

// MATERIAL · BAMBU LAB · FDM

# TPU 95A HF

The rubber of 3D printing: a flexible filament that bends, squashes and bounces back — printed slowly, dried always, and never sanded. Covers Bambu Lab's whole TPU family, with the 95A HF grade as the reference.

|                              |                                                                                                                      |
|------------------------------|----------------------------------------------------------------------------------------------------------------------|
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# TPU 95A HF

The rubber of 3D printing: a flexible filament that bends, squashes and bounces back — printed slowly, dried always, and never sanded. Covers Bambu Lab's whole TPU family, with the 95A HF grade as the reference.

## 1 · In plain words

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## 3 · How it is printed

## 4 · The numbers

## 5 · Compared with other brands

Everything else in this series is a hard plastic; TPU is a rubber. A printed TPU part flexes, compresses, stretches and returns to shape, grips instead of sliding, and survives drops that would shatter anything else here. It is the material for phone-case-style sleeves, gaskets, bumpers, feet, straps, flexible hinges and anything that has to be gentle on what it touches. TPU is sold by hardness rather than strength — the Shore number on the label — and this guide takes the manufacturer's 95A HF as its reference: the classic tyre-like flexibility, in a high-flow formulation that prints about three times faster than older 95A grades. The firmer TPU for AMS (68D), and the softer 85A and 90A grades, are covered in their own table further on. Printing TPU is slower and fussier than printing PLA — it must be dry, it strings, it needs glue on the bed, most of it cannot go through an automatic material system, and the surface that comes off the printer is final because TPU cannot be sanded.

### FEELS LIKE

#### Firm rubber

95A: like a car tyre or a shoe sole; bends easily in thin sections, resists in thick ones

### THE POINT

#### It flexes and survives

Stretches to more than six times its length before breaking; impact off the scale

### HARDNESS CHOICES

#### 85A · 90A · 95A · 68D

Softer to firmer; only the 68D grade runs through the AMS

### HEAT

#### Modest

No deflection temperature published; softens progressively, melts around 180 °C

### COLOUR RANGE

#### 6 colours

White, Black, Gray, Red, Blue, Yellow

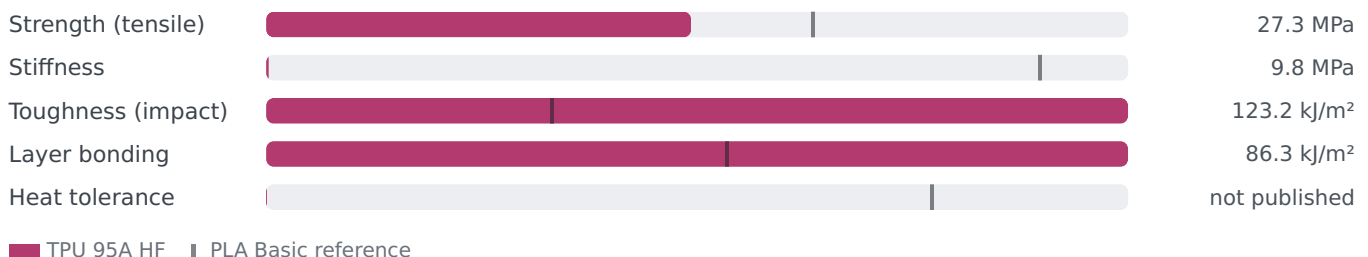
### EASE OF PRINTING

#### Hardest in the series

Slow, dry, glue on the bed, external spool; 12 mm<sup>3</sup>/s flow limit

## Where it sits in the range

TPU is a rubber, so this chart is deliberately lopsided: stiffness reads as almost nothing, impact toughness runs off the top of the scale, and heat tolerance is not published as a deflection temperature. 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).



### Good for

- Protective sleeves, bumpers and corner guards for devices and furniture
- Gaskets, seals, grommets and vibration dampers
- Feet, pads, grips and anti-slip inserts
- Straps, watch bands, flexible tags and keyring loops
- Living hinges, snap covers and parts that must flex thousands of times
- Wheels, tyres and rollers for models and small machines

### Not the right choice for

- Anything that must hold a precise shape under load — it creeps and sags
- Sharp detail, crisp edges and small text
- Long unsupported bridges and steep overhangs
- Automatic material systems — only the 68D grade is cleared; 95A and softer must be fed externally
- Food contact and hot environments; no certification, low heat tolerance
- Any part you intend to sand, polish or paint smooth

## Reading a TPU datasheet: Shore hardness and why the numbers look strange

Rigid-plastic figures do not describe a rubber well, so a TPU sheet reads oddly. Young's modulus is 9.8 MPa — a few hundredths of PLA's — because the material stretches under almost no force; that is the point. Tensile strength (27 MPa) is reached only after the bar has stretched to more than six times its length, so a TPU part is effectively unbreakable in normal use but also cannot hold a load without deforming. Impact toughness of 123 kJ/m<sup>2</sup> means the test hammer barely damaged it. Heat deflection temperature is not published because a rubber sags under the test load at any temperature. What matters instead is the Shore number: the manufacturer orders its range 68D (firmest) > 95A > 90A > 85A (softest), and states that grades of 95A and softer are too flexible to feed reliably through the AMS or AMS lite, where they buckle and jam. The 68D grade is firm enough to feed and is the one exception. Softness also changes what infill does: a 95A part at 20 % infill feels far softer than the same part solid, so hardness in the hand is a design choice as much as a material one.

## 2 · Living with a TPU 95A HF print

A TPU part is the most forgiving object in this series to live with and the least forgiving to keep pristine: it will not break, but it scuffs, attracts dust and cannot be refinished.

|                |                                                                                                                                                                                                                                               |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Heat           | No deflection temperature is published; the material softens progressively above room temperature and melts around 180 °C. Keep out of parked cars and away from radiators — a warm TPU part deforms under its own weight and stays deformed. |
| Cold           | Stays flexible in a household freezer; low-temperature limits are not published by the manufacturer.                                                                                                                                          |
| Sunlight       | Not published by Bambu Lab. Polymaker states TPU is not inherently UV-stable and adds stabilisers to some grades; SUNLU advises storing away from sunlight because it yellows. Assume slow yellowing and stiffening outdoors.                 |
| Water and damp | Insoluble and unaffected in use; the filament, not the printed part, is what must stay dry.                                                                                                                                                   |
| Chemicals      | Resistant to most oils, greases and fuels — the classic reason to choose TPU for grips and seals. Not resistant to acids or alkalis; only partially resistant to organic solvents; ketones such as acetone attack it.                         |
| Food           | No food-contact certification from any of the three brands; Polymaker states its TPU is unsuitable for kitchenware without certification.                                                                                                     |

|              |                                                                                                                                                                                                   |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Skin contact | The datasheet lists no skin hazard, and TPU is the polymer of watch straps and phone cases. Polymaker's TPU90 additionally passes ISO 10993 skin-contact tests; Bambu Lab publishes no such test. |
| Wear         | Abrasion-resistant — it outlasts rigid plastics as a wheel or a foot — but its surface picks up dust and scuffs to a dull sheen.                                                                  |
| End of life  | General waste or 3D-print recycling. Not compostable, not accepted in household recycling.                                                                                                        |

## Looks and feel

A satin to semi-gloss surface with visible layer lines and, unless printed very carefully, fine hairs and wisps of stringing between features. Colours are opaque and slightly muted. Thin walls are translucent at the edges. The as-printed surface is the final surface.

## Care

- Wash with soapy water; scrub gently — dust embeds in the surface
- Remove printing hairs with a quick pass of a hot-air gun or a lighter flame, never a blade
- Do not sand or polish; abrasives tear the surface rather than smooth it
- Glue with a flexible cyanoacrylate or a polyurethane adhesive; rigid superglue cracks off
- Keep away from heat and long-term sun

### Which hardness for which job

85A: squeeze toys, soft seals, phone-case edges. 90A: grips, straps, bumpers. 95A: tyres, feet, hinges, most functional flexible parts. 68D (TPU for AMS): stiff-flexible — tool holders, belt clips, cases that must hold shape — and the only one that feeds through the material system.

## What TPU actually is

TPU is thermoplastic polyurethane — the material of phone cases, shoe soles and the soft grips on tools. Chemically it is a chain of alternating hard and soft segments: the hard segments lock together like tiny crystals and hold the shape, the soft segments between them stretch and recover like rubber. Change the ratio and you change the hardness, which is why TPU is sold by Shore number rather than by strength: 85A is squashy like a pencil eraser, 95A like a car tyre, and the D-scale grades like a hard shoe sole. A printed TPU part bends, twists, compresses and springs back, absorbs a drop that would shatter PLA, and grips surfaces instead of sliding on them.

Its habits all follow from being soft. The filament itself is floppy, so it buckles between the extruder gear and the nozzle if pushed too fast — printing is slow, and a direct-drive extruder helps. The melt is elastic and does not retract cleanly, so TPU strings between features. It is markedly hygroscopic: a day in room air is enough to make it bubble and string, so it is dried before every print and kept sealed. It bonds fiercely to a smooth print bed, so glue goes down as a release layer. And because it is tough and elastic it cannot be sanded or polished — abrasive paper tears at it rather than cutting it — so what comes off the printer is the finished surface. TPU is not compostable and not accepted in household recycling; printed parts go to general waste or a dedicated 3D-print stream.

## 3 · How it is printed

TPU printing is about controlling a soft, sticky, elastic melt. The manufacturer's window for 95A HF is below; the other grades differ mainly in speed, nozzle size and feed path, and are tabulated after it. The universal rules: dry it, feed it from the external spool holder (except 68D), glue the bed, keep the bed cool, keep speeds and travel moves down, and print one object at a time.

## Manufacturer print window

|                              |                                                                                                                                                          |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nozzle temperature           | 220–240 °C (specimens printed at 230 °C)                                                                                                                 |
| Bed temperature              | 30–35 °C — cool, or the part welds itself to the plate                                                                                                   |
| Build plates                 | Cool Plate, Engineering Plate, High-Temperature Plate, Textured PEI — always with glue                                                                   |
| Bed adhesive                 | Glue stick or liquid glue required — as a release layer; TPU over-adheres to bare PEI                                                                    |
| Chamber                      | 25–45 °C; enclosure optional                                                                                                                             |
| Print speed                  | Up to 200 mm/s on paper; the 12 mm <sup>3</sup> /s volumetric limit is what actually governs — roughly 60–100 mm/s at 0.2 mm layers with a 0.4 mm nozzle |
| Max volumetric flow          | 12 mm <sup>3</sup> /s                                                                                                                                    |
| Part cooling fan             | On; 50–100 %                                                                                                                                             |
| Retraction                   | 0.8–1.4 mm at 20–40 mm/s — short; long retractions pull the elastic filament back and cause jams                                                         |
| Max overhang without support | About 55°                                                                                                                                                |
| Max unsupported bridge       | About 20 mm                                                                                                                                              |
| Support                      | Use sparingly; same-material supports fuse to the part, and interfaces are hard to remove from rubber                                                    |
| Print order                  | By object, to minimise travel moves and stringing                                                                                                        |

## Hardware and compatibility

|                            |                                                                                                                                                                                                                                                        |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nozzle sizes               | 0.4, 0.6 and 0.8 mm; 0.2 mm not compatible                                                                                                                                                                                                             |
| Nozzle material            | Hardened or stainless steel; not abrasive                                                                                                                                                                                                              |
| Abrasive                   | No                                                                                                                                                                                                                                                     |
| Automatic material systems | TPU 95A HF: NOT compatible with AMS or AMS lite — external spool holder only. The printer refuses it if loaded in the AMS. TPU 85A / 90A: the same, plus manual loading; AMS HT accepts manual loading. TPU for AMS (68D): AMS and AMS lite compatible |
| Extruder                   | Direct-drive (all Bambu printers) is what makes TPU workable; Bowden machines must print far slower                                                                                                                                                    |
| Spool identification       | RFID tag                                                                                                                                                                                                                                               |
| Spool                      | PC + ABS, rated to 90 °C — so it survives the 70 °C drying cycle                                                                                                                                                                                       |

## Moisture, drying and storage

TPU is the most hygroscopic material in this series: saturated uptake of 1.1–1.2 %, three times PLA. The manufacturer describes 95A HF as highly sensitive to humidity and states that a dried spool can start degrading print quality within 2–12 hours at ordinary room humidity. Wet TPU shows as stringing, holes, rough surfaces, popping and weak parts. Dry before every session and print from a dry box or with desiccant beside the spool.

|                                   |                   |
|-----------------------------------|-------------------|
| Forced-air oven or filament dryer | 70 °C for 8 hours |
|-----------------------------------|-------------------|

|                           |                                                                                                       |
|---------------------------|-------------------------------------------------------------------------------------------------------|
| Heated print bed method   | 80–90 °C for 12 hours, covered (85A / 90A: 90 °C for 16 hours, turned every 4 hours)                  |
| AMS HT (85A / 90A preset) | 75 °C for 18 hours — the manufacturer has not explained why this differs from the oven figure         |
| Storage                   | Sealed with desiccant, below 20 % relative humidity; dry box during long prints                       |
| Spool note                | The 85A / 90A spools swell by about 4 mm in width after drying; check they still fit a sealed dry box |
| Annealing                 | Not recommended for complex geometries; TPU gains little from it                                      |

## Bambu Lab's TPU grades side by side

Manufacturer datasheet values; X-Y direction unless stated. Impact figures are Charpy ISO 179 with the notch state not stated on the sheets. "—" means not published.

| Property                           | TPU 85A                                     | TPU 90A                                     | TPU 95A HF (this guide)         | TPU for AMS (68D)         |
|------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------|---------------------------|
| Shore hardness                     | 85A (softest)                               | 90A                                         | 95A                             | 68D (firmest)             |
| Density (g/cm³)                    | 1.18                                        | 1.24                                        | 1.22                            | 1.26                      |
| Melt flow index (210 °C, g/10 min) | 8.76                                        | 9.36                                        | 36.5                            | 21.8                      |
| Melting temperature (°C)           | 177                                         | 180                                         | 183                             | 183                       |
| Water absorption (%)               | 0.67                                        | 0.61                                        | 1.08                            | 1.20                      |
| Young's modulus X-Y / Z (MPa)      | 6.8 / 5.2                                   | 5.3 / 4.4                                   | 9.8 / 7.4                       | 1190 / 600                |
| Tensile strength X-Y / Z (MPa)     | 12.0 / 10.5                                 | 12.5 / 10.1                                 | 27.3 / 22.3                     | 22.4 / 11.2               |
| Elongation at break X-Y / Z        | > 700 % / > 350 %                           | > 650 % / > 350 %                           | > 650 % / > 480 %               | > 650 % / 31 %            |
| Charpy impact X-Y / Z (kJ/m²)      | 124.3 / 88.5                                | 124.2 / 87.3                                | 123.2 / 86.3                    | 124.3 / 9.6               |
| Nozzle temperature (°C)            | 200–250                                     | 200–250                                     | 220–240                         | 220–240                   |
| Bed temperature (°C)               | 30–35                                       | 30–35                                       | 30–35                           | 30–35                     |
| Max speed / volumetric flow        | < 200 mm/s                                  | < 200 mm/s                                  | < 200 mm/s · 12 mm³/s           | < 250 mm/s · 18 mm³/s     |
| Retraction                         | 0.4–0.8 mm @ 10–30 mm/s                     | 0.4–0.8 mm @ 10–30 mm/s                     | 0.8–1.4 mm @ 20–40 mm/s         | 0.8–1.4 mm @ 20–40 mm/s   |
| Nozzle sizes                       | 0.6 / 0.8 only                              | 0.4 / 0.6 / 0.8                             | 0.4 / 0.6 / 0.8                 | 0.4 / 0.6 / 0.8           |
| Max overhang / bridge              | ≈ 40° / 10 mm                               | ≈ 40° / 10 mm                               | ≈ 55° / 20 mm                   | ≈ 70° / 20 mm             |
| AMS / AMS lite                     | not compatible (manual load; AMS HT manual) | not compatible (manual load; AMS HT manual) | not compatible — external spool | compatible                |
| Drying (oven / bed)                | 70 °C 8 h / 90 °C 16 h                      | 70 °C 8 h / 90 °C 16 h                      | 70 °C 8 h / 80–90 °C 12 h       | 70 °C 8 h / 80–90 °C 12 h |
| Price per kg (US store)            | from \$41.99                                | from \$41.99                                | \$41.99                         | \$38.99                   |
| Datasheet version                  | V1.0                                        | V1.0                                        | V1.0                            | V1.0                      |

## Tips that make a visible difference

- Feed 95A and softer from the external spool holder; only the 68D grade goes in the AMS
- Think in volumetric flow, not speed: 12 mm³/s is the ceiling for 95A HF, 18 mm³/s for 68D — the slicer's speed limit follows from that

- Glue every time and keep the bed at 30–35 °C; if a part still will not release, a spray of isopropyl alcohol at the edge loosens it
- Print by object; every travel move across open air leaves a hair
- Soft grades (85A / 90A) will not push through a Bowden tube — load them by hand with the hotend already at temperature
- For a firmer feel without changing material, raise infill; for a softer one, lower it and use gyroid
- Remove hairs afterwards with hot air rather than trying to eliminate every one in the slicer

### Not through the AMS

The manufacturer's rule: TPU of 95A and softer is too flexible for the AMS and AMS lite — it bends in the feed path and causes loading failures and clogs — and the printer will refuse 95A HF loaded there. The 68D "TPU for AMS" grade is the one TPU designed to pass. On the H2D, 85A and 90A additionally need manual loading and the right-hand hotend.

## Known problems and their fixes

### Stringing, hairs and wisps everywhere

Moisture first — dry at 70 °C for 8 hours and print from a dry box. Then: print by object, reduce travel, keep retraction short (0.8–1.4 mm), and finish with hot air.

### Filament buckles or jams in the extruder

Pushed too fast, or too long a retraction, or a soft grade in a Bowden path. Lower the volumetric limit, shorten retraction, feed externally, and for 85A / 90A load manually with the hotend hot.

### Bubbles, holes, rough surface, weak part

Wet filament — TPU shows it within hours. Dry and store sealed.

### Part welded to the plate; plate coating damaged

No glue or bed too hot. Glue as a release layer, 30–35 °C bed, isopropyl spray to release.

### Loading error or jam in the AMS

Wrong grade for the AMS. Only 68D is cleared; move 95A and softer to the external holder.

### Droopy bridges and overhangs

Inherent — TPU bridges poorly (20 mm maximum, 10 mm for soft grades). Design them out or support them.

### Supports will not come off

Same-material supports fuse to rubber. Increase Z gap and reduce interface density, or design to avoid supports.

### Surface cannot be smoothed

Expected. TPU does not sand; the as-printed surface is final.

## 4 · The numbers — technical datasheet

Reference figures are from the Bambu Lab TPU 95A HF Technical Data Sheet V1.0 (specimens printed at 230 °C / 35 °C bed / 140 mm/s, 100 % infill, annealed 70 °C for 12 hours). TPU sheets omit glass transition, Vicat and heat deflection temperature, and do not state whether impact bars were notched. The other Bambu grades are tabulated in the printing section from their own V1.0 / V2.0 sheets.

### Physical and thermal properties

| Property       | Test method            | Value |
|----------------|------------------------|-------|
| Shore hardness | stated in product name | 95A   |

| Property                                    | Test method    | Value                                       |
|---------------------------------------------|----------------|---------------------------------------------|
| Density                                     | ISO 1183       | 1.22 g/cm <sup>3</sup>                      |
| Melt flow index (210 °C, 2.16 kg)           | ISO 1133       | 36.5 ± 2.6 g/10 min                         |
| Melting temperature                         | DSC, 10 °C/min | 183 °C                                      |
| Glass transition temperature                | DSC            | not published                               |
| Vicat softening temperature                 | ISO 306        | not published                               |
| Heat deflection temperature                 | ISO 75         | not published (not meaningful for a rubber) |
| Saturated water absorption (25 °C, 55 % RH) | —              | 1.08 %                                      |

## Mechanical properties

| Property                                  | Test method | X-Y (flat)              | Z (across layers)      |
|-------------------------------------------|-------------|-------------------------|------------------------|
| Young's modulus                           | ISO 527     | 9.8 ± 0.7 MPa           | 7.4 ± 0.6 MPa          |
| Tensile strength                          | ISO 527     | 27.3 ± 0.8 MPa          | 22.3 ± 0.6 MPa         |
| Elongation at break                       | ISO 527     | > 650 %                 | > 480 %                |
| Bending modulus                           | ISO 178     | not published           | not published          |
| Bending strength                          | ISO 178     | not published           | not published          |
| Charpy impact (notch state not stated)    | ISO 179     | 123.2 kJ/m <sup>2</sup> | 86.3 kJ/m <sup>2</sup> |
| Tear strength / compression set / rebound | —           | not published           | not published          |

Bending tests are not meaningful for a material this soft and are omitted from the manufacturer's sheet.

## What the mechanical numbers mean in practice

The two numbers that describe TPU 95A HF are 9.8 MPa (modulus) and > 650 % (elongation): it deforms under a fingertip and stretches to more than six times its length before it finally breaks at 27 MPa — a load it will never see in a printed part, because the part will have deformed out of usefulness long before. Impact toughness of 123 kJ/m<sup>2</sup> means the test hammer bounced. Layer bonding is excellent: Z tensile is 82 % of flat and Z elongation still exceeds 480 %, so a TPU part rarely fails along a layer. Compare the 68D grade in the table: forty times stiffer, half the flat toughness in Z, and only 31 % Z elongation — a different material in all but name, and the reason it is the one that feeds through the AMS.

## Product format

|                |                                                                                   |
|----------------|-----------------------------------------------------------------------------------|
| Diameter       | 1.75 mm ± 0.03 mm (tolerance from reseller listing; not printed on the datasheet) |
| Net weight     | 1 kg                                                                              |
| Spool          | PC + ABS, 200 × 67 mm, rated to 90 °C; reusable                                   |
| Colours        | 6: White, Black, Gray, Red, Blue, Yellow                                          |
| Price          | \$41.99 / £38.99 per kg (US / UK stores)                                          |
| Identification | RFID tag                                                                          |

## Safety, certifications and chemical resistance

- Declared composition TPU; odourless; no skin hazard listed; stable under normal handling
- Flammable; combustion products water, carbon oxides and nitrogen oxides. The older TPU 95A sheet described the material as self-extinguishing; the current sheets say flammable — the current wording is followed
- RoHS and REACH compliance stated across the filament line
- No food-contact certification; no skin-contact test (ISO 10993) published by Bambu Lab
- Not resistant to acids or alkalis; partially resistant to organic solvents; resistant to most oils and greases; insoluble in water
- Not published: UV resistance, low-temperature flexibility, abrasion test values, emissions

## 5 · Compared with Polymaker and SUNLU

Flexible filament is a category where the brands differ in print window and format more than in the material itself. Polymaker's PolyFlex family is the long-standing reference; SUNLU's TPU is the budget option with a surprising amount of published data.

### Polymaker

PolyFlex TPU95 · PolyFlex TPU95-HF · PolyFlex TPU90

Polymaker tests its TPU to rubber standards (ISO 37 tensile, ISO 7619 hardness), which makes its figures closer to how the material behaves: TPU95 gives 11 MPa stress at 100 % strain and 551 % elongation; TPU95-HF is the high-flow counterpart to Bambu's, prints at 30–100 mm/s even on Bowden machines, and carries UV stabilisers; TPU90 is the soft grade and the only TPU here with ISO 10993 skin-contact testing. All need 70 °C drying, all use much longer retractions than Bambu recommends (3–6 mm), and Polymaker advises against any of them in an AMS. TPU95 ships in 750 g spools.

|                                      |                                               |
|--------------------------------------|-----------------------------------------------|
| TPU95: Shore / density               | 95A (ISO 7619) / 1.20–1.24                    |
| TPU95: modulus (ISO 37) / elongation | 33.6 MPa / 551 %                              |
| TPU95-HF: tensile / elongation       | 26.6 MPa / 496 %                              |
| TPU90: tensile / elongation          | 30.1 MPa / 592 %                              |
| Nozzle / bed                         | 200–230 °C / 25–60 °C                         |
| Speed                                | 30–50 (95) · 30–100 (95-HF) · 30–70 (90) mm/s |
| Drying                               | 70 °C, 8 h                                    |
| Spool                                | 750 g (TPU95) · 1 kg (95-HF)                  |

### SUNLU

SUNLU TPU 95A (also sold as High Speed 95A) · TPU 90A

SUNLU's 95A publishes a high melt flow (28 g/10 min at 190 °C), 31 MPa tensile, over 900 % elongation and a notched Izod of 47 kJ/m<sup>2</sup>, with a cooler print window (190–230 °C) and a warm bed (50–60 °C) — the opposite of Bambu's cool-bed advice. Its 90A sheet gives an HDT of 36 °C, the only published heat figure for any TPU here. No AMS or extruder guidance, tight  $\pm 0.02$  mm tolerance, and the lowest price — but a 3 kg minimum order on the direct store. Several values on SUNLU's 90A product page contradict its own datasheet and are ignored.

|                           |                                          |
|---------------------------|------------------------------------------|
| 95A: Shore / density      | 95 (ISO 868) / 1.21                      |
| 95A: tensile / elongation | 31 $\pm$ 3 MPa / > 900 %                 |
| 95A: Izod notched         | 47 $\pm$ 5 kJ/m <sup>2</sup>             |
| 90A: HDT 0.45 MPa         | 36 $\pm$ 2 °C                            |
| Nozzle / bed              | 190–230 °C / 50–60 °C                    |
| Speed                     | 50–120 mm/s (95A) · $\leq$ 40 mm/s (90A) |
| Drying                    | 50–60 °C (no time stated)                |
| Diameter / MOQ            | 1.75 $\pm$ 0.02 mm / 3 kg                |

### 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.** On Bambu hardware the choice is really between 95A HF fed externally and 68D through the AMS. Polymaker's PolyFlex range is the pick for softer grades, skin-contact applications and UV-stabilised outdoor parts, at a higher price and with much longer retraction settings. SUNLU is the value option with the fullest rubber-style datasheet and the least printing guidance.

## How to read the datasheet

|                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>X-Y vs Z</b>                                | 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.                                                           |
| <b>Tensile strength (MPa)</b>                  | 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.                                                                                                                                                                                                                   |
| <b>Young's modulus (MPa)</b>                   | 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.                                                                                                                                                                                                                                                                  |
| <b>Elongation at break (%)</b>                 | 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.                                                                                                                                                                                                                                            |
| <b>Bending (flexural) strength and modulus</b> | 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.                                                                                                                                                                                                                                                                                     |
| <b>Charpy impact (kJ/m<sup>2</sup>)</b>        | 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). |
| <b>Glass transition, T<sub>g</sub> (°C)</b>    | 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 <sub>g</sub> a loaded part will slowly creep and deform. For PLA and PETG this is the single most important thermal number.                                                                                                                                                                             |
| <b>Heat deflection temperature, HDT (°C)</b>   | 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.                                                                                                                                                                              |
| <b>Vicat softening point (°C)</b>              | The temperature at which a needle under load penetrates 1 mm into the material. Another measure of when the surface stops being hard.                                                                                                                                                                                                                                                                                                           |

|                                                |                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Melting temperature, T<sub>m</sub> (°C)</b> | Where the crystalline regions melt, measured by DSC (a calorimeter). Printing happens well above T <sub>m</sub> so the polymer flows freely.                                                                                                                                                                        |
| <b>Melt flow index, MFI (g/10 min)</b>         | 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.       |
| <b>Water absorption (%)</b>                    | 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.                                                                                                             |
| <b>Density (g/cm<sup>3</sup>)</b>              | Mass per volume. A 1 kg spool of a 1.31 g/cm <sup>3</sup> material contains about 5 % less printable length than a 1 kg spool at 1.24 g/cm <sup>3</sup> — heavier fillers cost you metres.                                                                                                                          |
| <b>Shore hardness (A / D)</b>                  | How far a spring-loaded needle indents the material. The A scale is for soft rubbers (higher = firmer: 85A squashy, 95A tyre-like); the D scale continues above it for hard flexibles and rigid plastics (68D is firmer than any A-scale TPU). The two scales overlap only roughly and cannot be converted exactly. |
| <b>Annealing</b>                               | Baking a finished print at a temperature just above T <sub>g</sub> 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

- Speed: the datasheet says < 200 mm/s; the manufacturer's own product pages quote 147 mm/s for 95A HF in one region and 238 mm/s (< 250) for 68D. The volumetric limits (12 and 18 mm<sup>3</sup>/s) are the practical governor.
- Drying: oven 70 °C / 8 h; heated bed 80–90 °C / 12 h (95A HF, 68D) or 90 °C / 16 h (85A, 90A); AMS HT preset 75 °C / 18 h for 85A / 90A. The manufacturer has not reconciled these; the discrepancy is noted on its own forum.
- The 68D datasheet prints Young's modulus as 1190 ± 0.4 MPa — a scatter far too small to be plausible; the mean is quoted, the scatter is not.
- TPU 90A's published modulus (5.3 MPa) is lower than 85A's (6.8 MPa) despite the higher hardness; both are as published.
- Flammability wording changed between the older TPU 95A sheet (self-extinguishing) and the current sheets (flammable).
- No brand publishes a numeric Shore A ↔ Shore D conversion; the ordering 68D > 95A > 90A > 85A is the manufacturer's own.
- Independent testing: a published comparison of 68D against 90A found the 68D tank treads and belt failing at a fraction of the load the 90A parts held, while printing roughly twice as fast — consistent with the 68D sheet's low Z elongation.

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- Bambu Lab US Store, TPU 85A / 90A — <https://us.store.bambulab.com/products/tpu-85a-tpu-90a>
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