Ultimaker

# Ultimaker PLA
Technical data sheet

## General overview

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|---|---|
| **Chemical composition** | See PLA safety data sheet, section 3 |
| **Description** | Ultimaker PLA filament provides a no-hassle 3D printing experience thanks to its reliability and good surface quality. Our PLA is made from organic and renewable sources. It's safe, easy to print with, and it serves a wide range of applications for both novice and advanced users |
| **Key features** | Good tensile strength and surface quality, easy to work with at high print speeds, user-friendly for both home and office environments, PLA allows the creation of high-resolution parts. There is a wide range of color options available |
| **Applications** | Household tools, toys, educational projects, show objects, proto-typing, architectural models, as well as lost casting methods to create metal parts |
| **Non-suitable for** | Food contact and in vivo applications. Long term outdoor usage or applications where the printed part is exposed to temperatures higher than 59 °C |

## Filament specifications

| | Method (standard) | Value |
|---|---|---|
| **Diameter** | – | 2.85 ± 0.10 mm |
| **Max roundness deviation** | – | 0.10 mm |
| **Net filament weight** | – | 750 g |
| **Filament length** | – | ~ 95 m |

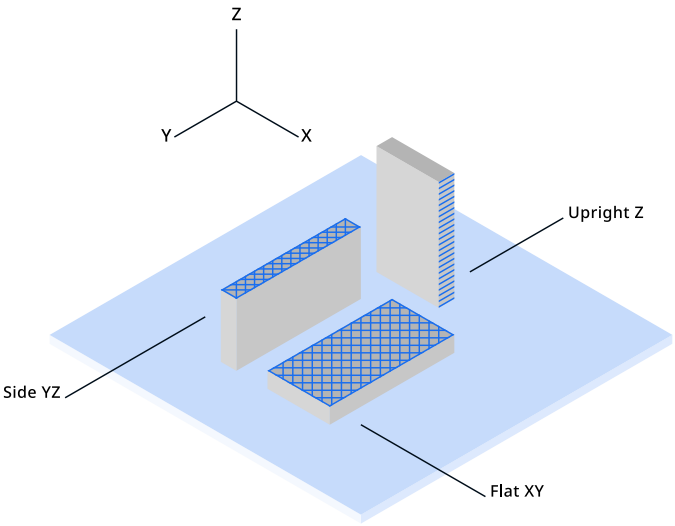
## Color information

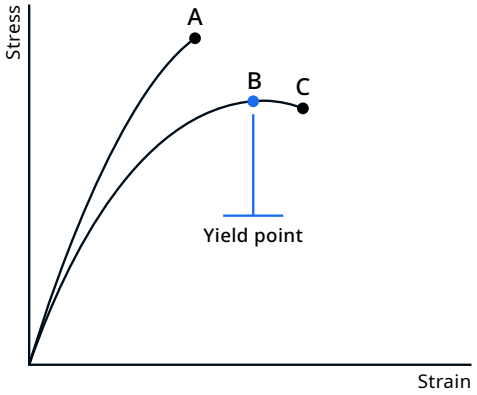
| Color | Color code |
|---|---|
| PLA Green | RAL 6018 |
| PLA Black | RAL 9005 |
| PLA Silver Metallic | RAL 9006 |
| PLA White | RAL 9010 |
| PLA Transparant | N/A |
| PLA Orange | RAL 2008 |
| PLA Blue | RAL 5002 |
| PLA Magenta | RAL 4010 |
| PLA Red | RAL 3020 |
| PLA Yellow | RAL 1003 |
| PLA Pearl White | RAL 1013 |

# Mechanical properties

All samples were 3D printed. See ‘Notes’ section for details.

| | Test method | Typical value | | |
|---|---|---|---|---|
| | | XY (Flat) | YZ (Side) | Z (Up) |
| **Tensile (Young’s) modulus** | ASTM D3039 (1 mm / min) | 3250 ± 119 MPa | 3292 ± 101 MPa | 3071 ± 181 MPa |
| **Tensile stress at yield** | ASTM D3039 (5 mm / min) | 52.5 ± 0.9 MPa | 59.0 ± 0.7 MPa | No yield |
| **Tensile stress at break** | ASTM D3039 (5 mm / min) | 45.5 ± 1.1 Mpa | 56.0 ± 1.5 MPa | 33.1 ± 2.8 MPa |
| **Elongation at yield** | ASTM D3039 (5 mm / min) | 3.4 ± 0.0% | 3.4 ± 0.1% | No yield |
| **Elongation at break** | ASTM D3039 (5 mm / min) | 7.8 ± 1.2% | 4.2 ± 0.7% | 2.0 ± 0.2% |
| **Flexural modulus** | ISO 178 (1 mm / min) | 3019 ± 87 MPa | 2894 ± 53 MPa | 2740 ± 47 MPa |
| **Flexural strength** | ISO 178 (5 mm / min) | 96.8 MPa at 2.5% strain | 101.3 MPa at 1.1% strain | 52.0 MPa at 4.4% strain |
| **Flexural strain at break** | ISO 178 (5 mm / min) | 4.8 ± 0.2% | No break (>10%) | 1.9 ± 0.2% |
| **Charpy impact strength (at 23 °C)** | ISO 179-1 / 1eB (notched) | 3.9 ± 0.4 kJ/m² | – | – |
| **Hardness** | ISO 7619-1 (Durometer, Shore D) | 84 Shore D | – | – |




A. Tensile stress at break, elongation at break (no yield point)
B. Tensile stress at yield, elongation at yield
C. Tensile stress at break, elongation at break

## Print orientation

As the FFF process produces part in a layered structure, mechanical properties of the part vary depending on orientation of the part. In-plane there are differences between walls (following the contours of the part) and infill (layer of 45° lines). These differences can be seen in the the data for XY (printed flat on the build plate - mostly infill) and YZ (printed on its side - mostly walls). Additionally, the upright samples (Z direction) give information on the strength of the interlayer adhesion of the material. Typically the interlayer strength (Z) has the lowest strength in FFF.

Note: All samples are printed with 100% infill - blue lines in the ilustration indicate typical directionality of infill and walls in a printed part.

## Tensile properties

Printed parts can yield before they break, where the material is deforming (necking) before it breaks completely. When this is the case, both the yield and break points will be reported. Typical materials that yield before breaking are materials with high toughness like Tough PLA, Nylon and CPE+.

If the material simply breaks without yielding, only the break point will be reported. This is the case for brittle materials like PLA and PC Transparant, as well as elastomers (like TPU).

# Thermal properties

Samples marked with an asterisk (*) were 3D printed. See ‘Notes’ section for details.

| | Test Method | Typical value |
|---|---|---|
| **Melt mass-flow rate (MFR)** | ISO 1133 (210 °C, 2.16 kg) | 6.1 g / 10 min |
| **Heat deflection (HDT) at 0.455 MPa*** | ISO 75-2 / B | 58.8 ± 0.4 °C |
| **Vicat softening temperature*** | ISO 306 / A120 | 64.5 ± 0.4 °C |
| **Glass transition** | ISO 11357 (DSC, 10 °C / min) | 59.1 °C |
| **Melting temperature** | ISO 11357 (DSC, 10 °C / min) | 151.8 °C |

# Other properties

| | | |
|---|---|---|
| **Specific gravity** | ASTM D1505 | 1.24 g / $cm^3$ |

# Notes

*3D Printing: all samples were printed using a new spool of material loaded in an Ultimaker S5 Pro bundle with engineering intent profiles using 0.15 mm layer height with AA0.4 printcore and 100% infill, using Ultimaker Cura 4.9. Samples were printed ‘one-at-a-time’. Printed samples were conditioned in room temperature for at least 24h before measuring.

Specimen dimensions (L x W x H):
- Tensile test: 215 x 20 x 4 mm
- Flexural/Vicat/HDT: 80 x 10 x 4 mm
- Charpy: 80 x 10 x 4 mm with printed Notch (Type 1eB)

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