Which filaments absorb the most moisture?

Asked 3D Content Team
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Abstract. PVA and PA6 nylon absorb the most: 6.25% and 2.35 to 2.56% at saturation on Bambu Lab's data sheets, against 0.43% for PLA and 0.25% for PC.

Keywords: nylon, polycarbonate, tpu, pla

1 Which filaments absorb the most moisture?

PVA (polyvinyl alcohol) and PA6 nylon absorb the most. At saturation in 25 °C air at 55 percent relative humidity (RH), Bambu Lab's data sheets give PVA 6.25 percent of its weight, glass-filled PA6 2.56 and carbon-filled PA6 2.35. TPU (thermoplastic polyurethane) 95A HF takes 1.08, PLA (polylactic acid) Basic 0.43 and PC (polycarbonate) 0.25.

1.1 The number

Each figure comes from the maker's own technical data sheet. Bambu Lab lists a saturated water absorption rate, Polymaker prints the equilibrium or maximum on a moisture curve, and Prusa Polymers gives uptake after 24 hours and 7 days. The table shows the 7-day value. GF and CF mean glass and carbon fiber. PPA is polyphthalamide and PPS polyphenylene sulfide. PETG is glycol-modified polyethylene terephthalate (PET), ABS acrylonitrile butadiene styrene and ASA acrylonitrile styrene acrylate.

The three methods differ in humidity and in time, so compare rows within one maker. A Prusament 7-day figure at 22 percent humidity can't be set against a Polymaker equilibrium at 70 percent RH. Bambu Lab's drying wiki says moisture problems grow as humidity rises and as exposure time lengthens.

1.2 Why

PVA tops the list because it's made to dissolve: Bambu Lab's sheet lists it as soluble in water. Nylon comes next. The Prusa Knowledge Base calls polyamide (nylon) highly hygroscopic, meaning it pulls water from the air, and says badly stored nylon filament can take on water up to 10 percent of its weight.

Chain length splits the nylons. On Bambu Lab's sheets, PA6-CF takes 2.35 percent and PAHT-CF (PA12 and other long-chain nylons) takes 0.88. On Polymaker's, PA6-GF25 takes 3.33 and PA12-CF10 1.5. Polymaker credits PA12-CF10′s

Table 1. The number

Filament	Water absorption	Test conditions	Source
Bambu Lab PVA	6.25%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V1.0
Polymaker Fiberon PA6-GF25	3.33%	Equilibrium, 23 °C, 70% RH	Polymaker data sheet V1.1
Bambu Lab PA6-GF	2.56%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V1.0
Bambu Lab PA6-CF	2.35%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V3.0
Polymaker Fiberon PA12-CF10	1.5%	Equilibrium, 23 °C, 70% RH	Polymaker data sheet V1.1
Bambu Lab PPA-CF	1.30%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V1.0
Bambu Lab TPU 95A HF	1.08%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V1.0
Bambu Lab PAHT-CF	0.88%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V3.0
Polymaker PolyFlex TPU95-HF	0.69%	Equilibrium, 23 °C, 70% RH	Polymaker data sheet V5.5
Bambu Lab ABS	0.65%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V3.0
Polymaker PETG	0.51%	Maximum over 12 days, 23 °C, 70% RH	Polymaker data sheet V3.0
Prusament PA11 Carbon Fiber	0.50%	After 7 days, 24 °C, 22% humidity	Prusa Polymers data sheet 1.0
Bambu Lab PETG Basic	0.45%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V3.0
Bambu Lab ASA	0.45%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V3.0
Bambu Lab PLA Basic	0.43%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V3.0
Bambu Lab PET-CF	0.37%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V3.0
Bambu Lab PC	0.25%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V2.0
Prusament PLA	0.19%	After 7 days, 24 °C, 22% humidity	Prusa Polymers data sheet 1.1
Prusament PC Blend	0.15%	After 7 days, 24 °C, 22% humidity	Prusa Polymers data sheet 1.1
Prusament PETG	0.10%	After 7 days, 24 °C, 22% humidity	Prusa Polymers data sheet 1.1
Bambu Lab PPS-CF	0.05%	Saturated, 25 °C, 55% RH	Bambu Lab data sheet V1.0

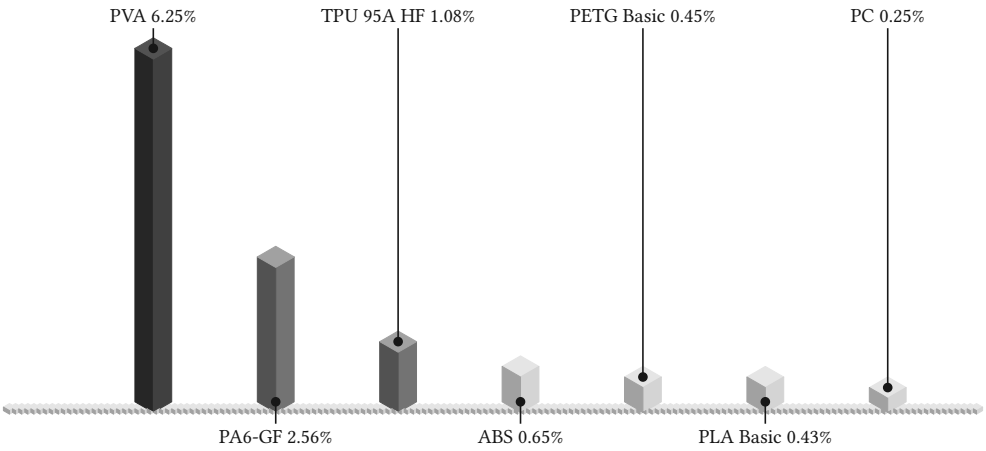


Figure 1. Column heights are Bambu Lab's saturated water absorption figures to scale, measured at 25 °C and 55 percent RH.

chemical structure for its lower moisture sensitivity than PA6-based grades.

The makers' word ratings don't always match their numbers. The Polymaker Wiki puts PETG in its highly hygroscopic group with nylon, PVA and TPU. It rates ABS moderate and PLA low. Prusa's examples of highly hygroscopic materials are polyamide, polypropylene, PVA and BVOH (butenediol vinyl alcohol copolymer), and PETG isn't on that list.

The numbers put PETG beside PLA. Polymaker's own PETG sheet tops out at 0.51 percent. Bambu Lab puts PETG Basic at 0.45, next to 0.43 for PLA Basic and below ABS at 0.65. Prusament PETG took up 0.10 percent in 7 days against 0.19 for Prusament PLA.

Bambu Lab's drying rules don't follow the ranking either. Its wiki marks drying as required before use for PC (0.25 percent) and PPS-CF (0.05), but only recommended for PETG and ABS.

1.3 How fast does nylon absorb moisture?

Fast enough to hurt a print within hours, and the weight keeps climbing for weeks. Bambu Lab says freshly dried filament in a typical 55 percent RH room picks up enough moisture to affect print quality within 2 to 12 hours. How hygroscopic the filament is sets where it falls in that range. The makers' sheets show the climb:

The Polymaker columns are read off the moisture curves on its Fiberon PA6-GF25 and PA12-CF10 data sheets, so treat them as approximate; only the equilibrium values are printed as numbers. Prusa Polymers publishes the 24-hour and 7-day PA11 Carbon Fiber figures directly.

At the long end, Bambu Lab says nylon-based filaments left in open air for about 3 months absorb so much water that drying them in a convection oven becomes very difficult. That's at 80 to 90 °C, the range its spools can take. What that water does to a finished nylon part is covered in whether 3D printed nylon is waterproof.

1.4 How to check it on your own print

- **Weigh the spool before and after drying.** The weight lost is water. Bambu Lab's PA6-CF comes as 1 kg of filament, so a spool at its 2.35 percent saturation figure holds about 23 g of water.
- **Keep the high absorbers sealed while printing, not only in storage.** Bambu Lab marks desiccant protection during use as required for PVA, nylon, PC and TPU. For PLA, PETG and ABS it's "not required but recommended." Every Bambu sheet above sets printing and storage humidity below 20 percent RH. Polymaker says highly hygroscopic filaments often need to stay in a dryer while they print, especially in humid climates.
- **Put a hygrometer in the box.** Bambu Lab says typical indoor air runs 45 to 65 percent RH, and that at 20 percent RH most filaments stay dry for 2 to 7 days.
- **Dry the high absorbers at the makers' settings.** Bambu Lab sets 75 to 85 °C for 8 to 12 hours in a forced-air oven for PVA, PA6-CF/GF and PAHT-CF/GF, and 100 to 140 °C for PPA-CF and PPS-CF. Prusa dries Prusament PA11 Carbon Fiber at 90 °C for 6 hours.

Table 2. How fast does nylon absorb moisture?

Time in humid air	Fiberon PA6-GF25, 23 °C, 70% RH	Fiberon PA12-CF10, 23 °C, 70% RH	Prusament PA11 Carbon Fiber, 24 °C, 22% humidity
1 day	about 0.6%	about 0.25%	0.20%
7 days	about 1.5%	about 0.6%	0.50%
Equilibrium	3.33%	1.5%	not given

- **Check the spool and the dryer first.** Bambu rates its PA6-CF and PVA spools to 90 °C and warns that some third-party spools deform during drying. In an oven, keep the spool away from the heating elements: Bambu says local overheating can deform the spool or the filament. Its AMS 2 Pro suits filaments that dry at 65 °C or below. Bambu says even its AMS HT may not fully dry PVA, PPS-CF or PPA-CF.
- **Reprint a test piece.** If bubbles, popping or stringing remain, dry it again. The symptoms and the clog risk are on can wet filament clog a nozzle.

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