What happens if retraction distance is too high?

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Abstract. Soft filament is pulled up into the heatbreak and jams, the gear grinds it, and lines restart with gaps. Bambu Lab and Prusa's MK3S cap it at 2 mm.

Keywords: retraction, hotends, slicer-settings

1 What happens if retraction distance is too high?

Too much retraction pulls soft filament out of the melt zone into the cooler heatbreak, where it sets into a plug and jams the hotend. It also grinds the filament and leaves gaps where lines restart. Bambu Lab recommends no more than 2 mm, the cap Prusa sets on its direct-drive MK3S, and UltiMaker Cura warns above 10 mm.

1.1 The number

Table 1. The number

Printer or extruder	Published ceiling or setting
Bambu Lab printers (direct drive)	No more than 2 mm; Bambu Studio ships 0.8 mm
Prusa MK2.5/S, MK3/S/+ (direct drive)	At most 2 mm
Slice Engineering Mosquito hotend on a direct drive	The nozzle diameter: 0.4 mm on a 0.4 mm nozzle
Most direct-drive extruders	0.5 to 2.0 mm is all they need
Prusa MINI, MINI+ (Bowden)	3.2 mm by default
Some Bowden extruders	Up to 15 mm
Any printer in UltiMaker Cura	Retraction Distance turns into a warning above 10 mm

Bambu Lab's cap is from its stringing and oozing article and the 0.8 mm from the X1 Carbon profile in Bambu Studio v02.08.02.61. Prusa's rows come from its stringing and oozing article and the Mosquito rule from Slice Engineering's FAQ. The general ranges are from Simplify3D's stringing guide, and the warning is the `maximum_value_warning` on Retraction Distance in UltiMaker Cura 5.13.0. None of these makers gives a Bowden ceiling below Cura's warning. On a Bowden, too high means longer than the shortest length that prints clean on a retraction test.

1.2 Why does too much retraction cause jams?

Because it drags molten plastic out of the hot zone. Prusa says filament should start melting just above the nozzle.

A short retraction lifts the molten tip a little within that zone. A long one pulls it up into the heatbreak, the neck between heater block and heatsink. Polymaker says long retractions pull semi-molten filament into cooler zones, "where it solidifies and creates plugs."

Bambu Lab says a retraction length that is too large "can easily cause clogging", and OrcaSlicer's wiki says too long "can lead to clogs or under-extrusion." The next deretraction pushes filament into the plug instead of the nozzle. Prusa describes how a jam there looks: the extruder grinds into the filament with a clicking or ticking sound.

It is the same jam as heat creep, reached from the other side. Heat creep sends heat up to solid filament; over-retraction pulls soft filament up into the cooler heatbreak. Clearing it takes the same steps (fixing a heat creep clog).

1.3 Can too much retraction grind filament?

Yes. Every retraction and deretraction drags the same stretch of filament back and forth through the drive gear's teeth. Cura's Maximum Retraction Count tooltip warns that retracting "repeatedly on the same piece of filament" can "flatten the filament and cause grinding issues." Simplify3D names retracting "far too much filament" as a cause of grinding: it "may put excessive stress on your extruder."

The signs, per Simplify3D: plastic shavings at the gear, and a motor that turns while the filament stays put.

Cura caps the repeats with Maximum Retraction Count inside a Minimum Extrusion Distance Window, which its tooltip says should be about the same as the Retraction Distance. Cura 5.13.0 allows 90 retractions per window equal to the Retraction Distance by default, 100 per 10 mm on Creality printers and 25 per 1 mm on UltiMaker printers.

1.4 Can too much retraction cause under-extrusion?

Yes. Bambu Lab says pulling the filament back too far, or too often, causes under-extrusion and layer gaps. Polymaker adds that over-retraction can create air gaps. Look where lines restart after a travel, since the extruder refills the hotend at that point.

It also costs time. The extruder pulls the full length back and pushes it in again on every retraction. Prusa notes that raising "Minimum travel after retraction", which triggers fewer of them, lowers printing time.

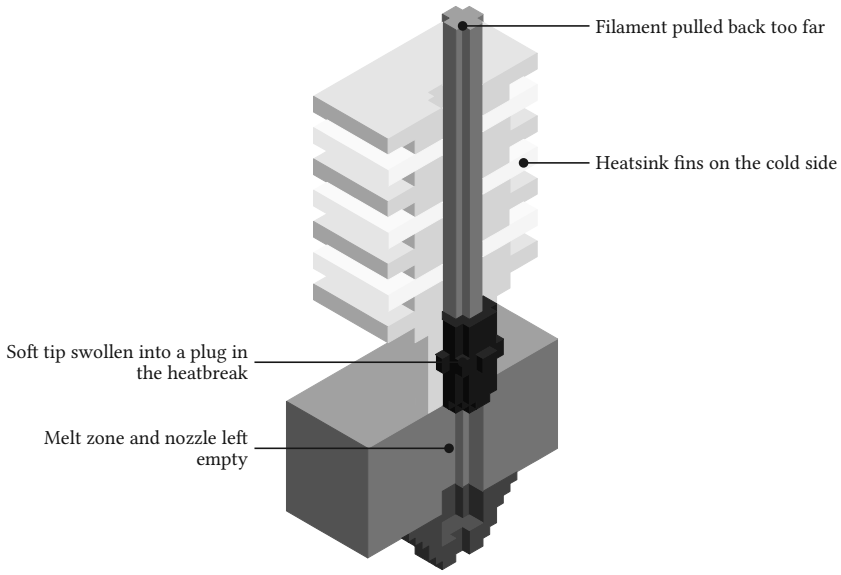


Figure 1. A long retraction drags the soft tip out of the melt zone into the cooler heatbreak, where it sets into a plug and leaves the nozzle empty.

1.5 How do you reduce retraction distance?

Set it back to your printer's shipped profile value (values by printer), then test downward:

- **Bambu Studio:** Printer Settings, Extruder, "Length" (0.8 mm on the X1 Carbon). Check Filament Settings, Settings Overrides too: a ticked value there replaces the printer's.
- **PrusaSlicer:** Printer Settings, Extruder 1, "Retraction length" (0.8 mm on the MK3S, 0.7 mm on the MK4S, 3.2 mm on the Bowden MINI).
- **UltiMaker Cura:** Travel, "Retraction Distance".

1.6 How to check it on your own print

1. **Compare your value with the table.** Anything above 2 mm on a Bambu Lab printer or a Prusa MK3S breaks the maker's cap.
2. **Clear any jam first.** If the extruder clicks and nothing comes out, clear it as you would a heat creep clog before you reslice.
3. **Check the gear and filament.** Shavings at the gear or a flattened, bitten stretch of filament mean grinding.
4. **Print a retraction tower.** OrcaSlicer's test runs 0 to 2 mm in 0.1 mm steps for direct drive. For a Bowden, its wiki suggests 1 to 6 mm in 0.2 mm steps (full method).
5. **Take the shortest clean length.** OrcaSlicer's wiki says the best length is the shortest one that gives the cleanest tower. For PLA (polylactic acid) or ABS (acrylonitrile butadiene styrene) that prints clean from the start, it says 0.2 to 0.4 mm should suffice.
6. **If stringing returns, don't raise it again.** Bambu Lab says damp filament usually can't be fixed with retraction alone, so dry the spool and lower the nozzle temperature.

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