controlled by an electronics board (located in the electronics box), shown in the following figure:



PELLET LEVEL CONTROLLER BOARD

The automatic pellet feeding system works as follows:

Turn on the pellet supply system switch (item 2.8 in figure)

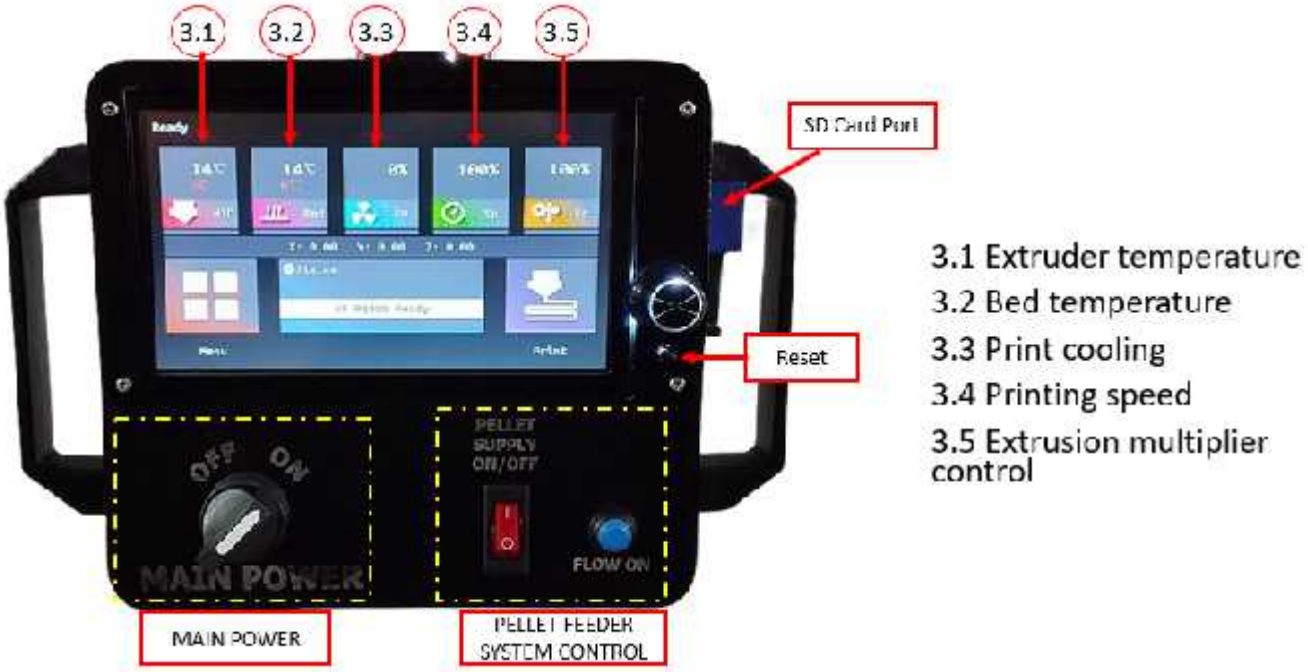
When the low-level sensor in the reservoir detects there is a low level of pellets (fill sensor in reservoir), the controller board activates the filling routine: the air blower (2.6) turns on to produce a high-speed air flow through the pellet sender (2.4), dragging pellets through the pellet hose (2.3) to the extruder reservoir (1.8). The pellet feeding process will stop when the system detects that the reservoir is full of pellets (full sensor in reservoir, (1.9)).
In case there is any problem with the supply of pellets, or if there is no more material in the pellet hopper, the pellet level in the reservoir will decrease down to the runout level in the reservoir (1.9). This will activate the runout sensor and the pellet controller board will command the printer to pause and wait for the user to check the system and reload pellets. After feeding the reservoir and hopper, the user can resume the print.

General remarks:

- The auxiliary pellet hopper is printed with a Pellet 3D printer with transparent PETG. In this way, the hopper pellet level can be monitored visually. Please note that there is no pellet low-level sensor for the hopper.
- The air flow can be activated manually by pressing the pellet activate pulsator (2.7) in case it is needed. For the air blower to operate, the main power supply must be turned on (2.8).
- The pellet feeder hose can be disassembled easily from the sender unit by unscrewing the securing nut.

B.3 Control Screen

This 3D printer is controlled by the main screen:



The three heating zones of the extruder (nozzle, mid, up) are controlled in the extruder temperature menu (3.1)

General remarks:

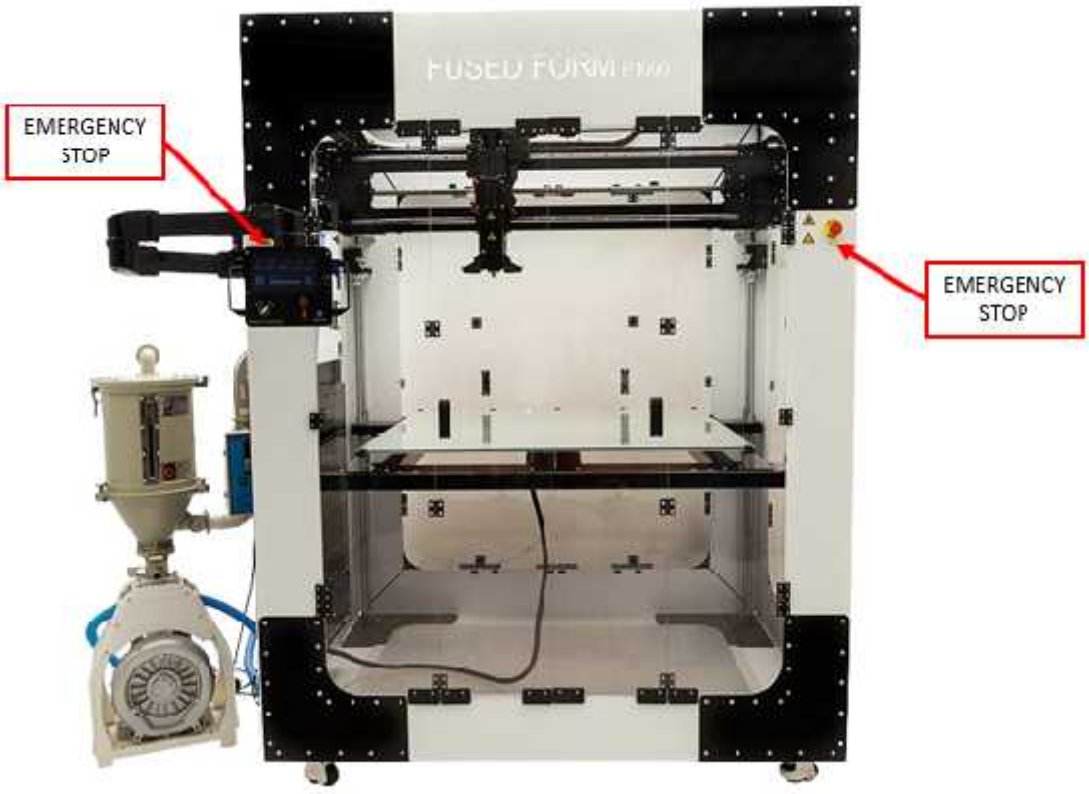
- Special care must be taken with the temperature of the upper zone: this temperature must be kept below the glass transition temperature of the pellets being printed. In case of semi-crystalline materials, keep the temperature below the melting temperature.
- Temperature at the upper heating zone must be kept below 170ºC in case the printer has a PEI feeding duct. In case there is a requirement for higher temperature at the upper zone, please contact support for further guidance.
- If the temperature at the upper zone is set above the glass transition temperature of the material (or melting point for semi-crystalline materials), the pellets can melt in this zone and the feeding of pellets will be interrupted, as shown in the following figure.

B.4 ON/OFF and emergency switch

This machine is turned on and off by the main power supply switch: rotate the knob to the right to turn on the machine, rotate to the left to turn off the machine.

This machine has two emergency switches located in each pillar in the front side. In case of an emergency, press either one of those buttons. This will turn off all the machine components immediately and the emergency button will remain locked in

the emergency position (emergency - off). To unlock the emergency button, rotate the knob to the right; this should let return the button to the normal operative state.



If the emergency button is pressed, the main on/off switch will be overridden by the emergency button state in off. If the emergency button is released, the main switch will recuperate its functionality.

C. FIRST STEPS

Once you have set the machine in an adequate space and correctly leveled and connected to the main power supply, you are ready to go!

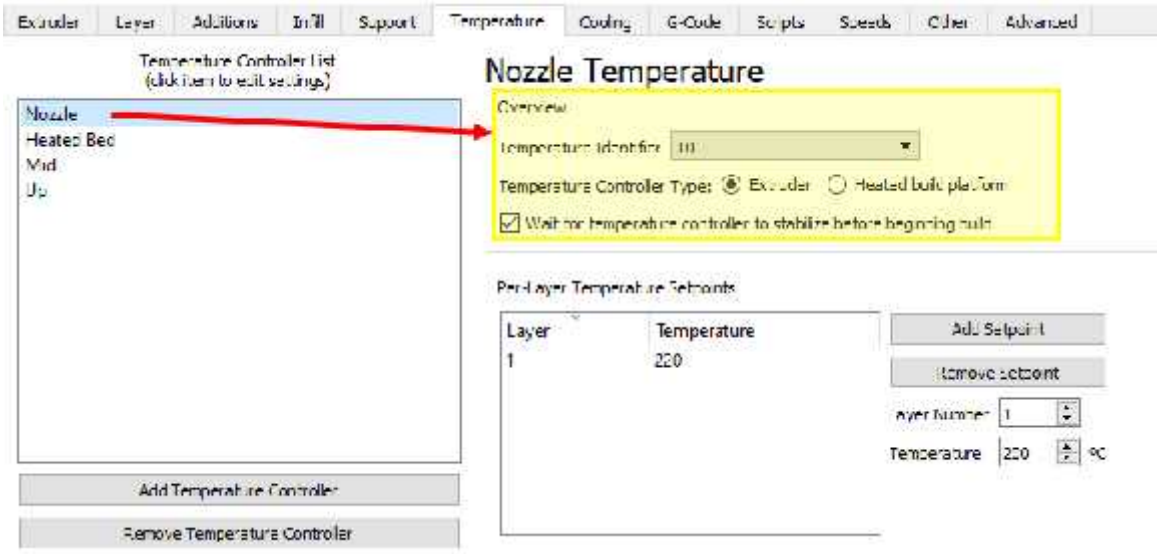
Attention!

Before any further step to be followed, it is important to modify the slicer configuration to enable the control of the 3 extruder heater zones.

In Simplify 3D:
Go to process settings, Temperature.
Add the additional temperature controllers according to the following images:

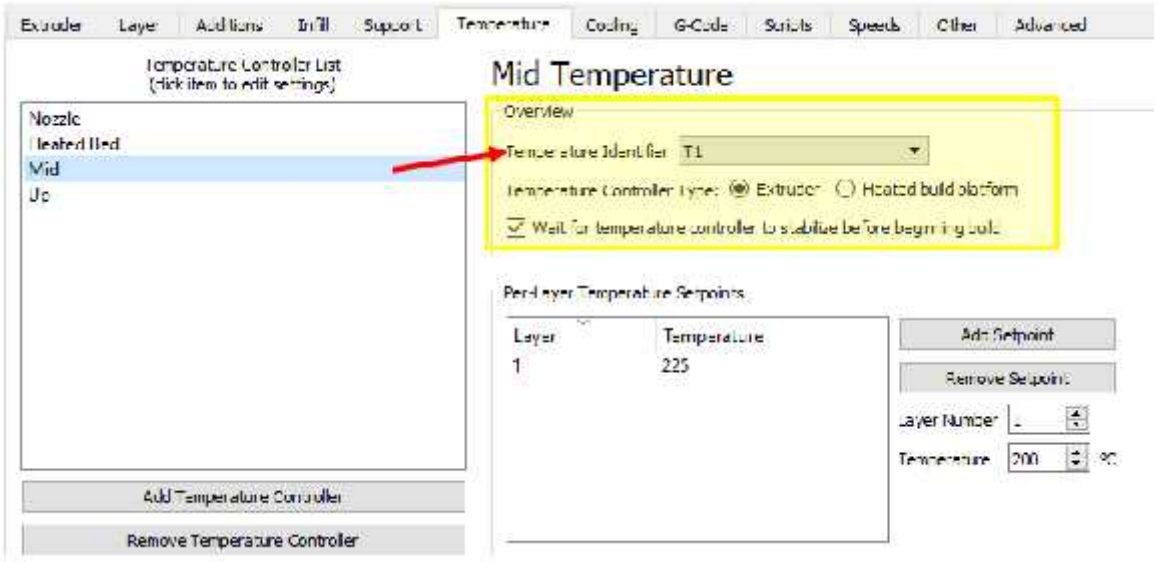
Nozzle controller

- Check that the temperature identifier is T0 and the controller type is extruder.



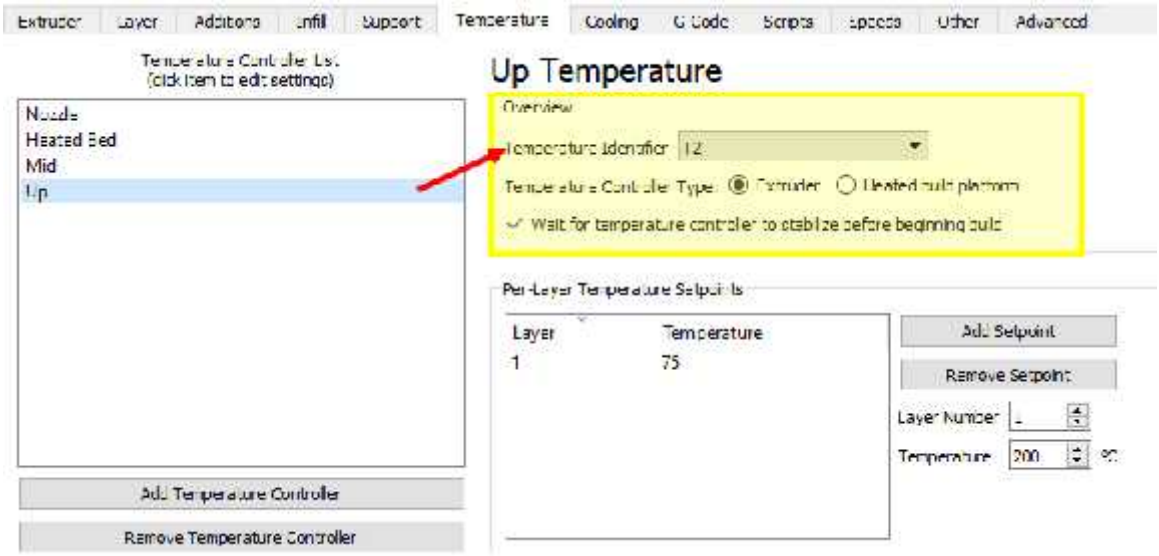
Mid heater controller

- Check that the temperature identifier is T1 and the controller type is extruder.



Upper heater controller

- Check that the temperature identifier is T2 and the controller type is extruder.



First steps for machine preparation

The first steps to follow to prepare the machine for printing are as follows:

1. Pre-heat extruder
2. Unload any material from hopper and reservoir
3. Purge the extruder with neutral material
4. Load a new material in hopper and reservoir
5. Purge the extruder with new material
6. Calibrate your build plate and prepare build plate
7. Set material-specific temperatures in base and extruder and pre-heat.
8. Open/close your machine cover

9. Set slicer parameters depending on material to be used
10. After printing: let the machine cool down before turning off

C.1 Pre-heat extruder

You can pre-heat your extruder to prepare it for the purging process to be followed in the next steps.
Note: If you have a fast-degrading material in the extruder, keep special attention on the time the extruder will remain heated as it can degrade while you follow the next steps.

To set the temperatures of nozzle, middle and upper zones according to the material present in the extruder. To modify the temperature in the controller screens, press the temperature controller box in the screen:

Set the temperature of each zone of the extruder from the screen according to the material present in the extruder:

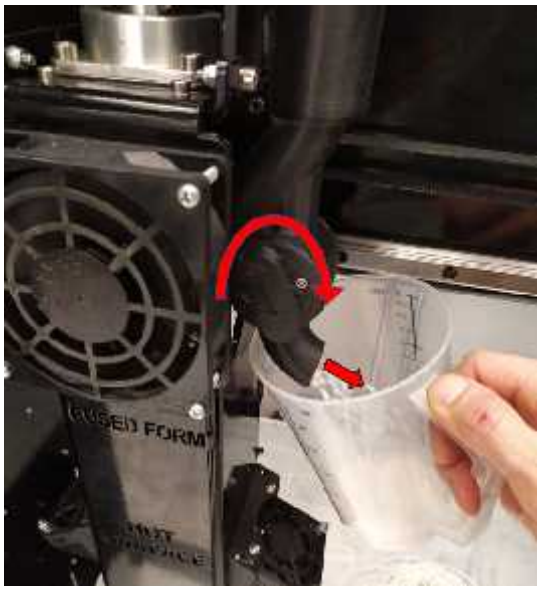
C.2 Unload any material from hopper and reservoir

Note: Verify that the pellet supply system is turned off to avoid it from activating when the pellets are drained from the reservoir.

It is always important to remove any material present in the hopper, reservoir and pellet hose to prevent material cross-contamination.
Turn on the machine.

Open the hopper lid and remove the pellets manually with the help of a plastic container.

To drain the pellets in the reservoir: turn the reservoir valve so that the arrow points downwards or upwards, keep a plastic container on the exit of the valve to receive the pellets exiting the reservoir. It is possible to activate the airflow to furtherly clean the system. Close the reservoir valve once this process is completed.



C.3 Purge the extruder with neutral material

Note: Verify that the build plate is around 20 cm down from the extruder to have space for the polymer to be purged.

It is very important to have a neutral material to purge the extruder and avoid cross reaction between incompatible materials and the clogging of the material inside the screw.

One very common neutral material used is Polypropylene as it is a very sable and non-reacting with many other polymers. However, it is recommended to look for an adequate neutral material depending on the specific materials being used.

Start with loading 100gr of material to the hopper and send it to the reservoir with the help of the manual activation button.

Note: Verify that the screw has been pre-heated sufficiently (around 10-15 mins). The motor would have issues forcing the extruder to rotate if the temperature in the extruder is too low

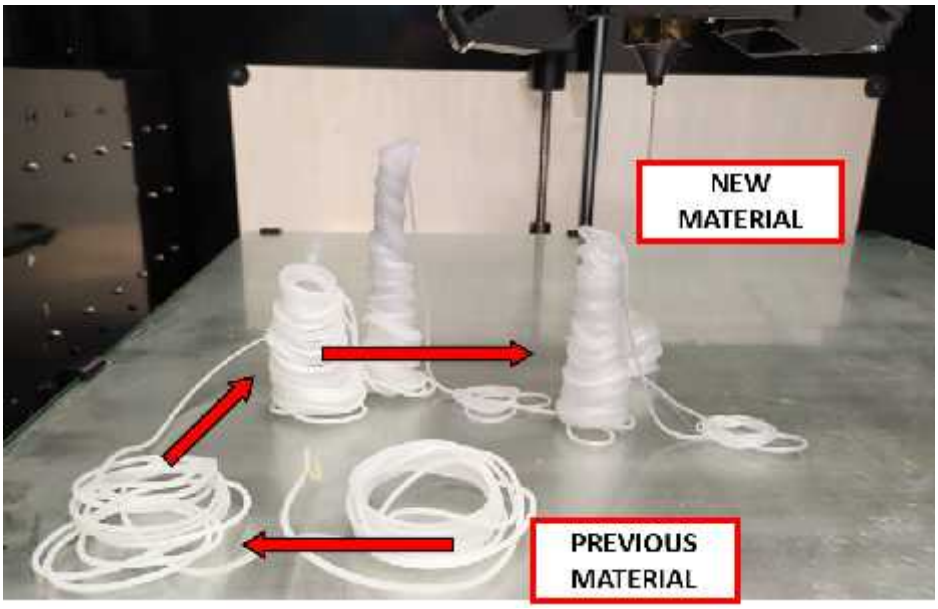
To start the purge routine of the extruder, select “menu” from the screen:

Then press “Custom”

There are two options for purge: “Purge extruder” and “Small Purge”. Each button extrudes approximately the following weight of material:

“Purge Extruder”: 70g approx.
“Small Purge”: 35g approx.

The purge process will last some minutes, wait patiently. You will see that the material exiting the extruder will transition from the older material to the new material. Verify that this transition is complete when the extruder stops. If the transition is incomplete, repeat the purge routine until the transition is complete.



You can now open the reservoir valve to evacuate the remaining pellets from the reservoir body. Check if these pellets are contaminated with the previous material. If so, it would be better to discard them to avoid any cross-contamination of materials next time the purge process is executed.

C.4 Load a new material in hopper and reservoir

Open the hopper lid and load the new pellets manually with the help of a plastic container.

Close the hopper lid, secure it, and activate the manual airflow to force the pellets to flow to the reservoir until it is filled to the full level. This process is done manually with the use of the manual airflow button.

C.5 Purge the extruder with new material

Set the temperatures in the extruder that are adequate for the new material to be used. Wait for the extruder to stabilize the temperature for some minutes.

Turn on the pellet supply system.

Proceed with the purge procedure described in section C.3 until the new material exits the extruder.

Once this procedure is completed, you are now ready with the material change!

C.6 Calibrate your build plate and prepare build plate

The procedure to calibrate the build plate can be seen in the following youtube link: https://www.youtube.com/watch?v=km6VhU19-Yw&t=190s

Pay special attention to the material you will be printing. Some materials will require special adhesives for the print to hold in place. These are some examples of different adhesives used:

Hairspray, Magigoo and Dimafix (standard formulation): for PLA, ABS, HIPS, PETG

Magigoo PC or Dimafix: for PC and PC + PBT blends

Magigoo PP of Smart Materials Smart Stick for PP and PE

C.7 Set material-specific temperatures in base and extruder and pre-heat.

The following table shows a starting point of printing temperatures for different tested materials.
Keep in mind that different brands and material formulations within each brand may alter the settings considerably.

MATERIAL	BED (ºC)	Z3 (Upper) ºC	Z2 (Middle) ºC	Z1 (Lower) ºC	REMARKS / BRAND
ABS	100-110	80	205	255	starex ABS SD0150W
PLA	60	75	175	175	Special attention to degradation times
HIPS	100-110	95	195	225	AMSTY - 484
PP	90	85	210	230	Braskem GR105PP
PETG	70	85	245 (280 max)	245 (270 max)	PETG Sky Green K2012 Print as cold as possible to reduce degradation
PC+PBT 50%	110	100	245	250	PBT 5000 GP PC Infino 1100 VR PBT + PC 1:1

C.8 Open / close your machine cover

The following table shows when to maintain closed or opened the machine cover. For some materials it is required to maintain closed the cover to maintain the temperature inside the chamber and avoid part contraction / warping, for other materials it is better to have a ventilated ambient to enhance material cooling.

MATERIAL	PRINTER COVER
ABS	ON
PLA	OFF
HIPS	ON
PP	ON
PETG	ON
PC+PBT 50%	ON

C.9 Set slicer parameters depending on material to be used

Some printing parameters are important for this type of extrusion 3D printers:

- Wipe distance: in general recommended around 3mm, this parameter makes the extruder extend the extrusion line in this length after finishing an extrusion line. This is helpful to reduce voids in end of extrusion lines.
- Retraction Z-axis hop: recommended 0mm.
- Travel speed: this speed can be set between 100mm/s and 150mm/s. A faster travel speed will reduce oozing during travels.
- Retraction length: 0mm

The following table shows a starting point for different settings of nozzle diameter, extrusion flow multiplier, print speed, and layer height.
The importance of these parameters is that the rate between the extruder rotation and material extruded is not proportional and the material flow is more related to the pressure built inside the extruder.

MATERIAL	Slicer Flow	PRINT SPEED MM/S	TESTED NOZZLE Dia (mm)	LAYER (mm)	REMARKS / BRAND
ABS	100	80	1.56		starex ABS SD0150W
PLA	100	60-80	1.56		Special attention to degradation times
HIPS	1.3	54	2	1.2	AMSTY - 484
PP	1.3	50	2	0.7	Braskem GR105PP
PETG	0.975	70	2	1.2	PETG Sky Green K2012 Print as cold as possible to reduce degradation
PC+PBT 50%	1.2	45	2	0.7	PBT 5000 GP PC Infino 1100 VR PBT + PC 1:1

Varying printing parameters will require an inspection of the printing results: in general, the extrusion flow multiplier can be modified from the slicer as well as in - line from the printer screen, so the user can measure the extrusion line width during the print and fine-tune the extruder flow until the extruded line width is according to the expected value.

C.10 After printing: let the machine cool down

Given that the extruder has 3 different temperature zones with very different temperatures, it is very important that the upper zone is not overheated by the remaining heat of the other zones of the extruder. For this purpose, it is important to leave the machine turned on for some minutes after the print finished so the extruder can cool down while the extruder feeding zone cooling fan is refrigerating the upper zone of the extruder screw.

For removing the printed part, it is important to let the bed cool down so the print loses adhesion to the bed. Removing the print from the build plate while it is still hot or warm can be dangerous and also can be damaged the build plate or de-calibrate the build plate.