How to remove or straighten a crooked heat-set insert

Asked 3D Content Team
Published September 21, 2026 · Last verified September 21, 2026

Abstract. Reheat a tilted insert at 20 °C above printing temperature (240 °C for PLA) and press it flush, or pull it out on a screw in about 10 seconds; drill 5.6 mm for an M4.

Keywords: heat-set-inserts, threads-and-fasteners, home-repair

1 How do you remove or fix a crooked heat-set insert?

Reheat the insert. Put the iron back in at about 20 °C above the material's printing temperature (240 °C for PLA per CNC Kitchen), wait for the plastic to soften, then press it flush with a flat face. To remove it instead, thread a screw in and pull straight up as it softens, about 10 seconds in PLA (polylactic acid).

1.1 The number

Table 1. The number

Step	Figure	Source
Iron temperature for reheating or removal	printing temperature + 20 °C; 240 °C for PLA	CNC Kitchen removal guide
Time for the plastic to soften, PLA	about 10 seconds	CNC Kitchen removal guide
Screw engagement for a pull	at least the length of the insert	CNC Kitchen removal guide
Extractor sizes	M2, M2.5, M3	CNC Kitchen
Drill sizes for a fresh hole	3.2 mm (M2), 4.0 mm (M3), 5.6 mm (M4), 6.4 mm (M5), 8.0 mm (M6)	Ruthex drill set
Minimum wall for the next size up	M3 1.6 mm, M4 2.1 mm, M5 2.6 mm	Ruthex table (3DJake)

Figures from CNC Kitchen's removal-tool guide and Tips & Tricks post, the Ruthex drill set page and the Ruthex size table as published by 3DJake. CNC Kitchen gives the 10 seconds for PLA only. No source states how many reheats a boss survives.

1.2 Why

A crooked insert is a plastic problem, not a brass one. The plastic around it solidified in the wrong shape, and a thermoplastic softens again once it returns to that temperature. So the fix is the installation in reverse, with the iron a little hotter so the wall lets go fast. CNC Kitchen sets 240 °C for PLA when extracting, 20 °C above its printing temperature.

Straightening works when the insert is tilted but still mostly in its hole. Once heat has travelled through the brass into the wall, you can push it square with a tool whose flat face is wider than the insert.

CNC Kitchen's straightener is an aluminum block with a small tip that locates in the bore and a large flat face that cannot land at an angle. A screwdriver blade or the flat of tweezers does the same job, less precisely. Hold it for a moment, because inserts creep back out right after melting.

Removal is for an insert that is the wrong size, too deep, or so tilted the hole is off-axis. A screw threaded into the insert becomes a handle and a heat path. CNC Kitchen has you screw in at least the length of the insert, hook under the head, and pull gently as the plastic softens. UltiMaker warns that some plastic comes out with the insert.

What is left decides whether you drill or reprint. Ruthex sells drills of 3.2, 4.0, 5.6, 6.4 and 8.0 mm for its M2 to M6 inserts and notes that heat-shrunk printed holes can be drilled back to size. A pulled M3 hole can often be drilled to 4.0 mm for a fresh M3, or to 5.6 mm for an M4.

The wall sets the limit: Ruthex asks for 1.6 mm around an M3 and 2.1 mm around an M4, so a boss (the printed column around the hole) modeled for M3 rarely has room for the bigger hole. A wall that split, whitened or bulged while hot has failed: reprint the part.

Get it wrong and the second heating pushes soft plastic into the thread or out the back of the boss, and a part that was slightly off becomes scrap.

1.3 How to check it on your own print

1. Decide the case. Tilted but in the hole: straighten. Wrong size, too deep, off-axis, or a screw that will not start: remove it.
2. Set the iron to the printing temperature plus about 20 °C, 240 °C for PLA. To straighten, seat the tip in the bore and wait for the plastic to soften. Lift the iron and press the insert square with a flat face held parallel to the surface, then hold it a few seconds.
3. To remove, thread a screw in at least the insert's length and heat the screw head with the iron. Pull straight up as the plastic gives, about 10 seconds in PLA. Never force the pull.

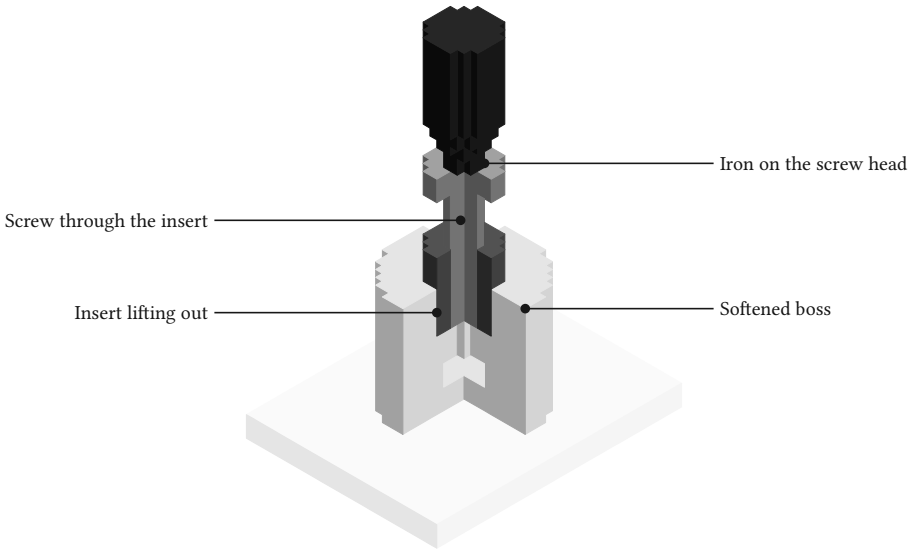


Figure 1. A screw threaded through the insert carries the iron's heat into the brass and gives a handle to pull straight up as the plastic softens.

4. Drill the hole to size for the insert going back in: 4.0 mm for M3, 5.6 mm for M4. Measure the remaining wall; under 1.6 mm for M3 or 2.1 mm for M4 means reprint.
5. Install the fresh insert with the two-stage push, thread a screw in and pull hard by hand. DigiKey's check applies: flush with the surface, aligned with the fastener path.

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Cite as: Asked 3D. "How to remove or straighten a crooked heat-set insert." September 21, 2026. https://asked3d.com/answers/remove-crooked-heat-set-insert. Last verified September 21, 2026.