

# **Ultrasint® PA11 Black CF**

**Superstrong | Bio-based |  
Carbon Fiber Reinforced**

## **Extended TDS**

**Complete Technical Documentation  
and Testing Summary**

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# Technical Data Sheet

**Carbon fiber-reinforced, bio-based nylon powder, offering exceptional strength, stiffness and durability. Ideal for demanding applications, it combines lightweight performance with high mechanical properties, thermal and chemical resistance.**

The data contained in this publication is based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, this data does not relieve processors from carrying out their own investigations and tests; neither does this data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose.

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The safety data given in this publication is for informational purposes only and does not constitute a legally binding MSDS. The relevant MSDS can be obtained upon request from your supplier or you may contact Mass Additive Manufacturing GmbH directly at [sales@forward-am.com](mailto:sales@forward-am.com).

| General Properties                     | Method            | Typical Values           |
|----------------------------------------|-------------------|--------------------------|
| Appearance                             | -                 | Black                    |
| Density (printed part)                 | DIN EN ISO 1183-1 | 1.07 g/cm <sup>3</sup>   |
| Density (Bulk Density)                 | DIN EN ISO 60     | 0.54 g/cm <sup>3</sup>   |
| Mean Particle Size d50                 | ISO 13320         | 40-55 µm                 |
| Melting Temperature (10 K/min)         | ISO 11357         | 202°C                    |
| Crystallization Temperature (10 K/min) | ISO 11357         | 165°C                    |
| Melt Volume Flow Rate (220°C, 2.16kg)  | ISO 1133          | 9 cm <sup>3</sup> /10min |

| Tensile Properties        | Method    | Typical Values<br>X-Direction |                    | Typical Values<br>Z-Direction |                    |
|---------------------------|-----------|-------------------------------|--------------------|-------------------------------|--------------------|
|                           |           | Dry <sup>1)</sup>             | Cond <sup>2)</sup> | Dry <sup>1)</sup>             | Cond <sup>2)</sup> |
| E Modulus                 | ISO 527-2 | 5900 MPa                      | 4550 MPa           | 2260 MPa                      | 1700 MPa           |
| Ultimate Tensile Strength | ISO 527-2 | 82 MPa                        | 71 MPa             | 45 MPa                        | 37 MPa             |
| Elongation at Break       | ISO 527-2 | 7%                            | 11%                | 3.6%                          | 5.2%               |

| Flexural Properties | Method         | Typical Values<br>X-Direction |                    | Typical Values<br>Z-Direction |                    |
|---------------------|----------------|-------------------------------|--------------------|-------------------------------|--------------------|
|                     |                | Dry <sup>1)</sup>             | Cond <sup>2)</sup> | Dry <sup>1)</sup>             | Cond <sup>2)</sup> |
| Flexural Modulus    | DIN EN ISO 178 | 5800 MPa                      | 5000 MPa           | 2500 MPa                      | 2100 MPa           |

| Impact Properties      | Method           | Typical Values    |                    | Typical Values    |                    |
|------------------------|------------------|-------------------|--------------------|-------------------|--------------------|
|                        |                  | X-Direction       |                    | Z-Direction       |                    |
|                        |                  | Dry <sup>1)</sup> | Cond <sup>2)</sup> | Dry <sup>1)</sup> | Cond <sup>2)</sup> |
| Charpy Notched, 23°C   | DIN EN ISO 179-1 | 6.4 kJ/m²         | 6.7 kJ/m²          | 4.7 kJ/m²         | 2.9 kJ/m²          |
| Charpy Unnotched, 23°C | DIN EN ISO 179-1 | 54 kJ/m²          | 63 kJ/m²           | 33 kJ/m²          | 44 kJ/m²           |
| Izod Notched, 23°C     | ISO 180          | 8.7 kJ/m²         | 8.5 kJ/m²          | 5.0 kJ/m²         | 5.5 kJ/m²          |
| Izod Unnotched, 23°C   | ISO 180          | 48 kJ/m²          | 52 kJ/m²           | 34 kJ/m²          | 45 kJ/m²           |

| Thermal Properties | Method         | Typical Values |
|--------------------|----------------|----------------|
| HDT/A (1.8 MPa)    | ISO 75-2       | 151°C          |
| HDT/B (0.45 MPa)   | ISO 75-2       | 189°C          |
| Vicat/A (10 N)     | DIN EN ISO 306 | 193°C          |
| Vicat/A (10 N)     | DIN EN ISO 306 | 188°C          |

| Fire, Smoke, Toxicity (FST) properties | Method | Typical Values  |
|----------------------------------------|--------|-----------------|
| Flammability                           | UL 94  | HB (0.8 -3.1mm) |

| Electrical Properties        | Method        | Typical Values          |                         |
|------------------------------|---------------|-------------------------|-------------------------|
|                              |               | X-Direction             | Z-Direction             |
| Dielectric Strength          | IEC 60243-1   | 0.03 kV/mm<br>(1 mm)    | 0.03 kV/mm<br>(1 mm)    |
| Volume Resistivity           | IEC 62631-3-1 | 5.5•10 <sup>1</sup> Ωcm | 1.4•10 <sup>2</sup> Ωcm |
| Specific Surface resistivity | IEC 62631-3-2 | 7.9•10 <sup>2</sup> Ω   | 1.5•10 <sup>3</sup> Ω   |

#### Mechanical properties overview

- 1) Measured after drying 14 days at 80°C / vacuum. Water content is about 0.03% acc. to DIN EN ISO 15512
- 2) Measured after conditioning 14 days at 70°C / 62% r.h. Water content is about 0.6% acc. to DIN EN ISO 15512
- 3) If not noted otherwise, all specimens are 3D printed. Samples were tested at room temperature, 23°C. All values measured with virgin material.

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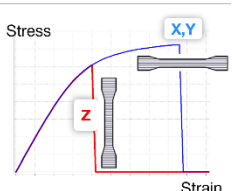
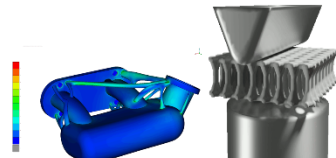
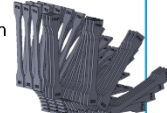
## Printing Performance

The combination of 3D printer and material has a huge impact on the quality of the parts produced.

# Material Model & FEA Simulation

FEA simulation can be used to predict how different parameters such as temperature and mechanical stress affect the final printed parts. This information can be used to significantly expedite application development, and to optimize the part design to ensure all performance requirements for the application are met. In order to run simulations with a specific material, a material model is required. This model is generated based on a wide range of testing data under different loads and at different temperatures and other relevant conditions.

We can support you with 3D simulation in different ways, ranging from simply supplying you with raw test data, to doing the full simulation for you. These are the 3 options we offer:

| Raw Material Data                                                                                                                                                                    | 3D Simulation                                                                                                                                                                                                                                                                     | Material Model as a Service                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Starter:</b></p> <p>Get the curves behind our TDS data to start basic simulation work.</p>  | <p><b>Premium:</b></p> <p>We run the simulation for you. We help you to speed up your engineering process and increases confidence in part performance using a digital twin of your part.</p>  | <p><b>Enterprise:</b></p> <p>Use our in-house developed material models for 3D-Printing incl. anisotropy of the process and FEA support of our experienced virtual engineers.</p> <ul style="list-style-type: none"> <li>■ Anisotropic</li> <li>■ Nonlinear</li> <li>■ Strain-rate sensitive</li> <li>■ Tensile-compression asymmetry</li> <li>■ Failure modelling</li> <li>■ Temperature dependent</li> </ul>  |

Specifically for Ultrasint® PA11 Black CF, below you can find some of the data (at specific temperatures / mechanical loads) we have available in our Ultrasim® Material Model or that we could provide to you for your own simulations. More information is available on request ([sales@forward-am.com](mailto:sales@forward-am.com)).

|                          | Available temperatures |      |      | Strain rate / loads |            | Print Orientation / Anisotropy |
|--------------------------|------------------------|------|------|---------------------|------------|--------------------------------|
|                          | Low                    | 23°C | High | Quasi static        | High speed |                                |
| Ultrasint® PA11 Black CF | ●                      | ●    | ●    | ●                   | ●          | ●                              |

- Validated, available as Material Data Set (can be converted into a Ultrasim® Material Model)
- Validated, available via Ultrasim® Material Model
- Preliminary

# Flammability

Ultrasint® PA11 Black CF does not contain any flame retardants and passes UL94 “HB” rating down to a wall thickness of 0.8 mm.

**\*\*\* Flame testing \*\*\***  
**Flammability HB acc. to UL 94 : 2021**

**Information about test procedure and test specimens**

| M 0 0321                                           |              |                 | Measurements & observations after application of flame (30 s) |                                            |                                                   |                                                |                                 | Flame class                     |
|----------------------------------------------------|--------------|-----------------|---------------------------------------------------------------|--------------------------------------------|---------------------------------------------------|------------------------------------------------|---------------------------------|---------------------------------|
| Dimensions of test specimens<br>127 * 12,7 * d mm* |              |                 | Flame front<br>ceases before<br>25mm mark                     | Flame front<br>ceases before<br>100mm mark | Damaged length<br>beyond<br>25mm mark<br><br>[mm] | Burning time<br>beyond<br>25mm mark<br><br>[s] | Burning<br>rate<br><br>[mm/min] |                                 |
| Requirements for d < 3 mm<br>for d >= 3 mm         |              |                 | ---<br>---                                                    | ---<br>---                                 | ---<br>---                                        | >= 60<br>>= 112,5                              | <= 75<br><= 40                  |                                 |
| Pre-conditioning                                   | Spec.<br>no. | Thickn.<br>[mm] |                                                               |                                            |                                                   |                                                |                                 | HB<br>HB<br>HB<br><br>HB @0.8mm |
| Conditioning<br>(2d / 23°C / 50%)                  | 1            | 0.78            | No                                                            | No                                         | 75                                                | 74                                             | 61                              |                                 |
|                                                    | 2            | 0.86            | No                                                            | No                                         | 75                                                | 86                                             | 52                              |                                 |
|                                                    | 3            | 0.83            | No                                                            | No                                         | 75                                                | 82                                             | 55                              |                                 |
| Comments                                           |              |                 | First test 2022-02-03 15:38 - 2022-02-03 15:45                |                                            |                                                   |                                                |                                 |                                 |
| Conditioning<br>(2d / 23°C / 50%)                  | 1            |                 |                                                               |                                            |                                                   |                                                |                                 |                                 |
|                                                    | 2            |                 |                                                               |                                            |                                                   |                                                |                                 |                                 |
|                                                    | 3            |                 |                                                               |                                            |                                                   |                                                |                                 |                                 |
| Comments                                           |              |                 | Repeated test -                                               |                                            |                                                   |                                                |                                 |                                 |