What filament should you use for 3D printed car parts?

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Abstract. A sunlit dashboard averaged 157 °F (69 °C), so dash parts need ABS, ASA or PC. Shaded cabin parts take PETG, exterior parts ASA, flexible parts TPU.

Keywords: replacement-parts, asa, abs, tpu

Table 1. The zone table

Zone	Temperature it reaches	Clears it (HDT)	Too close or below
Cabin out of direct sun: door pockets, glovebox, under the seats	Cabin air 116 °F (47 °C) after one hour parked in the sun	PETG 71 °C, ABS 87 °C, ASA 100 °C, PC 112 °C	PLA 57 °C, a 10 °C margin
Sunlit seats, steering wheel, console trim	Seats 123 °F (51 °C), steering wheel 127 °F (53 °C)	PETG, ABS, ASA, PC	PLA, a 4 to 6 °C margin
Dashboard top in direct sun	157 °F (69 °C)	ABS (+18 °C), ASA (+31 °C), PC (+43 °C)	PETG, a 2 °C margin and a 69 °C glass transition
Exterior: grille inserts, trim clips, covers	No absolute figure sourced; a black roof ran up to 45 °F (25 °C) hotter than an identical silver one	ASA, rated for UV	ABS turns yellowish and more brittle outdoors
Engine bay, turbocharger to intercooler (turbo diesel)	Up to 200 °C, spikes to 230 °C	Nothing on a desktop printer	Highest HDT here is PAHT-CF at 194 °C
Flexible parts: gaskets, grommets, small bumpers, cup-holder liners	Whichever zone they sit in	TPU, kept out of the sun	NinjaFlex TPU HDT 44 °C

1 What filament should you use for 3D printed car parts?

Pick by where the part lives. Shaded cabin parts handle PETG. A dashboard in direct sun averaged 157 °F (69 °C) in an Arizona State study, so dash parts need ABS, ASA or polycarbonate (PC). Exterior parts need ASA for UV. Flexible gaskets and liners are TPU (thermoplastic polyurethane). Near the turbo, no desktop filament holds up.

1.1 The zone table

Heat deflection temperature (HDT) is where a loaded test bar starts to bend. The figures below are at 0.45 MPa, from each maker's data sheet.

Cabin figures come from ASU News on the Vanos et al. study, the roof difference from Berkeley Lab, and the turbo-path figure from BASF in CHEManager. Material figures are from the Bambu Lab, NinjaTek and Prusa Knowledge Base pages listed below.

1.2 Why heat decides first

The Arizona State team measured six silver cars after one hour in Tempe, Arizona, on days above 100 °F. Even in the shade, dashboards averaged 118 °F (48 °C). Berkeley Lab measured cabin air about 5 to 6 °C cooler in a silver car than in an identical black one, so a dark car runs above the table.

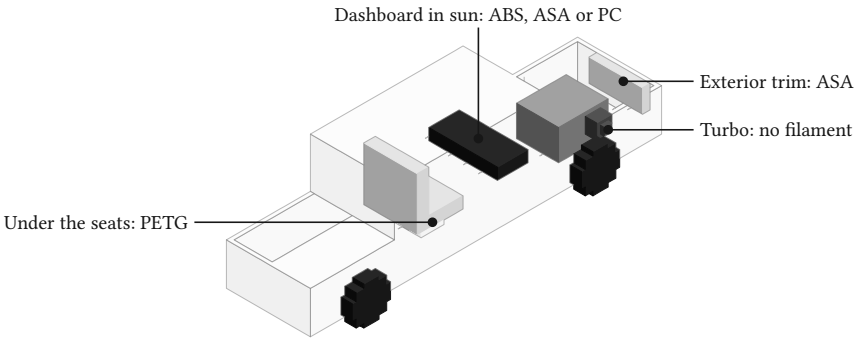


Figure 1. Each zone runs at a different temperature, so the filament follows where the part lives, and the turbo path in the engine bay is off the list.

PLA (polylactic acid) is the filament that fails first. The Prusa Knowledge Base says PLA softens and deforms above 60 °C, and Bambu Lab's PLA Basic has a glass transition of 60 °C. A PLA phone mount on a sunny dash sits 12 °C above its HDT. PETG (glycol-modified PET) has a glass transition of 69 °C, the dashboard average, so it belongs in the shaded rows only.

The general replacement-part table, with strength and chemical rows beyond heat, is on which filament to use for a replacement part.

1.3 ASA or ABS for exterior parts

ASA (acrylonitrile styrene acrylate). Prusa describes ASA as a successor to ABS (acrylonitrile butadiene styrene), with high UV resistance and use up to 93 °C. Of ABS it says the material lacks UV resistance and that outdoor ABS parts turn yellowish and more brittle over time. Bambu Lab rates its ASA at an HDT of 100 °C against 87 °C for its ABS.

For a part inside the car, ABS clears the 69 °C dashboard average by 18 °C.

1.4 TPU car parts

Use TPU for parts that must flex or seal: gaskets, grommets, small bump stops, cup-holder liners and anti-rattle pads. Bambu Lab's TPU 95A HF stretches past 650 percent before it breaks and is listed resistant to most oils and greases.

Heat is TPU's limit. NinjaTek gives NinjaFlex an HDT of 44 °C at 0.45 MPa, below the 47 °C sunlit cabin air, so a TPU part in a hot car can soften and take a set. Keep TPU parts unloaded and out of direct sun. Joints that hold pressure are covered under printing a gasket.

1.5 Carbon fiber car parts

You can print carbon-fiber filament, but not a carbon-fiber composite part like a woven hood or splitter. Carbon-fiber filament is an ordinary polymer with short chopped fibers mixed in. Stratasys describes its FDM Nylon-CF10 as a blended nylon with 10 percent chopped carbon fiber by weight. Bambu Lab lists its PLA-CF as polylactic acid and carbon fiber.

The fibers add stiffness along the layers, not heat resistance. PLA-CF has a bending modulus of 3,950 MPa in XY against 2,750 MPa for PLA Basic, but across the layers it drops to 2,260 MPa, below plain PLA's 2,370 MPa. Its HDT is 55 °C, two degrees below plain PLA. The polymer underneath sets the temperature limit, so carbon-fiber nylon 6 (PA6-CF) reaches an HDT of 186 °C while PLA-CF stays in the shaded rows.

1.6 What factory-printed car parts are made of

Factory-printed plastic parts come from industrial powder-bed machines, not filament. GM's 2022 Cadillac Blackwing V-Series cars carried two nylon-12 (PA12) HVAC ducts made by HP Multi Jet Fusion, Additive Manufacturing reported in 2021. BMW fitted its millionth printed part, an HP Multi Jet Fusion window guide rail, to the i8 Roadster in series production in 2018. Home-printed car parts use the filaments in the table.

1.7 Car parts you should never print

Never print brakes, steering, suspension, seat belts or restraints, airbag parts, fuel-system parts or wheels. A printed part is weakest across its layers, and a failure in any of these can injure people.

Close to the engine, BASF rates its glass-filled nylon 66 (PA66), Ultramid A3WG7, for a long-term service temperature of 170 °C. HDT is a short test under load, not a long-term rating, so the 186 °C of PA6-CF and the 194 °C of PAHT-CF, a high-temperature carbon-fiber nylon, do not make them engine-bay materials. Print only covers and clips well away from the engine and exhaust.

Under FTC guidance, using aftermarket parts does not void a car's warranty. The manufacturer must prove the part caused the damage before refusing coverage. If it did, the dealer can deny that repair and charge you for it.

1.8 How to check it on your own part

1. Find the zone in the table and print in a material that clears its temperature, with the main load running along the layers.
2. Leave the part on a sunny dashboard for a hot afternoon, or in an oven at 69 °C (157 °F), before fitting it. Press it while hot. Any give means the material sits too close to its HDT.
3. Check an exterior part after a few weeks outside for chalking, yellowing or cracks.
4. If a cabin part warps in summer, reprint it one row down the table: PETG to ABS or ASA, ABS to PC.

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