# What is heat creep in 3D printing?

Asked 3D Content Team
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**Abstract.** Heat rising into the heatbreak softens filament above the melt zone until it jams. PLA's glass transition is 60 °C; Bambu Lab opens the door over a 45 °C bed.

**Keywords:** pla, enclosures, chamber-heating

## 1 What is heat creep in 3D printing?

Heat creep is heat climbing from the hotend's hot side into the heatbreak and heatsink. Filament softens above the melt zone, swells and jams, so the extruder turns but nothing comes out. PLA (polylactic acid) is most prone. Prusa flags rooms above 35 °C, and Bambu Lab wants an enclosure at least 10 °C below the filament's glass transition.

### 1.1 The number

**Table 1.** The number

| Threshold | Value | Source |
|---|---|---|
| PLA glass transition (DSC, 10 °C/min) | 60 °C (Bambu PLA Basic), 61 °C (Polymaker PolyLite PLA) | Data sheets |
| PLA heat deflection (ISO 75, 0.45 MPa) | 57 °C (Bambu), 60 °C (Polymaker), 55 °C (Prusament) | Data sheets |
| PLA softening, Bambu's working figure | About 45 °C | Bambu Studio chamber guide |
| PETG glass transition (DSC, 10 °C/min) | 69 °C; Bambu's working softening figure is about 70 °C | Bambu PETG Basic data sheet, chamber guide |
| Enclosure air | At least 10 °C below the filament's glass transition, so about 50 °C for PLA at 60 °C | Bambu heat creep article |
| Room air | Above 35 °C (30 °C for some filaments), or any enclosure, is the most common cause | Prusa |
| Door-open rule, filaments softening below 60 °C (PLA, PVA, TPU) | Bed above 45 °C: open the front door and/or remove the top glass | Bambu filament guide |
| Door-open rule, filaments softening at 60 to 80 °C (PETG) | Bed above 60 °C in the guide's text; above 70 °C in its plate table | Bambu filament guide |
| PLA bed with the door closed | About 35 °C on the Cool Plate | Bambu heat creep article |
| P1S chamber fan with PLA | Switches on when the bed is set over 50 °C | Bambu heat creep article |
| Chamber heater (X1E) for PLA, PETG, TPU, PVA | Off (0 °C) | Bambu Studio chamber guide |
| Hotend heatsink fan | Marlin switches it on at 50 °C; Klipper keeps it on until the hotend drops below 50 °C | Marlin and Klipper defaults |
| Hotend fan speed, Prusa MK3 family | 4000 to 4400 RPM | Prusa |

The material figures come from the Bambu Lab, Polymaker and Prusament data sheets. The rules come from Bambu Lab's heat creep, filament guide and chamber temperature articles and Prusa's heat creep article; the fan threshold

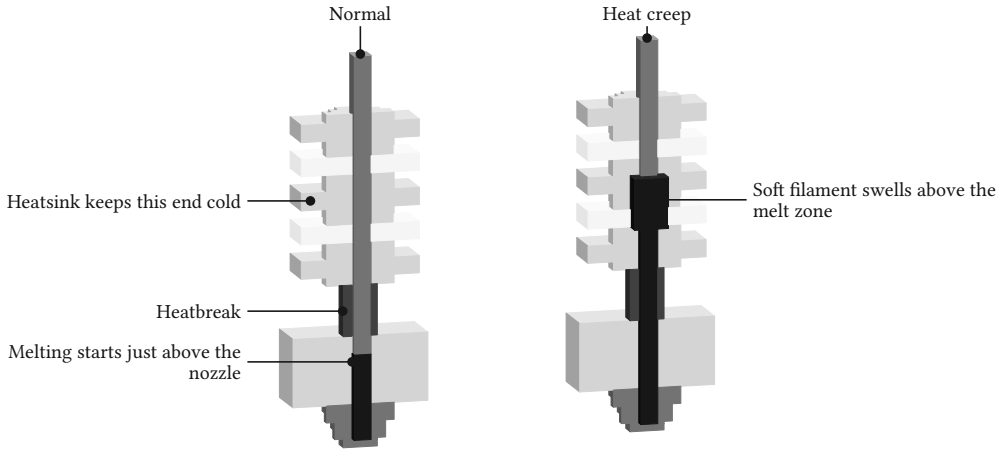



**Figure 1.** A hotend needs a sharp step from hot to cold, so filament should start melting just above the nozzle; with heat creep it softens higher up and jams.

is the Marlin `EXTRUDER_AUTO_FAN_TEMPERATURE` and Klipper `heater_temp` default. Bambu's filament guide disagrees with itself on PETG, so the table shows both bed figures. DSC is differential scanning calorimetry, PETG is glycol-modified polyethylene terephthalate, TPU thermoplastic polyurethane and PVA polyvinyl alcohol.

### 1.2 Why

A hotend needs a sharp step from hot to cold. Prusa describes it this way: filament should start melting just above the nozzle. When the heatbreak gets too hot, heat spreads upward unevenly and the filament softens higher inside the hotend. Bambu Lab adds that soft or swollen filament up there can no longer be pushed through reliably.

The heatsink and its fan hold that step. Moving filament helps too: Prusa notes the filament itself absorbs heat, so slow, low-flow printing lets the heat climb.

### 1.3 What are the symptoms of heat creep?

- Extrusion stops partway through, while the print head keeps moving and no error appears (Prusa).
- The extruder motor grinds the filament and clicks or ticks as it tries to push (Prusa).
- The print starts normally and turns into a partial clog after some time (Bambu Lab's example print).
- On some Bambu Lab printers, an HMS (Health Management System) warning appears: "The bed temperature exceeds filament's vitrification temperature, which may cause nozzle clog."

Prusa adds a caution: heat creep is only one cause of a clog, and usually not the most likely one. The other causes are on the repeat clogs page.

### 1.4 What causes heat creep clogs?

Prusa's list:

- A room above 35 °C (30 °C for some filaments), or an enclosure.
- Filament with metal particles, which conduct heat up the hotend.
- A hotend set too hot.
- Poor heat transfer between nozzle, heatbreak and heatsink, such as missing thermal paste on the heatbreak thread.
- Too little airflow over the heatsink: a dead, slow or backward fan, or dust in the fins.
- Too little flow: thin layers or slow printing.

Bambu Lab adds the bed. In a closed printer its heat warms the chamber air, and Bambu names a too-hot bed as a cause of heat creep.

### 1.5 Why does PLA clog in an enclosure?

PLA has the lowest glass transition of the common filaments, 60 to 61 °C on the data sheets above. Bambu Lab treats it as softening near 45 °C.

The bed alone can get the chamber there: Bambu's P1S needs a 55 °C bed for PLA on its Textured PEI (polyetherimide) plate, and Bambu says that heat builds up in the closed printer until PLA softens before it reaches the hotend. Prusa calls a fully closed, unventilated enclosure "very likely to cause problems" for PLA.

Bambu Lab's answer is the 45 °C door-open rule, or a Cool Plate at about 35 °C. In a cold room of 5 to 10 °C, Bambu says the door can stay closed.

### 1.6 Why does my printer clog mid print when the nozzle is clean?

Because the jam is above the nozzle. Heat creep softens filament in the heatbreak, inside the heatsink, where Bambu Lab says it should stay solid. Clear the nozzle tip and the blockage stays put. It builds during the job, which is why Bambu Lab's example print started normally and clogged later.

### 1.7 How to check it on your own print

- **Read the bed setting against the rule.** PLA, PVA or TPU above 45 °C in a closed printer, or PETG above 60 to 70 °C: open the door or lift the top glass and reprint.
- **Measure the air.** Put a thermometer inside the enclosure. For PLA, keep it at or below about 50 °C, 10 °C under its glass transition. In an open printer, check the room against Prusa's 35 °C.
- **Watch the hotend fan.** It should spin whenever the hotend is above 50 °C and push air into the heatsink. On a Prusa MK3 family printer, LCD Menu > Support > Extruder info > Fan speed should read 4000 to 4400 RPM.
- **Look at the fins.** Dust in the heatsink cuts its cooling. Prusa blows it out with canned air.
- **Check what the job was doing.** A jam on thin layers or slow, small sections points to low flow rather than air temperature.

Clearing the jam, and the settings that stop it coming back, are on the heat creep fix page.

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