Can you 3D print replacement LEGO pieces?

Asked 3D Content Team
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Abstract. Yes, for personal use. The brick patent expired in 1978, but LEGO molds to 1/200 mm and Prusa quotes 0.3 mm XY, so tune XY compensation on a test brick first.

Keywords: replacement-parts, slicer-settings, abs, pla

1 Can you 3D print replacement LEGO pieces?

Yes, for your own use. The US patent on the stud-and-tube brick was granted in 1961 and expired in 1978, but the LEGO name and logo are still trademarks. Fit is the catch: LEGO molds to 1/200 mm and Prusa quotes 0.3 mm in X and Y, so printed bricks clutch too tight or too loose until tuned.

1.1 The fit gap

Table 1. The fit gap

	Original LEGO brick	Printed brick
Material	ABS (acrylonitrile butadiene styrene), used for most LEGO pieces since 1963	Your choice of filament: ABS, PETG or PLA
Dimensional accuracy	Molded to 1/200 mm (0.005 mm)	0.3 mm in X and Y, 0.1 mm in Z on a well-assembled Original Prusa
How it holds	A tube clamped between four studs of the brick below	The same geometry, if the printer holds the sizes
Patent	US 3,005,282, granted October 24, 1961; expired	Free to copy the coupling

Material and molding figures from the LEGO Group's help and history pages; printer tolerance from the Prusa Knowledge Base FAQ; patent details from the patent itself on Google Patents and the 17-year term in USPTO MPEP 2701.

The printer's error band is 60 times wider than LEGO's molding accuracy. The same model can print tight on one machine and loose on the next, so a downloaded brick file is a starting point, not a finished part.

1.2 Why printed bricks clutch wrong

The patent describes the clamp: each tube under a brick touches four studs of the brick below and is held between them. The studs are also clamped against the inner face of the brick's outer wall. Both are press fits, so whether they grip depends on sizes the printer can only hold to its 0.3 mm band.

Bambu Lab's wiki lists the usual reasons a printed part comes out the wrong size:

- **Shrinkage**: filament contracts as it cools, which makes holes smaller.
- **Elephant's foot**: the first layer squashes outward on the build plate. On a brick, that narrows the bottom opening where studs enter.
- **Wet filament**: moisture makes extrusion uneven.

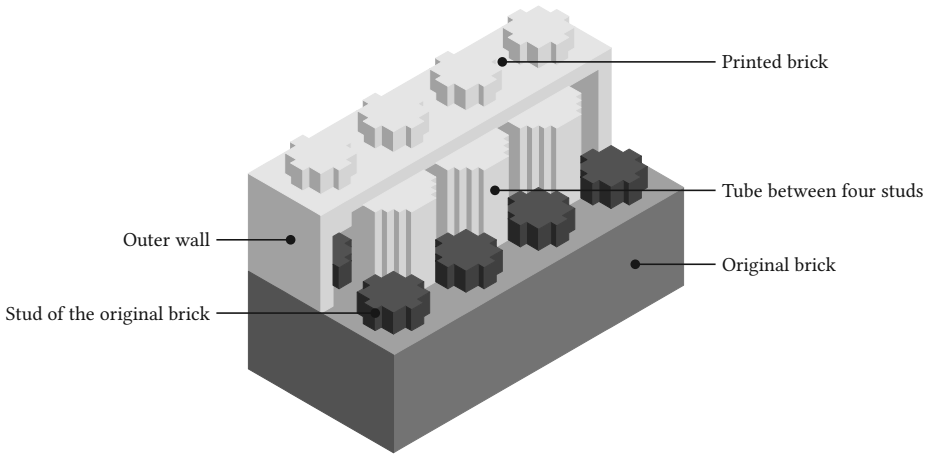


Figure 1. Each tube under a brick sits between four studs of the brick below, and the studs press against the inside of the outer wall, so both grips are press fits.

Table 2. Which filament grips most like ABS

Material (product, maker)	Bending modulus, XY	Elongation at break, XY	Elongation at break, Z
ABS (ABS, Bambu Lab)	1880 MPa	10.5 %	4.7 %
PETG (PETG Basic, Bambu Lab)	1950 MPa	9.5 %	5.2 %
PLA (PLA Basic, Bambu Lab)	2750 MPa	12.2 %	7.5 %

- **Seams**: the point where each layer starts can affect hole precision.

1.3 Which filament grips most like ABS

Figures from the Bambu Lab technical data sheets, ISO 178 for bending and ISO 527 for elongation.

PETG (glycol-modified polyethylene terephthalate) is close to ABS in stiffness, and LEGO's bricks are ABS. PLA (polylactic acid) Basic is about 46 % stiffer in bending than Bambu Lab ABS. The same interference therefore pushes back harder, so tune PLA bricks looser or they will be hard to pull apart. PLA also softens early: the PLA Basic sheet gives a heat deflection temperature of 57 °C (135 °F), against 87 °C (189 °F) for Bambu Lab ABS, both at 0.45 MPa.

A stud printed upright joins the brick through layer bonds, so it breaks in Z. The Z elongation figures show how little stretch every material has across layers.

1.4 What the patent and trademarks allow

Patent US 3,005,282 covers the stud-and-tube coupling, filed by Godtfred Kirk Christiansen in 1958. US patents of that era ran 17 years from grant, and Google Patents lists it as expired. The brick's working shape is free to copy.

The name and logo are a different matter. LEGO® is a trademark of the LEGO Group. Its Fair Play policy allows the word only in a non-commercial way to refer to LEGO products, and says the LEGO logo should never be used on an unofficial site. Two rules follow for printed parts: leave the logo off the studs, and do not sell or list printed parts as "LEGO". The legal guide to printing replacement parts covers copying a manufacturer's part more broadly.

1.5 How to check it on your own print

1. Get a brick model with adjustable dimensions. A parametric brick, from a model library or built in CAD, lets you change stud and wall sizes later. Skip any model with the logo on the studs.
2. Print one 2x4 brick (eight studs in two rows over three tubes, as claim 5 of the patent describes it) in the filament and settings you will use for the real parts.
3. Test both directions against an original. Press the printed brick onto an original brick: that tests its cavity. Press an original onto the printed brick's studs: that tests the studs.
4. Fix the cavity with XY hole compensation. Bambu Studio and OrcaSlicer list it under Quality, Precision. A positive value makes holes bigger, and Bambu Lab notes the hole diameter grows by twice the value. Too tight on original studs means raise it; too loose means lower it.
5. Fix the studs with XY contour compensation. Positive makes outer contours bigger. Bambu Lab's wiki steps it in 0.1 mm increments, up when loose and down when tight.
6. Change one setting per reprint, and save the result as its own process profile. Bambu Lab's wiki says the calibration is specific to each filament, so repeat it when you change material.

If the bottom edge flares or the fit changes between prints, rule out elephant's foot and wet filament before touching compensation again. The clearance method behind all this is on how to match tolerances on a replacement part.

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