

# UltiMaker PPS CF

## Technical data sheet

UltiMaker PPS CF is a carbon fiber reinforced polyphenylene sulfide (PPS) filament and the next level composite material for the UltiMaker Factor 4. It has excellent performance while still being easy to print using HT print cores.



### General overview

|                      |   |
|----------------------|---|
| Chemical composition | See UltiMaker PPS CF safety data sheet, section 3   |
| Key features         | Replace metal and PEEK parts with a cost effective and easy to manufacture solution. PPS CF prints reliably in great precision on the UltiMaker Factor 4 yielding flame retardant, temperature resistant (>230 °C) and chemical resistant (insoluble in all solvents below 200 °C) parts. It has great strength and stiffness with next level durability. |
| Applications         | Functional prototyping, tooling, manufacturing aids in various industries such as automotive, railway, aerospace.   |
| Non-suitable for     | In vivo applications. Applications where the printed parts are exposed to temperatures higher than 230 °C.  |

### Filament specifications

|                          | Method (standard) | Value   |
|--------------------------|-------------------|---------|
| Diameter                 | -                 | 2.85 mm |
| Max. roundness deviation | -                 | 0.1 mm  |
| Net. filament weight     | -                 | 500 g   |
| Filament length          | -                 | ~61 m   |

### Color information

|                     |            |
|---------------------|------------|
| Color               | Color code |
| Metallic Anthracite | RAL 7016   |

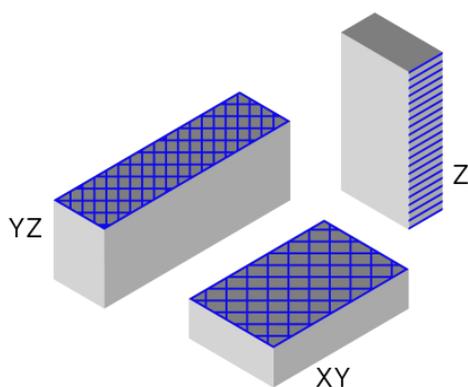
# Mechanical properties

All samples where 3D printed, see notes section.

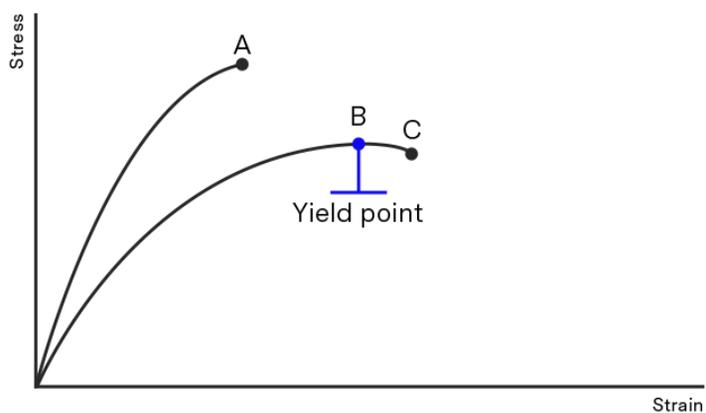
|                                  | Test method                     | Typical value XY (flat)       | Typical value YZ (side)       | Typical value Z (up)          |
|----------------------------------|---------------------------------|-------------------------------|-------------------------------|-------------------------------|
| Tensile (Young's) modulus        | ASTM D3039 (1 mm / min)         | 4376 ± 72 MPa                 | 7766 ± 166 Mpa                | 2392 ± 114 MPa                |
| Tensile stress at yield          | ASTM D3039 (5 mm / min)         | 47.5 ± 1.9 MPa                | -                             | -                             |
| Tensile stress at break          | ASTM D3039 (5 mm / min)         | 47.3 ± 1.7 MPa                | 72.6 ± 2.3 MPa                | 20.1 ± 1.3 MPa                |
| Elongation at yield              | ASTM D3039 (5 mm / min)         | 1.9 ± 0.1 %                   | -                             | -                             |
| Elongation at break              | ASTM D3039 (5 mm / min)         | 2.0 ± 0.1 %                   | 2.2 ± 0.1 %                   | 1.1 ± 0.2 %                   |
| Flexural modulus                 | ISO 178 (1 mm / min)            | 5106 ± 75 MPa                 | 6175 ± 96 MPa                 | 1886 ± 51 MPa                 |
| Flexural strength                | ISO 178 (5 mm / min)            | 87.0 ± 1.2 MPa at 2.6% strain | 95.2 ± 0.6 MPa at 1.9% strain | 56.3 ± 0.8 MPa at 3.6% strain |
| Flexural strain at break         | ISO 178 (5 mm / min)            | 2.8 ± 0.2 %                   | 1.9 ± 0.0 %                   | 3.6 ± 0.3 %                   |
| Charpy impact strength (at 23°C) | ISO 179-1/1eB (notched)         | 4.8 ± 0.2 kJ/m <sup>2</sup>   |                               |                               |
| Charpy impact strength (at 23°C) | ISO 179-1/1eU (Unnotched)       | 11.6 ± 0.8 kJ/m <sup>2</sup>  |                               |                               |
| Hardness                         | ISO 7619-1 (Durometer, Shore D) | 80 Shore D                    |                               |                               |

## Mechanical properties (Annealed)

|                                  |                                 |                               |                                |                               |
|----------------------------------|---------------------------------|-------------------------------|--------------------------------|-------------------------------|
| Tensile (Young's) modulus        | ASTM D3039 (1 mm / min)         | 4616 ± 94 Mpa                 | 8632 ± 184 MPa                 | 2507 ± 39 Mpa                 |
| Tensile stress at yield          | ASTM D3039 (5 mm / min)         | -                             | -                              | -                             |
| Tensile stress at break          | ASTM D3039 (5 mm / min)         | 52.3 ± 2.8 Mpa                | 83.9 ± 1.4                     | 19.4 ± 2.4                    |
| Elongation at yield              | ASTM D3039 (5 mm / min)         | -                             | -                              | -                             |
| Elongation at break              | ASTM D3039 (5 mm / min)         | 2.0 ± 0.1                     | 2.0 ± 0.1                      | 1.1 ± 0.2                     |
| Flexural modulus                 | ISO 178 (1 mm / min)            | 5558 ± 92 MPa                 | 6782 ± 98 MPa                  | 1880 ± 132 MPa                |
| Flexural strength                | ISO 178 (5 mm / min)            | 97.3 ± 1.3 MPa at 2.3% strain | 108.1 ± 1.7 MPa at 1.8% strain | 55.6 ± 1.3 MPa at 3.2% strain |
| Flexural strain at break         | ISO 178 (5 mm / min)            | 2.3 ± 0.1 %                   | 1.8 ± 0.1 %                    | 3.2 ± 0.1 %                   |
| Charpy impact strength (at 23°C) | ISO 179-1/1eB (notched)         | 3.8 ± 0.2 kJ/m <sup>2</sup>   |                                |                               |
| Charpy impact strength (at 23°C) | ISO 179-1/1eU (Unnotched)       | 12.0 ± 0.5 kJ/m <sup>2</sup>  |                                |                               |
| Hardness                         | ISO 7619-1 (Durometer, Shore D) | 81 Shore D                    |                                |                               |



- I. Side YZ
- II. Flat XY
- III. Upright Z



- 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 FDM process produces a 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 contours of the part) and infill (layer of 45° lines). These differences can be seen in the data for XY (printed flat on the build plate - mostly infill) and YZ (printed on its side - mostly walls). Additionally, the upright (Z direction) give information on the strength of the interlayer adhesion of the material. Typically the interlayer strength (Z) has the lowest strength in FDM.

**Note:** All samples are printed with 100% infill - blue lines in the illustration 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 Transparent as well as elastomers (like TPU).

# Thermal properties

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|                                    | Test method                  | Value           |
|------------------------------------|------------------------------|-----------------|
| Melt mass-flow rate (MFR)          | ISO 1133 (300 °C, 2.16 kg)   | 22.1 g / 10 min |
| Heat Deflection(HDT) at 0.455 MPa* | ISO 75-2 / B                 | > 230 °C        |
| Heat Deflection(HDT) at 1.82 MPa*  | ISO 75-2 / A                 | 104 °C          |
| Vicat softening temperature*       | ISO 306 / A120               | > 230 °C        |
| Glass transition                   | ISO 11357 (DSC, 10 °C / min) | 102 °C          |
| Melting temperature                | ISO 11357 (DSC, 10 °C / min) | 282 °C          |

# Thermal properties (annealed)

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|                                    | Test method    | Value    |
|------------------------------------|----------------|----------|
| Heat Deflection(HDT) at 0.455 MPa* | ISO 75-2 / B   | > 230 °C |
| Heat Deflection(HDT) at 1.82 MPa*  | ISO 75-2 / A   | 137 °C   |
| Vicat softening temperature*       | ISO 306 / A120 | > 230 °C |

# Other properties

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|                      | Test method   | Value                    |
|----------------------|---------------|--------------------------|
| Specific gravity     | ISO 1183      | 1.28 g / cm <sup>3</sup> |
| Flame classification | Meets UL94 V0 |                          |

# Notes

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\*3D printing: all samples were printed using a new spool of material loaded in a Factor 4 with normal intent profiles using 0.2 mm layer height with HT0.6 print core and 100% infill, using UltiMaker Cura 5.7.0. 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)

# Disclaimer

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