Can you 3D print car engine parts?

Asked 3D Content Team
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Abstract. Not internal engine parts. Suppliers rate the engine area at 125 °C (257 °F) and on-engine parts at 150 °C, above the HDT of PETG, ABS, ASA and PC filament.

Keywords: replacement-parts, nylon, polycarbonate, asa

1 Can you 3D print car engine parts?

Not the parts inside the engine. Pistons, valves, head gaskets and timing parts see combustion heat and pressure no desktop filament survives, and carmakers that print them use metal. Off the engine, clips, brackets and covers can work in carbon-fiber nylon. Its heat deflection temperature clears the 125 °C (257 °F) engine-area rating; polycarbonate, ABS and PETG fall short.

1.1 The temperatures under the hood

Table 1. The temperatures under the hood

Location	Temperature	What sets it
Passenger compartment (for comparison)	up to 100 °C (212 °F)	USCAR connector class T2
Engine area, off the engine	up to 125 °C (257 °F)	USCAR connector class T3; TXL wire, “the grade used for most underhood applications,” is rated 125 °C
On the engine	up to 150 °C (302 °F)	USCAR connector class T4
Exhaust manifold surface	250 °F (121 °C) at 30 mph on a level road to 1,020 °F (549 °C) at 70 mph up a 7 % grade	Measured on four vehicles
Air in the engine bay after you park	climbs almost 40 °C further, 3 to 24 minutes after shutdown	Wind-tunnel heat-soak study

Class ratings come from the SAE/USCAR-2 temperature classes as stated in Molex’s connector table, TE Connectivity’s Generation 50 guide (T2, 100 °C) and a Delphi connector drawing (T3, 125 °C; T4, 150 °C), plus Auto Service World’s wire-grade guide. Manifold figures are from the University of Washington’s Vehicle Fire Investigation pages, and heat soak from Khaled et al. (2015). A class rating is the worst case a supplier designs for. Many spots in the bay run cooler.

The heat deflection temperature (HDT) is where a loaded test bar starts to bend. Manufacturer figures at 0.45 MPa are 71 °C (160 °F) for Bambu Lab PETG Basic (glycol-modified PET), 93 °C (199 °F) for Prusament ASA (acrylonitrile styrene acrylate), 112 °C (234 °F) for Bambu Lab PC (polycarbonate) and 186 °C (367 °F) for Bambu Lab PA6-CF (carbon-fiber nylon 6). Fillamentum ABS Extrafill (acrylonitrile butadiene styrene) lists 81 °C (178 °F) at 1.8 MPa. Only PA6-CF clears the 125 °C engine-area class. At the 1.8 MPa load (164 °C) it clears the 150 °C on-engine class by a slim margin. The full table, with glass transition temperatures (Tg) and both test loads, is on which filament survives a dishwasher.

1.2 Why internal engine parts are out of reach

Inside the engine, parts carry combustion pressure, spin at engine speed, or seal hot oil and coolant. A printed part is weakest across its layers, and the exhaust manifold next door was measured at up to 549 °C, about three times the highest HDT above.

When carmakers do print engine internals, they print metal. In 2020 Porsche, MAHLE and Trumpf printed aluminum pistons for the 911 GT2 RS engine from metal powder by laser metal fusion (LMF). Porsche says they weigh 10 % less than the forged production pistons and allow up to 30 PS more from the 700 PS engine. MAHLE, which developed the aluminum alloy, reports that six of them completed 200 hours of endurance testing on the test bench.

1.3 Which engine-bay parts you can 3D print

Plastic parts that hold nothing but their own weight and sit away from the engine block and exhaust:

- clips and push-pins on engine covers and splash shields
- wiring-loom brackets and cable-tie mounts on the inner fender
- fuse box and relay box covers
- brackets for reservoir bottles (the bracket, not the cap or the bottle)
- air-box ducting on the cold side, between the grille and the filter

Do not print:

- anything in the fuel system: lines, fittings, fuel-rail parts, filler parts
- anything holding oil, coolant or brake fluid, including caps, filler necks and filter housings

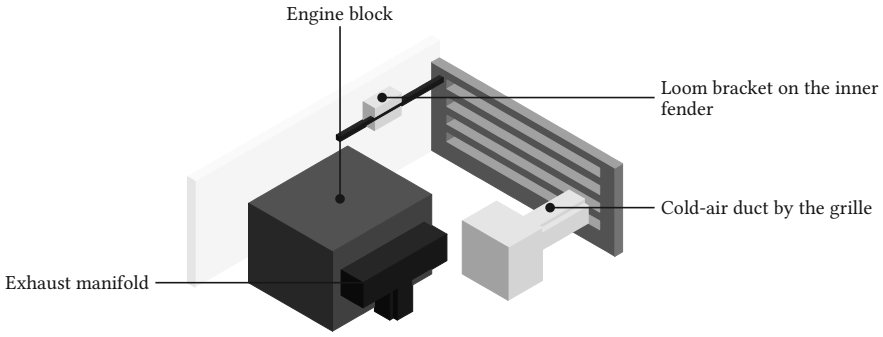


Figure 1. Printable parts sit away from the engine block and exhaust, like a loom bracket on the inner fender or the cold-air duct by the grille.

- anything near the exhaust manifold, turbocharger or catalytic converter
- intake parts after the turbo, where the air is under boost
- belt-drive, timing and pulley parts

A fuel or oil leak in the engine bay drips onto exhaust surfaces measured at 250 to 1,020 °F. That is a fire risk, not a broken clip.

Material choice follows the location. PA6-CF is the only filament here rated above the 125 °C engine-area class. PC and ASA can work in spots you have measured well below their HDT, such as the cold-air duct near the grille. PETG and ABS sit below even 100 °C, so keep them out of the engine bay.

Nylon absorbs water from the air: the PA6-CF sheet lists 2.35 % saturated uptake, so dry the spool before printing. PC and ASA warp without an enclosure. The replacement parts guide covers the layer-strength limits that apply on top of heat.

On warranty, a printed clip or bracket does not by itself cost you US coverage. The FTC says the Magnuson-Moss Warranty Act generally bars a warrantor from conditioning coverage on its own branded parts. A company may still refuse coverage for damage the unauthorized part caused.

1.4 How to check a printed engine-bay part

1. Measure the spot first. Drive until the engine is fully warm, with some highway in the mix. Park and read the mounting surface with an infrared thermometer right away. Read it again every few minutes for about 25 minutes, because the heat-soak study found temperatures still rising 3 to 24 minutes after shutdown. Take the highest reading.
2. Pick the material whose HDT sits well above that peak, using the 1.8 MPa figure where the sheet gives both.
3. Heat-test a spare print. Heat it through at your peak reading in an oven you do not use for food. Press it while hot. Any give or warp means it will fail in the car.
4. Fit the part, then check it after the first hot drive and again after a week: look for sag, warp, whitening at the layers and loose fasteners.
5. If a printed part sags or cracks, move to the next material up the HDT list, or buy the factory part.

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