3D printing replacement parts: what works, what lasts, what is legal

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Abstract. Printed parts are weakest across layers: Bambu Lab PETG Basic pulls 51 MPa in XY and 35 MPa in Z; Prusament PETG's interlayer adhesion is 18 MPa against 47 MPa flat.

Keywords: replacement-parts, home-repair, part-strength, reverse-engineering

1 Can you 3D print replacement parts for appliances?

Yes, when the part is a shape problem rather than a materials problem: knobs, clips, brackets, covers and low-speed gears. It gets harder as load, heat and chemical exposure rise. A printed part is weakest across its layers, and PLA (polylactic acid) softens above 60 °C, so match the plastic to the job.

1.1 What works

The parts that print well are the ones that failed because a small feature snapped, not because the polymer wore out: a dryer knob, a fridge shelf clip, a hinge bracket, a battery cover, a vacuum latch.

Prusa's Knowledge Base lists PETG (glycol-modified PET) as the everyday choice for mechanical parts, holders and clamps. It lists nylon (PA) for gears and for parts needing heat, chemical and mechanical resistance. PLA prints easily but, in Prusa's words, breaks along layers or into shards on impact and deforms above 60 °C. It suits knobs and covers rather than anything loaded or warm.

Gears work when they run slowly and lightly. A printed tooth has layer lines across it, so the material choice matters more than the geometry.

1.2 Where it stops working

Four things push a part out of reach.

- **Load.** A part that carried a spring or a clamped bolt in the original will see the same force across printed layers.
- **Heat.** The heat deflection temperature (HDT), where a loaded test bar starts to bend, is 57 °C for Bambu Lab's PLA Basic, 71 °C for its PETG Basic and 186 °C for its carbon-fiber PA6-CF, all at 0.45 MPa. Prusa rates PETG for use below 80 °C and ASA (acrylonitrile styrene acrylate) up to 93 °C.
- **Chemicals.** The Bambu Lab sheets rate PLA, PETG and PA6-CF as resistant to most oils and greases but not to acids, alkalis or some organic solvents. Prusa notes ASA dissolves in acetone.
- **Water.** Nylon is hygroscopic, meaning it absorbs water from the air. Bambu Lab lists 2.35 percent saturated uptake for PA6-CF against 0.43 percent for PLA Basic, and Prusa says polyamide can take up 10 percent of its weight.

Dishwasher and hot-water parts are the common case, and the heat figures per material are on which filament survives a dishwasher.

1.3 The discontinued-parts case

The strongest case for printing is the part nobody sells any more. Model libraries such as Printables and Thingiverse carry user-made replacements for many appliance parts, searchable by brand and model number.

When no model exists, the broken part has to be measured and redrawn. A pair of digital calipers and the two halves of the break usually suffice, and the method is on how to measure a broken part without a 3D scanner. Whether reproducing a manufacturer's part is allowed, and how right to repair changes that, is covered on is it legal to 3D print replacement parts.

1.4 Is a printer worth it for repairs?

It depends on how many parts you expect to print and whether a print service could supply them instead. One knob does not justify a machine. A household that keeps fixing things, or a workshop, has a stronger case. This page makes no call either way.

2 How strong is a 3D printed part compared with the injection-molded original?

Weaker across the layers, close to the bulk polymer along them. Prusament PETG yields at 46 MPa as filament and 47 MPa printed flat, but its interlayer adhesion is 18 MPa. Bambu Lab's PETG Basic pulls 51 MPa in XY and 35 MPa in Z. The sheets cited here give no injection-molded figure.

2.1 The number

Figures from the Bambu Lab and Prusa Polymers data sheets, all ISO 527 on specimens printed at 100 percent infill. The Bambu Lab PLA and PA6-CF specimens were annealed before

Table 1. The number

Material (product, manufacturer)	Tensile strength, XY (MPa)	Tensile strength, Z (MPa)	Z as a share of XY
PLA (PLA Basic, Bambu Lab)	35 ± 4	31 ± 3	89 percent
PETG (PETG Basic, Bambu Lab)	51 ± 1	35 ± 6	69 percent
Carbon-fiber nylon (PA6-CF, Bambu Lab)	102 ± 7	48 ± 6	47 percent
PETG (Prusament PETG, Prusa Polymers)	47 ± 2 printed flat; 46 ± 1 as filament	18 ± 4 interlayer adhesion	38 percent

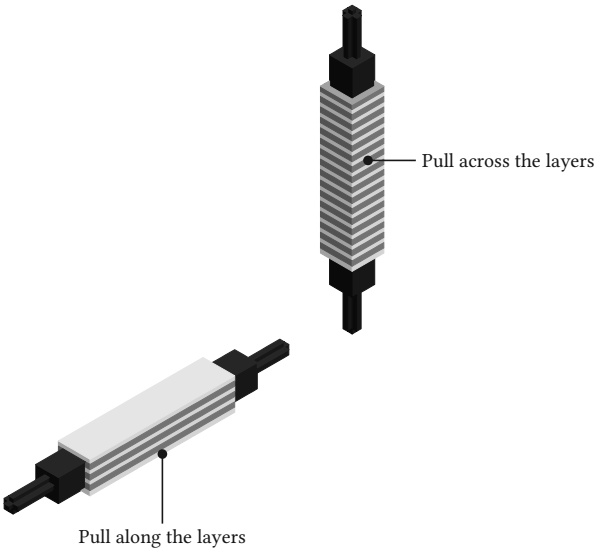


Figure 1. Printed flat, the pull runs along the layers; printed upright, the same pull runs across them and loads every layer bond.

testing, and the Prusament interlayer value is Prusa Polymers' own method. Neither maker publishes an injection-molded value for the same grade, so the molded comparison here is qualitative.

2.2 Why layers are the weak direction

Injection molding fills a mold with one continuous melt, so the finished part is the same polymer in every direction. Fused deposition modeling (FDM) lays down a line, lets it cool and lays the next on top. The bond between lines is a weld made under no pressure. Protolabs Network's design guide states that in FDM the bond between layers is always weaker than the plastic strands themselves, with XY tensile strength typically 4 to 5 times that of Z.

The data sheets above show a smaller gap, from 11 percent lost in Bambu Lab's PLA to 62 percent in Prusament PETG's interlayer test, so the ratio depends on material and settings. Impact behaves the same way: Bambu Lab's PETG Basic takes 34.2 kJ/m² in XY and 10.5 kJ/m² in Z.

The practical rule is orientation. Print so the load runs along the layers, not across them, and the part behaves close to its XY figure. Print a hook with layers across its neck and it sees the Z figure.

Where the geometry forces a cross-layer load, the answer is a wider section, more perimeters or a tougher material. Carbon-fiber filament raises strength in XY far more than it helps the layer bond, as the PA6-CF row shows.

Get it wrong and the part fails the way Prusa describes PLA failing: along a layer.

Questions answered in this guide

- Can you 3D print car body parts?
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  https://asked3d.com/answers/3d-print-car-engine-parts
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  https://asked3d.com/answers/snap-fit-replacement-clips
- How to measure a broken part for 3D printing without a scanner
  https://asked3d.com/answers/measure-broken-part-without-3d-scanner

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