Can 3D printed parts hold water pressure?

Asked 3D Content Team
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Abstract. Published pressure results for printed parts: Prusa Research's 20 and 30 meter dives, a forum test at 5 to 8 bar, and the O-ring rule for threaded fittings.

Keywords: watertight, waterproofing, pla, petg

1 Can 3D printed parts hold water pressure?

Yes, within limits. Prusa Research's closed PLA and carbon-fiber polycarbonate boxes stayed dry at 20 meters, about 2 kg/cm² (28 psi), and an O-ring flashlight housing held at 30 meters. Untreated PETG leaked at the seams, and in a forum test at 5 bar PLA and PETG both let water in. Pressure needs thick walls and a real seal.

1.1 The published results

Every row is one test someone published. The first block is Prusa Research's own testing. The second is a user's pressure-chamber thread on the Prusa forum, reported by the poster, not verified by Prusa.

Prusa's rule of thumb from the same post: water pressure rises by about 1 kg/cm² (14 psi) every 10 meters, so a 20 meter dive loads the wall with 2 kg/cm² (28 psi). The forum poster's 5 bar chamber is the equivalent of roughly 50 meters.

1.2 Why pressure finds leaks that a full cup does not

A cup on a bench only has to hold the weight of its own water. Under pressure, water is pushed into every path through the wall: the seam, the gap between perimeters and infill, and the pores between layers. The pillar page lists those paths. Pressure drives water through the ones already there.

Prusa's starting settings for a pressure part are four perimeters and 60 % infill, with walls of 2 to 3 mm at minimum and solid walls for deeper dives. Its design principle is blunt: the best watertight model is "a hollow round container with no openings or moving parts, printed in one piece".

The forum thread shows the other failure. The polypropylene cylinder held every drop at 7 bar and then imploded. A wall can be tight and still too weak to carry the load. Pressure parts need both.

1.3 Plumbing parts and threaded fittings

Printed gaskets are a dead end. Prusa tested several and wrote that "none of our printed creations held water". What worked was an O-ring in a groove, which Prusa calls "the best, easiest, and most proven method", with silicone grease on the ring before every use. That is how the flashlight housing reached 30 meters.

Printed threads do not seal on their own. Treat them as a clamp that squeezes an O-ring or a gasket, and let the ring do the sealing. For a tapered pipe thread, MarineLab3D's guide gives the tape rule: 3 to 5 wraps of PTFE tape in the tightening direction, started one thread back from the end, then "snug plus a quarter turn". Its stop rule for a weeping joint: "if you find yourself reaching for a bigger wrench, stop".

Table 1. The published results

Part and material	Walls	Pressure	Outcome	Source
Closed box, PLA (polylactic acid)	4 perimeters, 60 % infill starting point	20 m dive	Dry, no post-processing	Prusa Research blog
Closed box, carbon-fiber PC (polycarbonate)	Same	20 m dive	Dry, no post-processing	Prusa Research blog
Closed box, untreated PETG (glycol-modified PET)	Same	20 m dive	"Leaked really quickly through the seams and contact points"	Prusa Research blog
Closed box, PETG coated in epoxy	Same	Dive test	"Perfect watertightness"	Prusa Research blog
Flashlight housing, threaded lock and O-ring	Not stated	30 m dive	Held	Prusa Research blog
Cylinder, PLA, 0 % infill	4 perimeters, 7 top and bottom layers	5 bar chamber	90 % full of water within minutes	Prusa forum user
Cylinder, PETG, 0 % infill	Same	5 bar chamber	75 % full after 2 hours	Prusa forum user
Cylinder, polypropylene, 1.1 extrusion multiplier, ironing	4 perimeters, 0.6 mm extrusion width	7 bar overnight	Watertight, but the cylinder imploded	Prusa forum user
Cylinder, PLA with one brushed coat of epoxy	4 perimeters	8 bar for 5 days	No leak	Prusa forum user

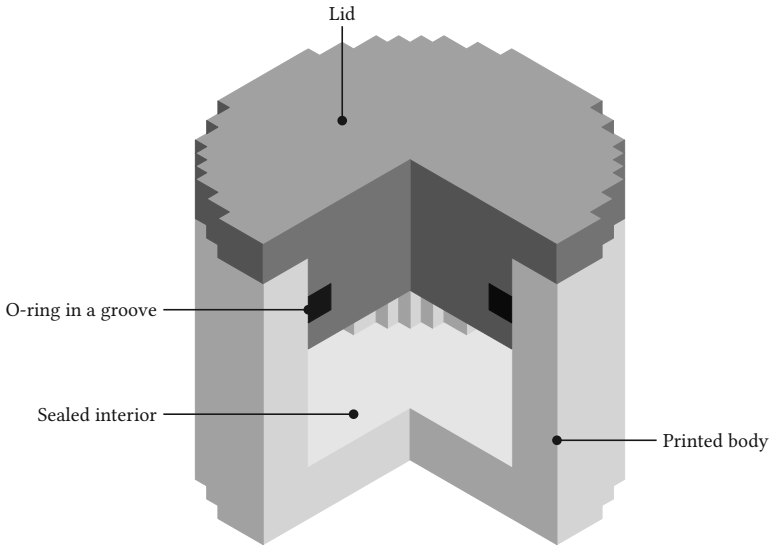


Figure 1. The printed parts only hold the O-ring in place, and the ring squeezed between its groove and the body does the sealing.

If a flat joint needs a printed seal, MarineLab3D specifies a TPU (thermoplastic polyurethane) gasket at Shore 95A, 1.5 to 2.5 mm thick, designed for 15 to 25 percent compression at 100 percent infill.

1.4 Long-term pressure

No source here gives a long-term figure for an uncoated FDM part. The longest published test is the forum poster's epoxy-coated PLA cylinder: 8 bar for 5 days without a drop. The Formlabs white paper on deep-sea housings, run in a university implosion chamber, eliminated FDM (fused deposition modeling) samples before pressure testing because they "absorb water immediately upon submersion". Treat a short bench pass as a starting point and re-test after the part has been wet for a few days. The pillar's absorption figures show how much water each material takes up.

1.5 What to do

1. Design the part as one closed body where possible. Move every opening to a single lid sealed by an O-ring in a groove, greased before assembly.
2. Print with at least four perimeters and 60 percent infill, or solid walls, at 0.15 mm layers and 5 to 10 percent extra flow. The perimeter page has the per-material counts.
3. Skip PETG for a pressure part unless you will coat it. Prusa's PETG box leaked untreated and sealed once brushed with epoxy.
4. Run a leak test at the working pressure, not just a fill-and-wait, and repeat it after the part has been submerged for a few days.

References

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