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PLA TOUGH+

An impact-modified PLA that bends and bounces where ordinary PLA snaps — for parts that get dropped, flexed and knocked, not for parts that get hot.

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An impact-modified PLA that bends and bounces where ordinary PLA snaps — for parts that get dropped, flexed and knocked, not for parts that get hot.

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Ordinary PLA is strong but brittle: it holds a heavy load in a slow pull and then shatters when it hits the floor. PLA Tough+ adds a rubbery impact modifier to the polymer so that the energy of a knock is absorbed by tiny deformations instead of starting a crack. On the datasheet the effect is dramatic — roughly three times the impact toughness of PLA Basic in the flat direction and nearly twice across the layers — and it is bought for RC cars, clips, springs, tool handles and anything that lives a rough life. What it does not do is raise the heat limit: it softens at the same 55–60 °C as every other PLA, and independent testing has been less flattering than the marketing about its layer strength.

FEELS LIKE

Slightly waxy, less glassy

Flexes a little under thumb pressure where PLA Basic feels rock-hard

THE EFFECT

Survives drops and bending

Charpy impact 80.6 kJ/m² flat, three times PLA Basic

TRADE-OFF

Less stiff, slightly weaker in a pull

Modulus about 28 % below PLA Basic; strength roughly equal

HEAT

No better than PLA Basic

Glass transition 61 °C; "ABS-like" refers to toughness, not temperature

COLOUR RANGE

7 colours

Black, White, Gray, Silver, Cyan, Orange, Yellow

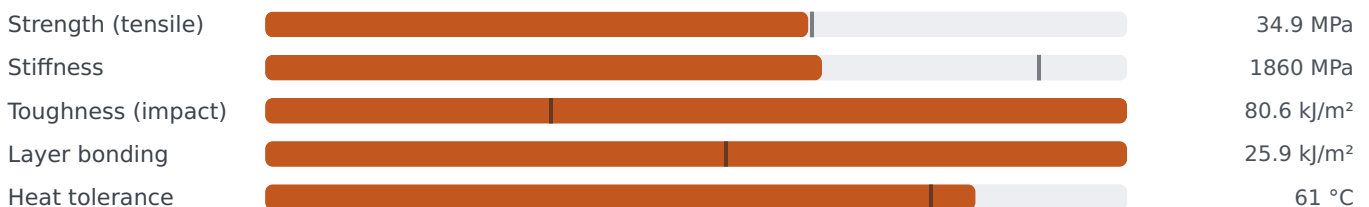
EASE OF PRINTING

Easy but hotter

220–250 °C nozzle; more odour than PLA Basic; supports harder to remove

Where it sits in the range

Each bar shows this material against the strongest value found anywhere in this series of guides, PLA and PETG together (bar full = best in the series). The dark tick marks plain PLA Basic, the material most people know, so you can see at a glance where this one gives up or gains something. Values come from the manufacturer's own datasheets, measured on test bars printed flat (X-Y).



■ PLA Tough+ ■ PLA Basic reference

Good for

- RC car bodies, bumpers, chassis parts and model-aircraft fittings
- Clips, latches, buckles, carabiner-style parts and other things that flex once in a while

Not the right choice for

- Anything that gets warm — engine bays, dashboards, near lamps or heaters
- Parts that must be stiff: long unsupported arms, thin plates, precision fixtures

- Tool handles, jigs and workshop fixtures that get dropped
- Phone stands, hooks and wall mounts that see knocks
- Functional prototypes that must survive handling before a final material is chosen
- Pickleball paddles, drone frames and similar impact-facing hobby parts

- Living hinges that flex thousands of times — it is tough, not elastic
- Food contact; no certification
- Prints with heavy support in tight places — supports bond hard and are difficult to remove

Toughness, stiffness and what "ABS-like" means

Toughness is the energy a material can absorb before it breaks; stiffness is how much it resists bending. Impact modifiers raise the first and lower the second, and the datasheet shows both: Charpy impact leaps from 26.6 to 80.6 kJ/m² while Young's modulus falls from 2580 to 1860 MPa. Tensile strength is almost unchanged at 34.9 MPa. The manufacturer's comparison with ABS is about that impact figure, which is indeed in ABS territory; ABS itself has a heat deflection temperature around 85–90 °C, which Tough+ does not approach. The company also claims up to twice the layer adhesion of standard PLA. The datasheet supports this for impact across layers (25.9 against 13.8 kJ/m²), but the Z tensile strength is actually lower than PLA Basic's (20.9 against 31 MPa), and an independent tester found Tough+ worse than plain PLA on every measure except impact. Both things can be true: the layers resist a sharp blow better and a slow pull worse.

2 · Living with a PLA Tough+ print

A Tough+ print is the PLA you can hand to a child or drop on concrete. Its everyday limits are otherwise those of any PLA.

Heat	Softens from about 60 °C. Same rules as all PLA: no cars, radiators, dishwashers or hot liquids. The toughness does not help once it goes soft.
Drops and knocks	The reason to buy it. Parts dent or flex rather than shatter; thin features bend and mostly spring back.
Sunlight	As PLA; the impact modifier does not add UV resistance.
Water and damp	Insoluble; unusually low moisture uptake for a PLA (0.27 %).
Chemicals	As PLA: fine with oils and isopropyl alcohol, attacked by acids, alkalis and some solvents.
Food	Not certified for food contact.
Load over time	Less stiff than PLA Basic, so it sags more under a sustained load. Design thicker sections.
End of life	General waste or 3D-print recycling. The impact modifier is a non-PLA polymer; do not expect compostability.

Looks and feel

Semi-gloss with a slightly softer, less glassy sheen than PLA Basic. Layer lines are visible. Colours are opaque and the palette is functional rather than decorative.

Care

- Wipe clean; no dishwasher
- Keep away from heat sources
- Sands well with wet paper; slightly gummier than PLA Basic, so use fresh paper and light pressure

- Takes paint and superglue normally

If heat is the problem, this is not the answer

People reach for Tough+ when a PLA part failed, but the two common failures need different fixes: a part that broke needs Tough+; a part that warped needs PETG, ASA or an annealed high-temperature PLA.

What PLA actually is

PLA stands for polylactic acid. It is a polyester made by fermenting plant sugars — usually corn starch or sugarcane — into lactic acid and then linking those molecules into long chains. That plant origin is why PLA is often described as a bioplastic: the carbon in it was recently in a field, not in an oil well. It is the most widely used material in desktop 3D printing for a practical reason: it melts at a low temperature, barely shrinks as it cools, and therefore prints reliably on almost any machine without an enclosure.

Its two well-known limits follow from the same chemistry. PLA is a semi-crystalline polymer with a glass transition around 55–60 °C, so it starts to soften at temperatures a car dashboard or a sunny windowsill can reach. And although it is compostable in principle, that only happens in an industrial composting plant at around 60 °C with the right microbes; in a garden heap, in soil or in the sea it behaves like any other plastic for many years. Printed PLA should go into general waste or a dedicated 3D-print recycling stream, not the organic bin. Every variant in this series is a PLA base with something changed — a filler, a pigment system, an additive package or a foaming agent — and each guide explains what that change does to the material's behaviour.

3 · How it is printed

Tough+ prints on standard hardware but runs 20–30 °C hotter than PLA Basic, which brings more odour, and its strong layer bonding works against you when removing supports. The manufacturer publishes complete drying figures, including for the in-AMS dryers.

Manufacturer print window

Nozzle temperature	220–250 °C
Bed temperature	35–65 °C
Build plates	Textured PEI, Smooth PEI, Cool Plate SuperTack
Bed adhesive	Glue stick or liquid glue
Chamber	25–45 °C, no enclosure
Print speed	Up to 300 mm/s
Part cooling fan	On
Retraction	0.6–1.0 mm at 20–40 mm/s
Max overhang without support	About 55°
Max unsupported bridge	About 30 mm
Support material	A dedicated support filament (Support for PLA / PLA-PETG) is strongly advised; same-material supports fuse to the part

Hardware and compatibility

Nozzle sizes	0.2, 0.4, 0.6 and 0.8 mm
Nozzle material	Any; hardened steel not required
Abrasive	No
Automatic material systems	Compatible with AMS, AMS lite, AMS 2 Pro and AMS HT
Spool identification	RFID (reads as PLA Tough)
Ventilation	Print in a ventilated room; the higher temperature releases more odour than PLA Basic

Moisture, drying and storage

Tough+ has the lowest moisture uptake of any PLA in the range, but the impact modifier makes it sensitive to what little it absorbs — wet Tough+ strings and loses toughness. Drying figures are fully published.

Forced-air oven or filament dryer	55 °C for 8 hours
Heated print bed method	65–75 °C for 12 hours, covered
AMS 2 Pro / AMS HT	55 °C for 8 hours
Storage	Sealed with desiccant, below 20 % relative humidity
Annealing (optional)	50–60 °C for 6–12 hours; may warp

Tips that make a visible difference

- Use a dedicated support filament for any interface you care about; if you must use Tough+ for supports, raise the top Z-gap and reduce interface density
- Start at 235 °C; go higher for layer strength, lower for sharper detail and less odour
- For parts loaded across layers, add walls rather than infill — the Z tensile figure is the weak one
- A textured PEI plate at 55–60 °C removes most adhesion questions

Known problems and their fixes

Supports will not come off cleanly

Same-material supports fuse. Switch to a dedicated support filament, or increase the support Z-distance and use a lower interface density.

Noticeable smell while printing

Expected at 220–250 °C. Ventilate; do not print at the low end of the window to reduce it, as layer strength suffers.

Part is not as strong as expected in a slow pull

Tough+ is tough, not strong: its Z tensile strength is below PLA Basic. Orient the load along the layers or choose PLA Basic / PETG.

Stringing

Wet filament — the modifier is moisture-sensitive. Dry at 55 °C for 8 hours.

Part sags under sustained load

Lower stiffness. Thicken the section or add ribs.

4 · The numbers — technical datasheet

Figures are from the PLA Tough+ Technical Data Sheet V3.0 (product name on the sheet: PLA Tough). One label on the sheet appears to be a typographical error and is flagged below.

Physical and thermal properties

Property	Test method	Value
Density	ISO 1183	1.21 g/cm ³
Melt flow index (210 °C, 2.16 kg)	ISO 1133	18.0 ± 2.5 g/10 min
Melting temperature	DSC, 10 °C/min	151 °C
Glass transition temperature	DSC, 10 °C/min	61 °C
Vicat softening temperature	ISO 306	62 °C
Heat deflection temperature, 0.45 MPa	ISO 75	61 °C
Heat deflection temperature, 1.8 MPa	ISO 75	58 °C
Saturated water absorption (25 °C, 55 % RH)	—	0.27 %

Mechanical properties

Property	Test method	X-Y (flat)	Z (across layers)
Young's modulus	ISO 527	1860 ± 70 MPa	1920 ± 20 MPa
Tensile strength	ISO 527	34.9 ± 1 MPa	20.9 ± 1 MPa
Elongation at break	ISO 527	5.1 ± 0.6 %	10.4 ± 2 %
Bending modulus	ISO 178	2140 ± 80 MPa	2066 ± 100 MPa
Bending strength	ISO 178	65 ± 1 MPa	54 ± 4 MPa
Charpy impact, unnotched	ISO 179	80.6 ± 9.5 kJ/m ²	25.9 ± 3.3 kJ/m ²
Charpy impact, notched	ISO 179	72.3 ± 6.1 kJ/m ²	18.6 ± 2.3 kJ/m ² ¹

¹ The datasheet labels the second Z impact value "(Silver)" where the X-Y row says "(notched)"; two independent copies of the sheet carry the same label. It is presumed to mean notched.

What the mechanical numbers mean in practice

The impact row is the whole story. An unnotched Charpy of 80.6 kJ/m² is three times PLA Basic, and — unusually — the notched figure of 72.3 kJ/m² is almost as high, which means a scratch or a sharp corner barely weakens it. That notch-insensitivity is exactly the property you want in a part that gets abused. Everything else is a modest step down from PLA Basic: stiffness about 28 % lower, bending strength 15 % lower, and Z tensile strength only 60 % of the flat value. The elongation numbers are odd — lower flat than across layers — and hint at how differently the modifier behaves in a slow pull compared with a hammer blow. Thermal figures are ordinary PLA; if anything, Tough+ has a marginally higher HDT than PLA Basic, but not enough to matter.

Product format

Diameter	1.75 mm ± 0.03 mm
Net weight	1 kg

Spool	ABS, 200 × 67 mm, rated to 70 °C
Colours	7: Black, White, Gray, Silver, Cyan, Orange, Yellow
Identification	RFID tag
Datasheet version	V3.0

Safety, certifications and chemical resistance

- Declared composition polylactic acid (impact modifier not named); odourless at rest, noticeable odour when printing at 220–250 °C — ventilate
- Flammable; combustion products water and carbon oxides
- RoHS and REACH compliance stated across the filament line
- No food-contact or toy certification
- Resistant to oils and greases; not to acids, alkalis or some organic solvents

5 · Compared with Polymaker and SUNLU

Toughened PLA is a category every brand serves, and it is the one where the published numbers diverge most — partly because the brands use different impact tests. Polymaker's PolyMax PLA is the long-standing benchmark; SUNLU's PLA+ 2.0 and PLA Meta are the budget contenders.

Polymaker

PolyMax PLA (Tough PLA) · also PolySonic PLA Pro, Polymaker PLA Pro

PolyMax publishes the highest notched Charpy in this entire comparison, 38.9 kJ/m², alongside a tensile strength of 41 MPa and — notably — the best layer retention of any Polymaker PLA (Z tensile 78 % of flat, against 60 % for Tough+). CNC Kitchen's independent test measured PolyMax at roughly 20 kJ/m² and four times tougher than PolyLite in a drop test, with a 25 % strength penalty; that is the same shape of trade-off as Tough+. Bambu's unnotched 80.6 and notched 72.3 kJ/m² cannot be set directly against PolyMax's notched 38.9 because the specimen preparation differs, but both sit in the same toughened class.

Tensile X-Y / Z	41.3 / 32.4 MPa
Young's modulus X-Y	2151 MPa
Elongation X-Y / Z	5.7 / 4.7 %
Charpy notched X-Y	38.9 ± 2.4 kJ/m²
HDT 0.45 / 1.8 MPa	55 / 52 °C
Nozzle / bed	190–230 °C / 25–60 °C
Drying	55 °C, 6 h
Spool	cardboard, 1 kg

SUNLU

SUNLU PLA+ 2.0 · PLA Meta

SUNLU quotes PLA+ 2.0 at 46 MPa tensile with a notched Izod of 10 kJ/m² and markets it as two to three times tougher than standard PLA — a multiple that cannot be checked because SUNLU publishes no impact figure for its standard PLA. PLA Meta trades a little toughness (6.5 kJ/m² Izod) for a higher tensile figure and prints unusually cool. Izod and Charpy are different tests; neither SUNLU number is comparable to the Bambu or Polymaker Charpy values. SUNLU's advantages are price and refill availability.

Tensile (PLA+ 2.0)	46 ± 5 MPa
Elongation (PLA+ 2.0)	10 ± 2.5 %
Bending (PLA+ 2.0)	83 ± 5 MPa
Izod notched (PLA+ 2.0)	10 ± 3 kJ/m²
HDT (PLA+ 2.0)	56 ± 3 °C
Nozzle / bed	205–245 °C / 50–60 °C
MFI (PLA+ 2.0)	8.3 ± 2 g/10 min
Formats	cardboard spool, refill, master spool

Reading cross-brand numbers fairly

Manufacturer datasheets are produced by different labs on different printers, and two numbers are comparable only when the test standard, specimen orientation and impact method match. Charpy and Izod impact results are not interchangeable; notched and unnotched results differ by a factor of three or more; and Polymaker publishes Z-direction data where SUNLU publishes none. Treat cross-brand figures as an indication of class, not a ranking. Where a brand's marketing claim is not backed by its own datasheet, this guide says so.

Bottom line. For impact resistance on Bambu hardware with RFID profiles, Tough+ delivers what it promises. For a toughened PLA with better layer strength in a slow pull and the most credible independent test record, PolyMax is the stronger all-rounder. SUNLU PLA+ 2.0 is the value pick when the numbers matter less than the price.

How to read the datasheet

X-Y vs Z	A 3D print is a stack of layers. X-Y describes a test bar printed lying flat, where the load runs along the extruded lines. Z describes a bar printed standing up, where the load tries to pull the layers apart. Z values are always lower, and the ratio between them tells you how well the layers have fused. Real parts fail along layer lines far more often than through them.
Tensile strength (MPa)	The stress at which a bar pulled from both ends breaks. Megapascals are newtons per square millimetre: a 10 mm × 10 mm cross-section of a 35 MPa material holds roughly 3.5 kN, about 350 kg, before it snaps in a slow pull.
Young's modulus (MPa)	Stiffness — how much force it takes to stretch the material by a given amount. Higher means more rigid. It says nothing about strength: a stiff material can still be brittle.
Elongation at break (%)	How far the bar stretched before it broke, as a percentage of its original length. Low values (under 5 %) mean the material snaps with little warning; higher values mean it yields and bends first.
Bending (flexural) strength and modulus	The same two ideas measured by pressing down on the middle of a bar supported at both ends — closer to how brackets, clips and shelves are actually loaded.
Charpy impact (kJ/m²)	A pendulum hammer strikes the bar; the energy it absorbs before breaking is divided by the fracture area. This is the best single indicator of toughness — resistance to drops and knocks. Unnotched bars measure the bulk material; notched bars have a small cut that concentrates stress and give much lower numbers. Never compare a notched figure with an unnotched one, or a Charpy figure with an Izod one (a different test geometry).
Glass transition, T_g (°C)	The temperature at which the polymer's chains gain enough mobility for it to change from glassy and rigid to leathery and soft. Above T _g a loaded part will slowly creep and deform. For PLA and PETG this is the single most important thermal number.
Heat deflection temperature, HDT (°C)	The temperature at which a bar under a fixed bending load sags by a set amount. Quoted at 0.45 MPa (light load) and 1.8 MPa (heavy load); the light-load figure is always the higher of the two. Practical rule: keep loaded parts well below the 0.45 MPa figure.
Vicat softening point (°C)	The temperature at which a needle under load penetrates 1 mm into the material. Another measure of when the surface stops being hard.

Melting temperature, T_m (°C)	Where the crystalline regions melt, measured by DSC (a calorimeter). Printing happens well above T _m so the polymer flows freely.
Melt flow index, MFI (g/10 min)	How much molten material flows through a standard die in ten minutes under a fixed weight (210 °C for PLA; PETG sheets use 210–250 °C, so compare only at equal temperature). Higher means runnier and easier to push at speed; lower means more viscous, which is why some variants have lower speed limits.
Water absorption (%)	How much moisture the filament takes up from air at 55 % relative humidity. Absorbed water boils in the nozzle, causing pops, bubbles, stringing and rough surfaces — hence the drying recommendations.
Density (g/cm³)	Mass per volume. A 1 kg spool of a 1.31 g/cm ³ material contains about 5 % less printable length than a 1 kg spool at 1.24 g/cm ³ — heavier fillers cost you metres.
Annealing	Baking a finished print at a temperature just above T _g to let it crystallise further. It can raise heat resistance and stiffness but usually shrinks and sometimes warps the part.

Data notes and sources

Where sources disagree

- Independent testing (My Tech Fun, reported by Hackaday, September 2025) found PLA Tough+ worse than Bambu's own PLA Basic on tensile, layer adhesion and other static tests, with an advantage only in impact, and did not reproduce the doubled layer-adhesion claim.
- The datasheet lists the product as PLA Tough; the store sells it as PLA Tough+. Same product.
- The ABS comparison in the marketing refers to impact toughness only; the HDT of Tough+ (58 °C at 1.8 MPa) is far below ABS.

Sources

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