Do heat-set inserts work in TPU?

Asked 3D Content Team
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Abstract. Not reliably: UltiMaker advises against heat-set inserts in flexible TPU because the plastic deforms and the insert loosens. What to use instead, and how to test.

Keywords: tpu, heat-set-inserts, threads-and-fasteners

1 Do heat-set inserts work in TPU?

Not reliably. UltiMaker's heat-set insert guide says to avoid flexible materials like TPU (thermoplastic polyurethane): the plastic deforms, so the insert will not stay in place securely. Ruthex's material examples are all rigid plastics. The insert melts in with the iron 10 to 20 °C above printing temperature, but it can turn or pull out under load.

1.1 The number

Table 1. The number

Figure	Value	Source
Guidance on TPU	"Avoid flexible materials like TPU"	UltiMaker
Plastics named as suitable	PLA, PETG, ABS, PPS, PP; TPU not named	Ruthex
Iron temperature rule	printing temperature + 10 to 20 °C	CNC Kitchen
Nozzle temperature, PolyFlex TPU95	210 to 230 °C	Polymaker
Iron temperature for that filament, by the rule	220 to 250 °C	CNC Kitchen rule applied to Polymaker figure
Nozzle temperature, flexible filaments generally	230 to 245 °C, by hardness and brand	Prusa Knowledge Base
Shore hardness, PolyFlex TPU95 and Ultimaker TPU 95A	95A	Polymaker, UltiMaker
Tensile modulus, Ultimaker TPU 95A, printed	26 MPa (ASTM D638)	UltiMaker
Tensile modulus, Ultimaker PLA, printed	2,346.5 MPa (ISO 527)	UltiMaker

Guidance from UltiMaker's insert guide and the Ruthex product page; the temperature rule from CNC Kitchen; printing temperatures from the Polymaker data sheet and the Prusa Knowledge Base; hardness and modulus from the Polymaker and UltiMaker data sheets. Ruthex's list covers PLA (polylactic acid), PETG (glycol-modified PET), ABS (acrylonitrile butadiene styrene), PPS (polyphenylene sulfide) and PP (polypropylene). The two modulus figures use different test standards, so read the gap as an order of magnitude, not an exact ratio. None of these sources publishes a pull-out or torque test in TPU, or a Shore hardness above which inserts become dependable.

1.2 Why

An insert holds because its knurl, the ridged outside of the brass, sits locked in plastic that does not move. Markforged puts the limit plainly: an insert's pull-out strength "cannot be further reinforced beyond the material properties of the plastic surrounding the insert."

TPU is built to move. In UltiMaker's data sheets, printed TPU 95A has a tensile modulus of 26 MPa against 2,346.5 MPa for its PLA, so the TPU stretches about 90 times as far under the same stress. When you torque a screw, the soft wall gives instead of holding the knurl. The insert turns with the screw. Under a pull, it walks out. Even in ASA (acrylonitrile styrene acrylate), a rigid plastic softer than PLA, CNC Kitchen saw a shallow-knurled insert start rotating. TPU offers the knurl much less to bite into.

Installing is the easy part. A TPU like PolyFlex TPU95, printed at 210 to 230 °C, takes an iron at about 220 to 250 °C by CNC Kitchen's rule. Ruthex gives 10 to 15 °C above hotend temperature instead. Use your own spool's printing temperature as the base. The full rule is on What temperature should the iron be for PLA, PETG and ABS inserts?.

1.3 What to use instead

- **An embedded nut.** Markforged's method: model a cavity the size of the nut around the bolt hole, pause the print just before the layer that closes the cavity, drop the nut in and resume. The printed plastic then traps the nut on every side. Markforged prefers square nuts, which are less likely to strip the cavity walls than hex nuts.
- **A nut pocket open to one face**, if you need to replace the nut later. The trade-offs against inserts are on Heat-set inserts or captive nuts: which is better for printed parts?.
- **A rigid filament for the boss**, if the part does not have to flex where the screw goes. UltiMaker suggests ABS or PETG for inserts.

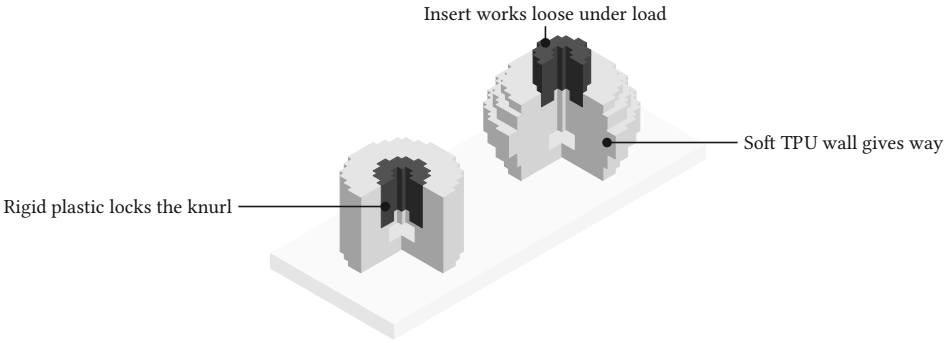


Figure 1. The rigid boss holds the knurl still, while the soft TPU wall gives under load and lets the insert turn or pull out.

1.4 How to check it on your own print

1. Print a test boss in your TPU, with the hole size from the insert maker's table. For M3, see What hole diameter does an M3 heat-set insert need?.
2. Set the iron 10 to 20 °C above your TPU's printing temperature and sink the insert.
3. Let it cool fully, then thread a screw in and tighten it by hand to the torque the real part will see.
4. Watch the insert, not the screw. If the insert turns, lifts or the boss bulges, switch to an embedded nut.
5. Pull the screw firmly by hand. An insert that slides out at hand force will not survive the part's use.

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