What does the part cooling fan do?

Asked 3D Content Team
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Abstract. It cools plastic leaving the nozzle so it sets before the next line lands, making bridges, overhangs and fine tips work. Base PLA profiles run it at 100% after layer 1.

Keywords: part-cooling, hotends, slicer-settings

1 What does the part cooling fan do?

The part cooling fan blows air onto the plastic leaving the nozzle so it hardens before the next layer, or the next unsupported line, lands on top. That makes bridges, overhangs, small details and sharp tips printable. The slicer sets its speed layer by layer: base PLA profiles keep it off on layer 1, then ramp to 100%.

1.1 The number

Table 1. The number

What	Value	Where it comes from
Part fan speed for PLA	100%	PrusaSlicer and Bambu Studio PLA profiles; Cura's default Fan Speed
Part fan on the first layer	Off, then full by layer 2 (Bambu Studio, Cura) or layer 4 (PrusaSlicer)	The same three
Part fan on PLA bridges and overhangs	100%	Bridges fan speed, Fan speed for overhang, Bridge Fan Speed
Part fan in G-code	`M106 S0` to `M106 S255`: S255 is 100%, S128 is 50%. `M107` turns it off	Marlin's G-code reference
Hotend fan	Full speed above 50 °C (Marlin); in Klipper, on with the heater until the hotend cools below 50 °C	`EXTRUDER_AUTO_FAN_TEMPERATURE` and `EXTRUDER_AUTO_FAN_SPEED` Klipper `heater_temp`
PLA glass transition	60 °C	Bambu Lab PLA Basic data sheet

The slicer values are read from the profiles shipped with PrusaSlicer 2.9.6, Bambu Studio v02.08.02.61 and Cura 5.13.0. The firmware values come from Marlin 2.1.2.9′s `Configuration_adv.h`, Marlin's M106 and M107 pages and Klipper v0.13.0, and the glass transition from Bambu Lab's PLA Basic data sheet (V3.0).

1.2 What is the part cooling fan responsible for?

It makes fresh plastic hold its shape. Prusa's cooling guide names two jobs. Each layer must go down on one that has already set, or the nozzle drags and distorts the soft layer. Bridges and overhangs must freeze in place before they sag.

PLA leaves the nozzle at 190 to 230 °C (Bambu Lab's data sheet range) and stays soft until it drops below its 60 °C glass transition. The fan has to get each line there before the nozzle returns.

- **Bridges:** the line spans open air and has to set before it droops.
- **Overhangs:** each line rests partly on nothing. Bambu Studio switches to its overhang fan speed once more than 50% of a PLA line's width is unsupported.
- **Small parts and sharp tips:** a tiny layer brings the nozzle back before the last one has cooled, so slicers raise the fan and slow down on short layers (see why small prints melt).

More air is not always better. Prusa notes that some materials warp or split between layers under a strong fan. Its guide says Keep fan always on is usually off for ABS, ASA, polycarbonate (PC) and some flexibles.

1.3 Which 3D printer cooling fan is which?

A 3D printer's toolhead usually has two cooling fans: the hotend fan cools the heatsink so the filament stays solid until the melt zone, and the part cooling fan cools the plastic you just printed. The firmware runs the hotend fan; the slicer sets the part fan.

Never turn off the hotend fan. Do not slow it down either. A weak or stopped hotend fan causes heat creep, and Bambu Lab printers halt with hotend cooling fan speed abnormal.

- **Hotend fan (heatsink fan):** blows through the heatsink fins above the heater. Marlin runs it at full speed once the nozzle passes 50 °C, and Klipper keeps it on until the hotend cools below 50 °C.
- **Part cooling fan:** usually a blower with a duct aimed at the nozzle tip. The slicer sets its speed from the filament profile. In Klipper it is the `[fan]` section; Bambu Studio has a separate Auxiliary part cooling fan group for printers that have one.

Fans on the mainboard, the power supply or a chamber exhaust cool the electronics or the enclosure, not the print.

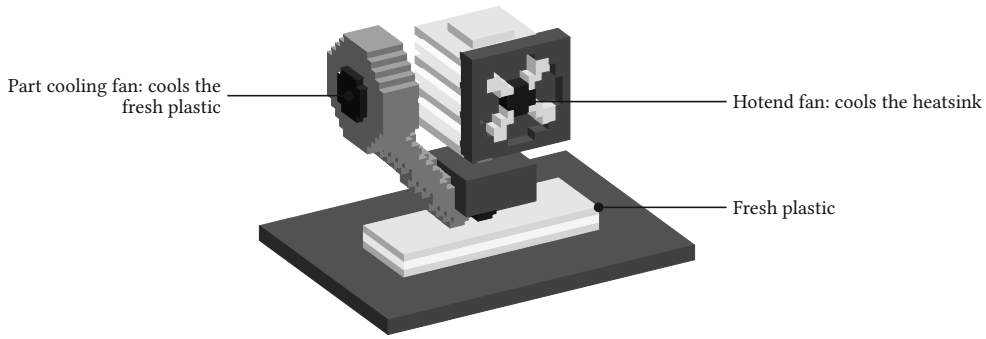


Figure 1. The hotend fan keeps the heatsink cool, while the part cooling fan aims its air at the plastic leaving the nozzle.

Table 2. What are the part cooling fan settings?

What it controls	PrusaSlicer: Filament Settings, Cooling	Bambu Studio: filament settings, Cooling	Cura: Cooling
Master switches	Keep fan always on; Enable auto cooling	Keep fan always on	Enable Print Cooling
Speed range	Fan speed: Min and Max	Fan speed in Min fan speed threshold and Max fan speed threshold	Regular Fan Speed; Maximum Fan Speed
Layer-time switch points	Enable fan if layer print time is below; Slow down if layer print time is below	Layer time, beside each threshold	Regular/Maximum Fan Speed Threshold; Minimum Layer Time
First layers	Disable fan for the first; Full fan speed at layer	Initial layer fan; Linear ramp up to	Initial Fan Speed; Regular Fan Speed at Layer
Bridges and overhangs	Bridges fan speed; Dynamic fan speeds	Force cooling for overhang and bridge; Cooling overhang threshold; Fan speed for overhang	Bridge Fan Speed, under Experimental, Enable Bridge Settings

1.4 What are the part cooling fan settings?

PrusaSlicer and Bambu Studio keep them on the filament profile's Cooling page, and Cura in the Cooling section of its print settings.

The speed follows layer time. In PrusaSlicer and Bambu Studio, a layer that takes longer than the upper threshold runs at the minimum speed if Keep fan always on is ticked; otherwise the fan stays off. A layer quicker than the lower threshold gets the maximum, and layers in between get a proportional speed.

By default, Cura runs Regular Fan Speed on layers longer than 10 s and ramps toward Maximum Fan Speed on quicker ones. In all three slicers' base PLA settings, minimum and maximum are both 100%, so the thresholds matter only for materials with a range.

1.5 How do you control the part fan with G-code?

`M106 S255` runs the part cooling fan at 100%, `M106 S128` at 50%, and `M107` turns it off. `M106` with no `S` means full speed.

Without a fan index, Marlin sends both commands to the print cooling fan, and Klipper sends them to its `[fan]` section. Neither command touches the hotend fan. In Marlin the new speed starts once the moves already queued are done.

1.6 How much part cooling for PLA, PETG and ABS?

- **PLA:** 100% from layer 2 in Bambu Studio's PLA profile, 100% minimum and maximum in PrusaSlicer's. Some printer-specific PLA profiles start lower. See PLA fan speed.
- **PETG:** 30 to 50% in PrusaSlicer's PETG profiles for the MK3S and MK4, far below PLA's 100%. See PETG cooling.
- **ABS:** 10% on layers longer than 30 s in Bambu Studio's base ABS profile, up to 80% on fast layers and overhangs. See ABS and the fan.

1.7 How to check it on your own print

1. **Tell the fans apart.** With nothing printing, heat the nozzle past 50 °C. The fan that starts is the hotend fan, and it should keep running until the hotend cools. If it never starts, do not print until it is fixed.
2. **Test the part fan.** Send `M106 S255` from a G-code terminal; the fan that spins up is the part cooling fan. `M107` stops it. If nothing spins, clear filament strings from the blower and check its plug.
3. **Check the profile.** Open the Cooling settings and compare the speed range and first-layer values with the settings table.
4. **Preview the fan.** In PrusaSlicer, set the preview view to Fan speed (%) and check that bridges and overhangs show the bridge speed.
5. **Adjust from what fails.** If bridges sag or overhangs curl, raise the bridge or overhang fan speed (see drooping overhangs). If ABS layers split apart, turn the fan down. To print with no part fan at all, see printing without a cooling fan.

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