Is PLA waterproof?

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Abstract. PLA plastic is: insoluble, 0.43 percent water uptake. A PLA print often leaks at the seam until it has 4 perimeters, more flow, or a coat of epoxy or lacquer.

Keywords: pla, watertight, waterproofing

Table 1. Water figures by PLA type

Filament	In water	Water absorption	Measured at	Heat deflection, 0.45 MPa
Bambu Lab PLA Basic	insoluble	0.43 percent, saturated	25 °C, 55 percent RH	57 °C
Bambu Lab PLA Matte	insoluble	0.40 percent, saturated	25 °C, 55 percent RH	58 °C
Bambu Lab PLA Silk+	insoluble	0.40 percent, saturated	25 °C, 55 percent RH	60 °C
Polymaker PolyLite PLA Pro	not stated	0.291 percent, equilibrium	23 °C, 70 percent RH	59 °C
eSUN PLA+	not stated	not stated	not stated	53.78 °C

1 Is PLA waterproof?

The plastic is; the print often is not. PLA (polylactic acid) is insoluble in water and takes up only 0.43 percent at saturation on Bambu Lab's data sheet. A printed part leaks through gaps at the seam and between lines. In Prusa Research's tests a PLA vessel needed 4 perimeters, or one vase-mode wall, to hold water.

1.1 Water figures by PLA type

Silk, matte and PLA+ filaments are still PLA. Where their data sheets list water uptake, it sits at or below plain PLA's:

Figures are from each maker's technical data sheet. RH is relative humidity: these are uptake figures from humid air, not from immersion. Heat deflection is the temperature at which a loaded test bar bends. For a part sitting in water, heat is PLA's limit, not absorption.

- **Is silk PLA waterproof?** The material is. Bambu Lab lists PLA Silk+ as insoluble at 0.40 percent absorption, and its leak guide ships a PLA Silk vase profile alongside the PLA Basic one.
- **Is matte PLA waterproof?** The material is: Bambu Lab PLA Matte is insoluble at 0.40 percent. Its data sheet gives a tensile strength of 22 MPa across the layers against 30 MPa along them, so the layer bond is its weak direction.
- **Is PLA plus waterproof?** Neither PLA+ data sheet above claims more water resistance than plain PLA. eSUN marks Water Repellency as N/A and UV Resistance as NO, and Polymaker's PolyLite PLA Pro levels off at 0.291 percent. Print PLA+ to the same watertight settings as plain PLA.

1.2 Why a PLA print leaks when the plastic does not

Water gets out through gaps in the print. Prusa Research traced most leaks to the seam, where each layer starts and ends, and to the joint between perimeters and solid infill. Under-extrusion leaves channels between lines. Bambu Lab adds that damp filament leaves holes in the extruded lines.

That makes "waterproof after printing" a question of settings. In Prusa's vessel tests PLA needed at least 4 perimeters. Prusa also notes that PLA does not dissolve but in some conditions can swell and wick water.

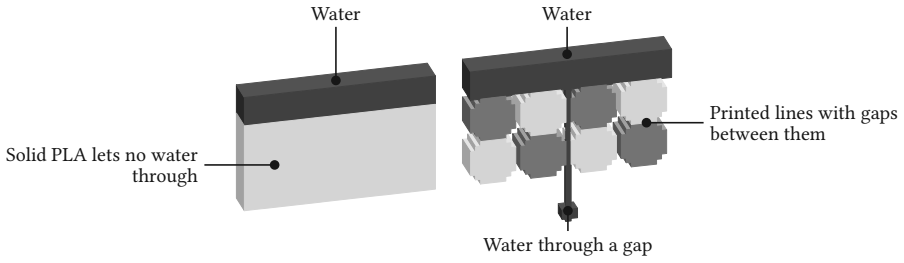


Figure 1. The plastic itself does not let water through; a print leaks through the gaps it leaves between lines and at the seam.

1.3 Can you put PLA in water?

Yes, cold water. Prusa's PLA flower pots showed no leakage over a long test, and its closed PLA boxes stayed dry 20 meters (66 feet) underwater with no coating. The limits are heat and sun. The Prusa Knowledge Base says PLA softens and deforms above 60 °C and degrades under UV light, so hot water, a dishwasher and a sunny outdoor spot are out.

Drinking water and food add hygiene rules, covered on PLA water containers. How long a PLA part survives submerged is on how long PLA lasts in water.

1.4 How to make a PLA print waterproof

There are two routes, and they stack.

1. Print it watertight.

Figures are from Prusa Research's blog and Knowledge Base, and Bambu Lab's leak guide:

1. Dry the spool first. Bambu Lab's data sheets give 50 °C for 8 hours for PLA Basic and Matte, 55 °C for 8 hours for Silk+.
2. Set 4 or more perimeters. Prusa's Knowledge Base suggests 3 to 4, rising to 5 to 6 where the geometry allows.
3. Raise flow 5 to 10 percent, or widen the line from 0.40 mm to 0.44 mm. Bambu Lab's version: flow ratio up 0.02 to 0.05, from 0.98 to between 1.00 and 1.03 for PLA Basic.
4. Run the nozzle 5 to 10 °C above the preset.
5. Use 0.15 mm layers. Prusa's 0.05 mm layers leaked least and 0.3 mm layers most.
6. Raise infill/perimeter overlap from the 10 percent default to 25 to 35 percent if the joint still weeps.
7. For an open shape, print it in vase mode (spiralize outer contour). One vase-mode wall held water in every material Prusa tested.

Bambu Lab's vases printed this way kept the tissue underneath dry after 48 hours. Its guide still warns that settings reduce the risk without guaranteeing a leak-proof part. The per-material perimeter table is on how many walls make a print watertight.

2. Coat it.

Prusa lists acrylic lacquer from a spray can, epoxy resin and nail polish as coatings. Its fourth method, chemical smoothing, does not apply to PLA. Epoxy gave Prusa perfect watertightness on a box that had leaked.

Smooth-On's data sheet says its XTC-3D brush-on epoxy works with PLA. The full procedure is on sealing prints with epoxy. Spray options are on waterproof sprays for 3D prints.

A coating does not fix the heat limit: a coated PLA part still softens above 60 °C.

1.5 How to check it on your own print

1. Let the print cool, then stand it on a dry paper towel.
2. Fill it to the brim with cold water.
3. After a few minutes, look at the towel and at the seam line.
4. If both are dry, leave it filled overnight and check again.

A wet seam points at flow or temperature; damp patches across the wall point at too few perimeters. The timed version with pass criteria is on how to test a print for leaks.

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