Does bed temperature affect warping?

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Abstract. Yes. In a 2021 ABS test, corner lift was lowest at a 90 °C bed, 0.89 mm, and grew both cooler and hotter: 1.65 mm at 80 °C, 1.37 mm at 100 °C.

Keywords: warping, bed-adhesion, pla, petg

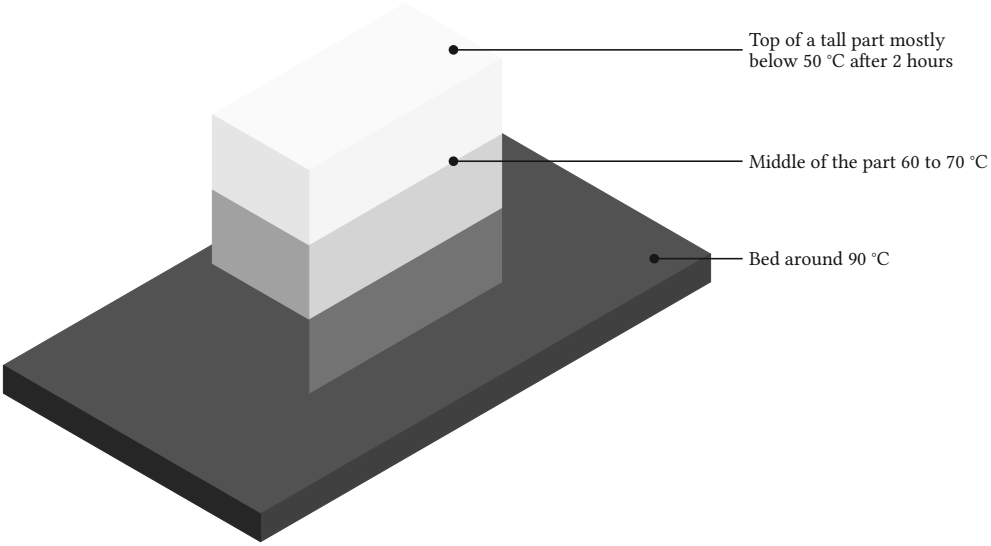


Figure 1. A thermal camera showed the bed keeping only the lower part warm. The upper layers ran far cooler than the bed.

1 Does bed temperature affect warping?

Yes, within a narrow band. In a 2021 test of ABS (acrylonitrile butadiene styrene) cubes on an open printer, corner lift was smallest on a 90 °C bed (0.89 mm) and grew either side: 1.65 mm at 80 °C, 1.37 mm at 100 °C. The bed warms only the base. Higher up, room air sets the cooling.

1.1 The number

Table 1. The number

Bed temperature	Average corner lift	Spread (standard deviation)
75 °C	1.51 mm	± 0.36 mm
80 °C	1.65 mm	± 0.45 mm
85 °C	1.18 mm	± 0.35 mm
90 °C	0.89 mm	± 0.31 mm
95 °C	1.14 mm	± 0.45 mm
100 °C	1.37 mm	± 0.46 mm

All six rows are group F of Ramian, Ramian and Dziob's warping study in Materials (2021): 30 mm cubes of Fiberlogy ABS printed at 255 °C on an open Ultimaker 3. Lift was measured with calipers at each vertical edge.

The filament maker lists 90 to 110 °C for that ABS, and the least warping came at the setting it suggests. The authors printed one cube per setting and the spreads overlap, so read the dip at 90 °C as a trend. Part size mattered more than the bed: a 120 mm bar on the same 90 °C bed lifted 4.27 mm.

1.2 What bed temperature prevents warping?

Stay inside the maker's range, and go toward its top end when corners lift. For these three plastics the top of the range sits close to the glass transition, the point where the plastic turns from rigid to rubbery. Spörk and colleagues measured why that matters. With PLA (polylactic acid) and ABS, first-layer adhesion rose significantly once the bed sat slightly above the plastic's glass transition.

Bed ranges come from Polymaker's PolyLite data sheets, Bambu Lab's filament guide and the Prusa Knowledge Base page for each plastic. The glass transitions are Polymaker's, measured by differential scanning calorimetry (DSC) at 10 °C/min. PEI is polyetherimide.

Table 2. What bed temperature prevents warping?

Plastic	Polymaker bed range	Bambu Lab bed range (PEI plates)	Prusa setting	Glass transition (Polymaker)	What the makers say about warping
PLA	25 to 60 °C	45 to 65 °C	60 °C	61 °C	Bambu Lab: "Not prone to warping"; Prusa: "not prone to significant warping"
PETG (glycol-modified PET)	70 to 80 °C	60 to 80 °C	85 °C first layer, 90 °C after	81 °C	Prusa: "does not shrink or warp"
ABS	90 to 100 °C	90 to 100 °C	100 °C, or 80 to 110 °C with larger parts higher	101 °C	Bambu Lab: needs "higher heatbed and chamber temperatures to suppress warping"; Prusa lists "significant warping"

1.3 PLA bed temp to prevent warping

Raise it 5 to 10 °C when corners lift. That's Bambu Lab's fix for lifting PLA corners, with a target of 55 to 65 °C on its textured PEI plate and an 8 to 10 mm brim. Prusa runs PLA at 60 °C. On an open-frame printer such as the A1 in a room below 20 °C, Bambu Lab adds another 10 °C.

Check the plate type first. Slicing for Bambu Lab's Cool Plate (35 °C for PLA) and printing on textured PEI leaves the adhesion temperature "far too low," per its warping guide.

Stop at the makers' ceiling of 60 to 65 °C, around PLA's 61 °C glass transition. Wijnen, Sanders and Pearce found that PLA held at 50 °C neither shrank nor crystallized. At 90 °C it crystallized to about 20 percent and shrank 5 percent in both horizontal directions. They concluded PLA beds should stay at 50 °C or lower to avoid early release, below Prusa's 60 °C.

On an enclosed printer with a PLA bed above 45 °C, Bambu Lab says to open the front door or lift the top glass cover. Otherwise the warm chamber can soften the filament before the nozzle.

1.4 PETG bed temp and warping

Look at adhesion first. Prusa and Bambu Lab both class PETG as low-warp, and Prusa says it has "very little thermal expansion." Bambu Lab's exception is a cold room: below 20 °C, "warping can occur even with PLA and PETG." If a corner lifts, go to the top of the 60 to 80 °C band and check the glue and plate on the PETG bed temperature page.

On an enclosed printer, Bambu Lab says to open the front door or lift the top glass cover once a PETG bed runs hot. Its guide sets the trigger at 60 °C in the text and 70 °C in its plate table.

1.5 Can the wrong bed temperature cause warping?

Yes, in both directions. In the ABS test, lift rose from 0.89 mm at 90 °C to 1.37 mm at 100 °C, and the 80 °C cube lifted 1.65 mm. For PLA, Wijnen and colleagues link a hot bed to crystallization, shrinkage and early release.

1.6 Why

Warping is shrinkage. The part contracts as it cools from its glass transition to the surrounding air, and the edges cool first. Ramian's thermal camera showed how little of that the bed controls. With the bed around 90 °C, the middle of the part sat at 60 to 70 °C and the chamber walls at 20 to 30 °C. After two hours the top of a tall part was mostly below 50 °C. That gradient "peeled off the cooler corners."

The bed does two jobs at the base. It keeps the first layers soft enough to grip the plate, and it slows their cooling while the rest prints. The ABS study doesn't explain why lift rose again above 90 °C. Wijnen's annealing test shows one way heat backfires with PLA: held well above its glass transition, it crystallizes and shrinks.

In an enclosure, the bed also heats the air. In CNC Kitchen's test, the 325 x 325 mm bed of a closed QIDI X-Max 3 brought the chamber to slightly below 50 °C in a 20 °C room. With the door open and the lid off, the chamber never passed 26 °C. That air is the next lever for ABS: see ABS chamber temperature. PLA wants the opposite, CNC Kitchen adds: a hot chamber gives "curling layers and heat creep jams."

1.7 How to check it on your own print

- **Start mid-range on your spool's data sheet.** Match the plate type in the slicer to the plate on the printer.
- **Print one test part at full size.** Measure each corner with calipers, as Ramian did: maximum height minus the height at the edge is the lift.
- **Raise the bed 5 to 10 °C and reprint the same part.** For ABS and ASA (acrylonitrile styrene acrylate), Bambu Lab raises it 10 to 15 °C, with every door and the top cover closed and the chamber at 40 °C or more. Change nothing else.
- **Stop at the top of the maker's range.** If the lift grows, go back down. In the ABS test, settings above and below the maker's both lifted more.
- **If the bed changes nothing, look elsewhere.** Wash the plate with dish soap and add a brim. On large flat parts, Bambu Lab switches to gyroid infill at 25 percent or less. If only one corner lifts, it's a grip or draft problem: see why a print warps on one corner.

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