# Glass +

This material is composed of Polyamide 6 copolymer with 10 % v/v of glass microsphere.

Our Glass + is rigid, light and with good flexural resistance, i.e., it's ideal for all applications that require low weight, flexural and thermal resistance. It also has low thermal and electrical conductivity.

Poor, however, is its resistance to UV light and is partially soluble in organic solvents and hydrocarbons.

Cyano-acrylic glues tend to accelerate the aging of the piece; instead, epoxy and polyurethane glues are recommended.

The product must be kept scrupulously dry, to avoid unsightly spinning.

## *Suggested use*

| | |
|---|---|
| Automotive | |
| Prototypes | |
| Mech tests | |
| Multimaterial parts | |
| Jigs and fixtures | |

## *Compatibilities*

| | |
|---|---|
| **Support compatibility** | SSU04 (Soluble in hot water) |
| | SSU09 (Soluble with WAVE powder[1]) |
| **Material compatibility** | Carbon + |
| | Nylon + |
| | Elasto 85 |
| | Elasto 95 |
| | |

[1]The SSU09 support is degradable with an alkaline solution obtained by WAVE powder; the proportion of 170 g of powder per 7 liters of water is recommended. We recommend the use of an ultrasonic tank and water at 70 °C.

## Easy profiles suggested

| Layer | Ø 0.3 mm | Ø 0.4 mm | Ø 0.6mm | Ø 0.8 mm |
|---|---|---|---|---|
| **0.10** | | | | |
| **0.15** | | ** | | |
| **0.20** | | ** | ** | |
| **0.25** | | ** | | |
| **0.30** | | * | ** | ** |
| **0.40** | | | * | ** |
| **0.50** | | | | * |

** : Recommended
* : Discrete quality

## Before printing

| | |
|---|---|
| **Drying** | Drying before (at least 4h at 90 °C) and during the hob is recommended |
| **Cleaning** | It's suggested to clean the bed with IPA before print |
| **Print directly on Veltra bed** | Not recommended |
| **Extruder** | HI-TEMP |
| **Nozzle** | BLISS |
| **SPFU** | Not compatible |

## General advice

An excessive increase in skin thickness or high filling density can cause deformations of the piece during the printing phase.

## *Physical properties**

| Propriety | Symbol | Standard | Value |
|---|---|---|---|
| **Density** | $\rho$ | ISO 1183 | 1.01 g/cm$^3$ |
| **Water absorption** | $w_w$ | ISO 62 | < 0.3 % |

## *Thermal properties**

| Propriety | Symbol | Standard | Value |
|---|---|---|---|
| **Melting flow index** | M. F. I. | ISO 1133 | 2.2 g/10 min |
| **Glass transition temperature** | $T_g$ | ISO 11357 | 61 °C |
| **Temperature deflection under load** | $T_f$ 1,8 | ISO 75<br>Unannealed | 90 °C |
| **Continuous service temperature (20.000 h)** | – | IEC 60216 | 120 °C |
| **Coefficient of linear thermal expansion** | $\alpha$ | ISO 11359 | N/A |

## *Electrical properties**

| Propriety | Symbol | Standard | Value |
|---|---|---|---|
| **Surface resistivity** | $\sigma_e$ | DIN IEC 60167 | > $10^{12}$ Ω |
| **Electric strength** | $E_B$ | N.A. | N/A |

* values provided by polymer supplier

## *Mechanical properties*

Based on layer-by-layer deposition, additively manufactured parts, especially with the FDM technique, present a not negligible anisotropy on mechanical properties.

The user must think about the correct displacement of the part in the machine for maximize its mechanical properties.

For this reason, we report the mechanical properties of our specimens considering the three main orientations, by plane x-y (flat), by plane y-z (on edge), and by plane z-x (upright).

All specimens are made with the same printing conditions:

- Infill: 100%
- Nozzle: 0,4 mm
- Layer thickness: 0.2 mm
- Raster angle: 45 °

For more information about the test and specimens' conditions, we suggest checking the ISO references that are reported in the following tables.

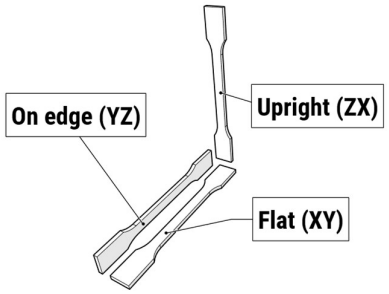



*Figure 1: specimen displacement to determine tensile properties (ref. ISO 527-2)*

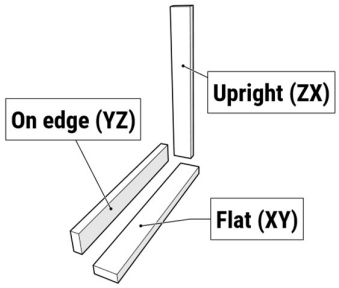
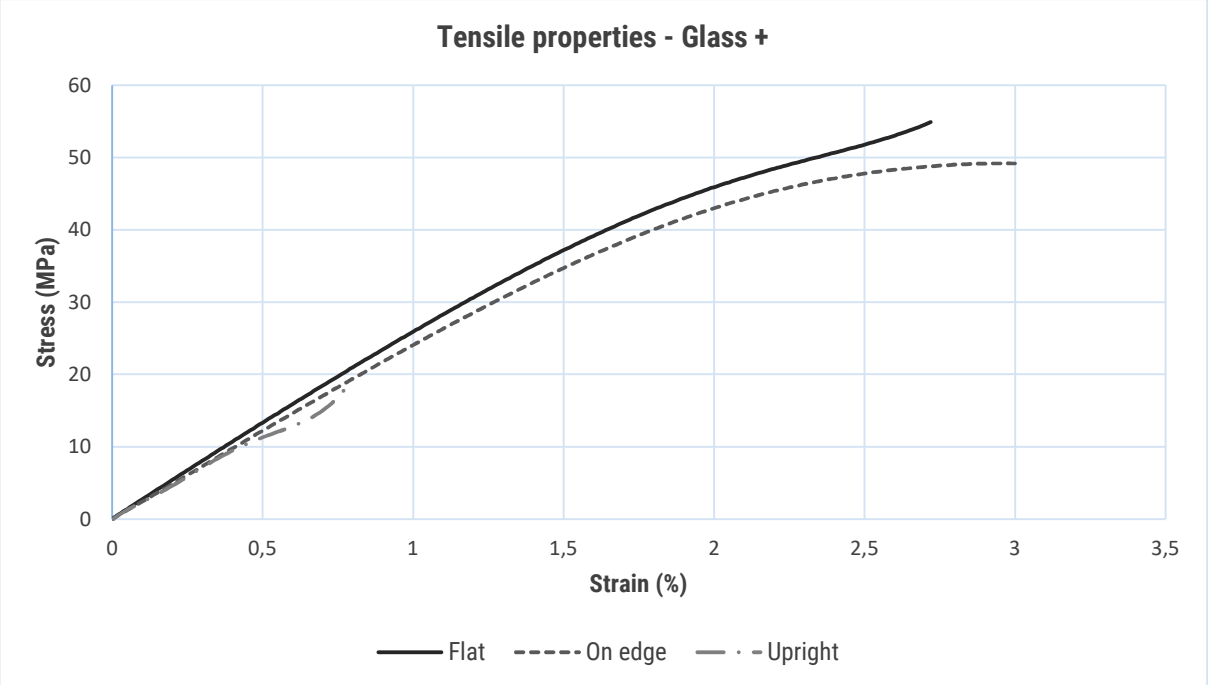



*Figure 2: specimen displacement to determine flexural and impact properties (ref. ISO 178 and 179-1)*

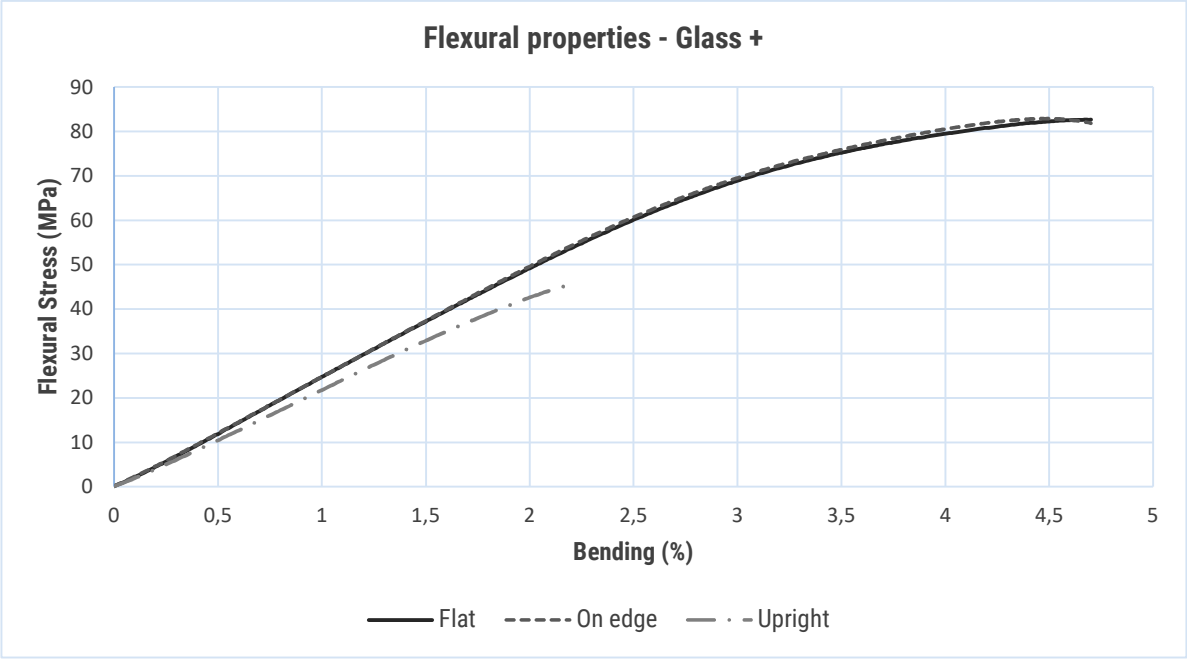
## *Tensile properties*

| Propriety | Symbol | Standard | Specimens build direction | Value |
|---|---|---|---|---|
| **Tensile modulus** | $E_t$ | ISO 527-2 | Flat | 2671 MPa |
| | | | On edge | 2414 MPa |
| | | | Upright | 2356 MPa |
| **Yield stress** | $\sigma_y$ | | Flat | No Yield |
| | | | On Edge | No Yield |
| | | | Upright | No Yield |
| **Yield strain** | $\varepsilon_y$ | | Flat | No Yield |
| | | | On Edge | No Yield |
| | | | Upright | No Yield |
| **Strength at break** | $\sigma_b$ | | Flat | 51 MPa |
| | | | On Edge | 49 MPa |
| | | | Upright | 16 MPa |
| **Strain at break** | $\varepsilon_b$ | | Flat | 2.7 % |
| | | | On Edge | 3.0 % |
| | | | Upright | 0.8 % |



## *Flexural properties*

| Propriety | Symbol | Standard | Specimens build direction | Value |
|---|---|---|---|---|
| **Flexural modulus** | $E_f$ | ISO 178 | Flat | 2296 MPa |
| | | | On edge | 2324 MPa |
| | | | Upright | 2018 MPa |
| **Flexural strength** | $\sigma_{fC}$ | | Flat | 75 MPa |
| | | | On Edge | 76 MPa |
| | | | Upright[2] | 47 MPa |




## *Impact properties*

| Propriety | Symbol | Standard | Specimens build direction | Value |
|---|---|---|---|---|
| **Charpy unnotched impact strength** | $a_{cu}$ | ISO 179 | Flat | 15.2 kJ/m$^2$ |
| | | | On edge | 19.1 kJ/m$^2$ |
| | | | Upright | 3.3 kJ/m$^2$ |
| **Type of failure** | ToF | | Flat | Comp. Break |
| | | | On Edge | Comp. Break |
| | | | Upright | Comp. Break |

[2] This value was reached at the breaking point (with 2.2 % of bending)

## The fine print

The information and values listed into this document are provided in good faith, based on specimens printed with 3ntr machines according to the latest version of SSI print parameters valid at the date of issuance.

3ntr provides you with this information for your guidance to select the correct polymer and setup but user is responsible for determining that 3ntr material is safe, technically correct and legal for the selected application.

The values listed in this documents are not meant for design specification or quality control guidelines: is it user responsibility to design parts with appropriate safety margins to comply with any material variation due part design, production, test conditions, use conditions.

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