# Carbon +

Few polymers achieve the rigidity and mechanical strength of this product, based on a PA12 blend reinforced with 15 % of chopped carbon fiber.

Ideal for all applications where it is necessary to combine good thermal, mechanical and chemical resistance.

The thermal resistance is very good as well as its impact resistance. Poor, however, is its resistance to UV and is partially soluble in organic solvents and hydrocarbons. Cyano-acrylic glues tend to accelerate the aging of the piece; in-stead, the epoxy and polyurethane glues are recommended.

Excellent stability during the printing phase, it allows to obtain high performance parts rather easily.

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

## *Suggested use*

| | |
|---|---|
| Prototypes | Multi-material applications |
| Fit and assembly | Final parts |
| Mech tests | Spare parts |
| Tools | MRO |
| Jig and fixtures | |

## *Compatibilities*

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

[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** | Dying before and during the job. 90 °C for 4-5 h are 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

Low infill values (it depends on which infill pattern you choose) may require to increase the skin thickness of the part.

High infill values (depending on which infill pattern you chose) may require to decrease the extrusion width of the infill.

Very high values of infill can cause deformation and/or warping of the component.

To ensure good overall surface quality, it's suggested to modify the loop order to "Perimeter First".

## *Physical properties**

| Propriety | Symbol | Standard | Value |
|---|---|---|---|
| **Density** | $\rho$ | ISO 1183 | 1.07 g/cm$^3$ |
| **Water absorption** | $w_w$ | ISO 62 | 1.1 % |

## *Thermal properties**

| Propriety | Symbol | Standard | Value |
|---|---|---|---|
| **Melting flow index** | M. F. I. | N/A | N/A |
| **Glass transition temperature** | $T_g$ | 11357 | 104 °C |
| **Temperature deflection under load** | $T_f$ 1,8 | ISO 75<br>Unannealed | 100 °C |
| **Vicat softening temperature** | VST B50 | ISO 306<br>50 °C/min | 173 °C |
| **Coefficient of linear thermal expansion** | $\alpha$ | N/A | N/A |
| **Flammability** | | UL94 | N/A |

## *Electrical properties**

| Propriety | Symbol | Standard | Value |
|---|---|---|---|
| **Surface resistivity** | $\sigma_e$ | IEC 600093 | 50 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.

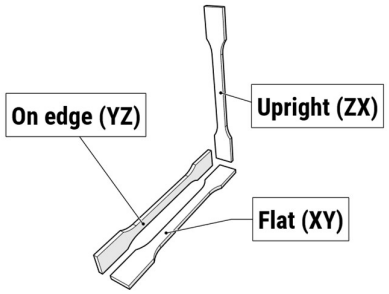



*Figure 1: specimen displacement to determine tensile properties (ref. ISO 527-2)*

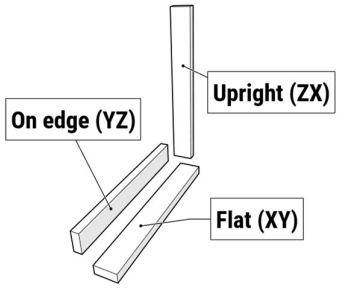
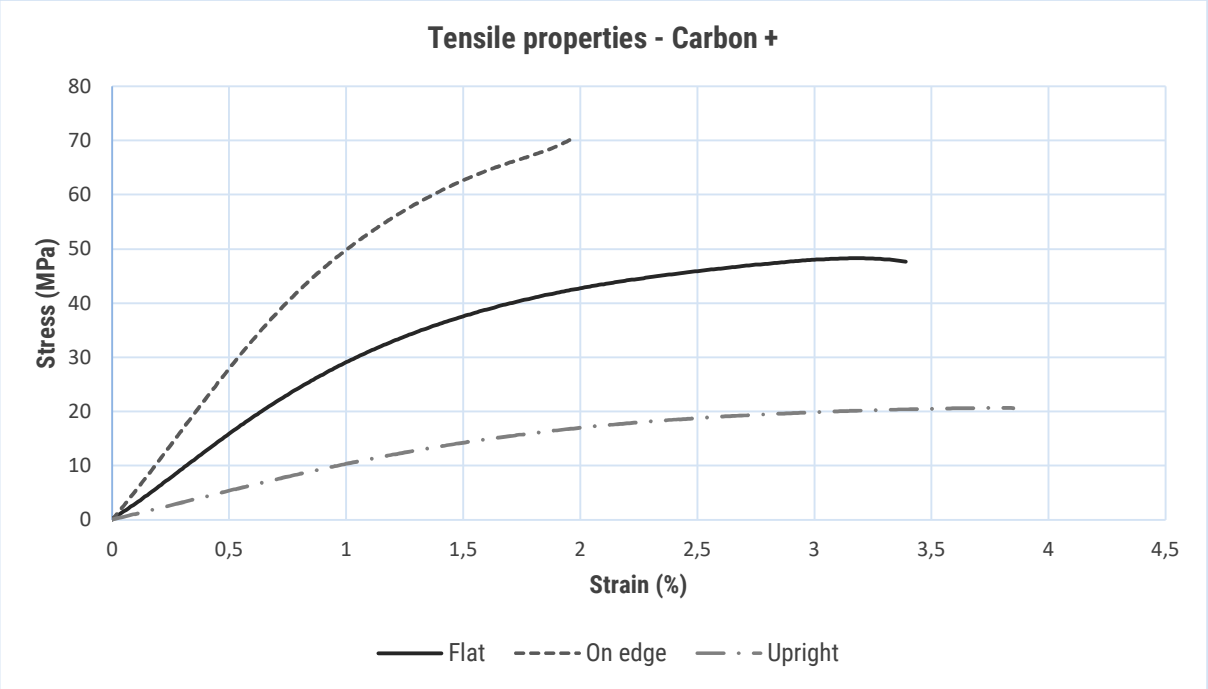



*Figure 2: specimen displacement to determine flexural and impact properties (ref. ISO 178 and 179-1)*

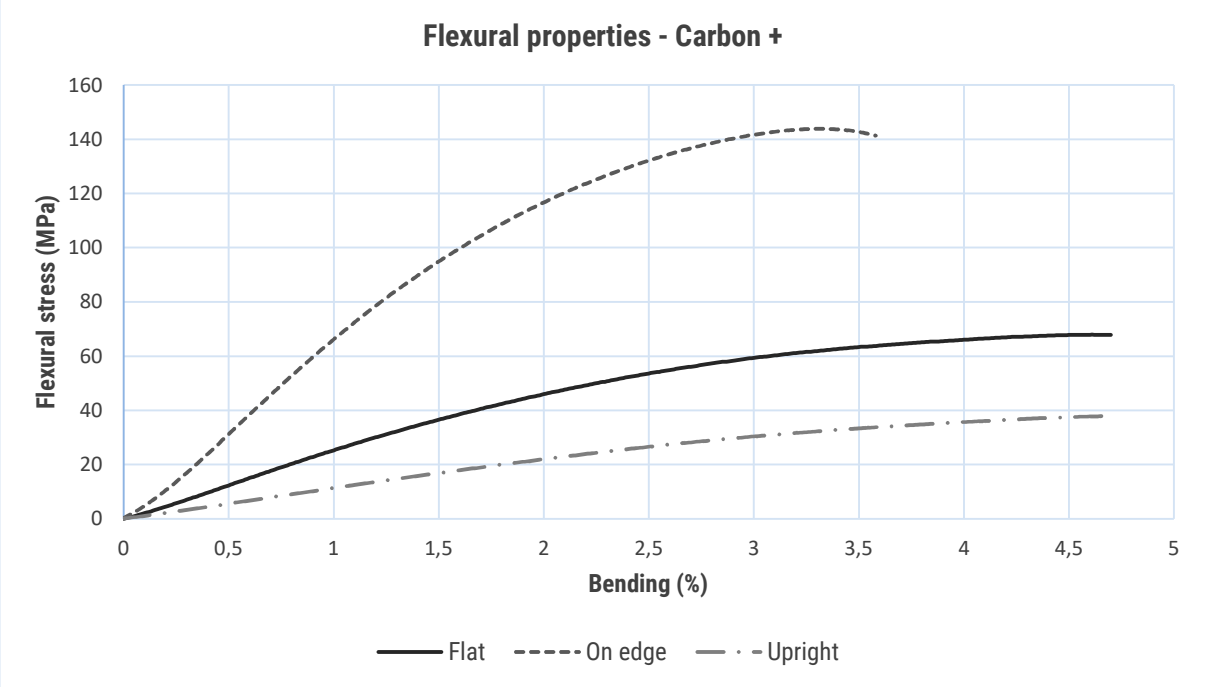
## *Tensile properties*

| Propriety | Symbol | Standard | Specimens build direction | Value |
|---|---|---|---|---|
| **Tensile modulus** | $E_t$ | ISO 527-2 | Flat | 3040 MPa |
| | | | On edge | 5502 MPa |
| | | | Upright | 1024 MPa |
| **Yield stress** | $\sigma_y$ | | Flat | 49 MPa |
| | | | On Edge | No Yield |
| | | | Upright | No Yield |
| **Yield strain** | $\varepsilon_y$ | | Flat | 3.5 % |
| | | | On Edge | No Yield |
| | | | Upright | No Yield |
| **Strength at break** | $\sigma_b$ | | Flat | 46 MPa |
| | | | On Edge | 69 MPa |
| | | | Upright | 21 MPa |
| **Strain at break** | $\varepsilon_b$ | | Flat | 3.4 % |
| | | | On Edge | 2 % |
| | | | Upright | 3.9 % |



## *Flexural properties*

| Propriety | Symbol | Standard | Specimens build direction | Value |
|---|---|---|---|---|
| **Flexural modulus** | $E_f$ | ISO 178 | Flat | 2392 MPa |
| | | | On edge | 3471 MPa |
| | | | Upright | 1038 MPa |
| **Flexural strength** | $\sigma_{fC}$ | | Flat | 64 MPa |
| | | | On Edge | 114 MPa |
| | | | Upright | 33 MPa |




## *Impact properties*

| Propriety | Symbol | Standard | Specimens build direction | Value |
|---|---|---|---|---|
| **Charpy unnotched impact strength** | $a_{cu}$ | ISO 179 | Flat | 35 kJ/m$^2$ |
| | | | On edge | 31 kJ/m$^2$ |
| | | | Upright | 10 kJ/m$^2$ |
| **Type of failure** | ToF | | Flat | Comp. Break |
| | | | On Edge | Comp. Break |
| | | | Upright | Comp. Break |

## 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.

The user has also the responsibility to assess the suitability of the product to the selected use, built with part(s) made with 3ntr materials and/or technologies.

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