X-CCF 1K Technical Parameters

As the core reinforcing material for continuous fiber printing systems, X-CCF 1K features finer individual carbon fiber tows. It delivers steadier filament feeding and consistent resin impregnation, which effectively reduces nozzle clogging and boosts the printing success rate.

Mechanical Properties

Standard test specimens of X-CCF 1K are fabricated with a minor dosage of CFC co-extrusion matrix filament. The table below presents the mechanical properties of typical CFC material combinations:

Test Metric	Method (ASTM)	X-CCF/CFC PLA	X-CCF/CFC PETG	X-CCF/CFC PA
Tensile Strength (MPa)	D3039	883 ± 156.3	859 + 71	865 ± 37.7
Tensile Modulus (GPa)	D3039	84 ± 3.6	82 ± 11.7	81 ± 4.7
Tensile Strain at Break (%)	D3039	0.91 ± 0.2	1.05 ± 0.09	1.0 ± 0.09
Compressive Strength (MPa)	D6641	287.3 ± 43.8	202.9 ± 30.6	140.8 ± 22.5
Compressive Modulus (GPa)	D6641	52.3 ± 3.8	32.5 ± 4.6	27.2 ± 4.7
Compressive Strain at Break (%)	D6641	0.5 ± 0.03	0.62 ± 0.02	0.5 ± 0.02
Flexural Strength (MPa)	D790	494.1 ± 41.5	294.2 ± 37.7	319.4 ± 21.3
Flexural Modulus (GPa)	D790	40.1 ± 2.6	33.8 ± 1.8	32.8 ± 1.4

Filament Application

When matched with different co-extrusion materials, X-CCF 1K exhibits unique performance traits suited to different application scenarios, as summarized in the table below:

Filament Combination	Characteristics	Scenarios
X-CCF/CFC PLA	High rigidity, excellent dimensional stability, easy printing, low cost	UAV frames, low-load robotic parts, racing chassis, educational demo prototypes...
X-CCF/CFC PETG	High tensile strength, low moisture absorption, stable dimensions, wide versatility	Load-bearing UAV arms, robotic arm parts, sports equipment, device frame housings, functional jigs or fixtures, lightweight metal substitutes ...
X-CCF/CFC PA	Superior strength, toughness, fatigue resistance, wear & impact resistance, long service life	Robotic joints, transmission brackets, automotive functional parts, industrial fixtures, gear & pulley substrates, cyclic load-bearing components, ...

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X-CGF 1K Technical Parameters

X-CGF 1K enables consistent, smooth printing while endowing printed parts with outstanding tensile strength, stiffness and dimensional stability.

Mechanical Properties

Standard test bars of X-CGF 1K are manufactured with a small amount of CFC co-extrusion matrix resin. The table below presents the mechanical properties of typical CFC material combinations:

Test Metric	Method (ASTM)	X-CGF/CFC PLA	X-CGF/CFC PETG
Tensile Strength (MPa)	D3039	714 ± 165	625 ± 48
Tensile Modulus (GPa)	D3039	31 ± 0.4	25 ± 1.7
Tensile Strain at Break (%)	D3039	1.59 ± 0.73	2.36 ± 0.38
Compressive Strength (MPa)	D6641	133 ± 10.5	104 ± 5.5
Compressive Modulus (GPa)	D6641	26 ± 2.0	21 ± 3.8
Compressive Strain at Break (%)	D6641	0.5 ± 0.03	0.49 ± 0.07
Flexural Strength (MPa)	D790	185.7 ± 20.8	144.5 ± 9.4
Flexural Modulus (GPa)	D790	17.7 ± 1.0	11.9 ± 0.7

Filament Application

X-CGF delivers distinct characteristics and applicable scenarios when paired with different co-extrusion materials, as detailed below:

Filament Combination	Characteristics	Scenarios
X-CGF/CFC PLA	Low cost, electrically insulating, moderate stiffness	Teaching test pieces, consumer goods frames, electronic brackets, low-cost jigs or fixtures, beginner prototypes, non-conductive structural parts
X-CGF/CFC PETG	High toughness, excellent impact resistance and insulation	Electrically insulated supports, outdoor equipment frame skeletons, tool grips, sports protective gear, impact-resistant fixtures, general industrial functional parts

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Composite Material Performance

Flexural Strength

The figure below compares the bending mechanical properties of neat matrix materials, short-fiber reinforced thermoplastics, continuous fiber reinforced composites and 6061-T6 aluminum alloy.

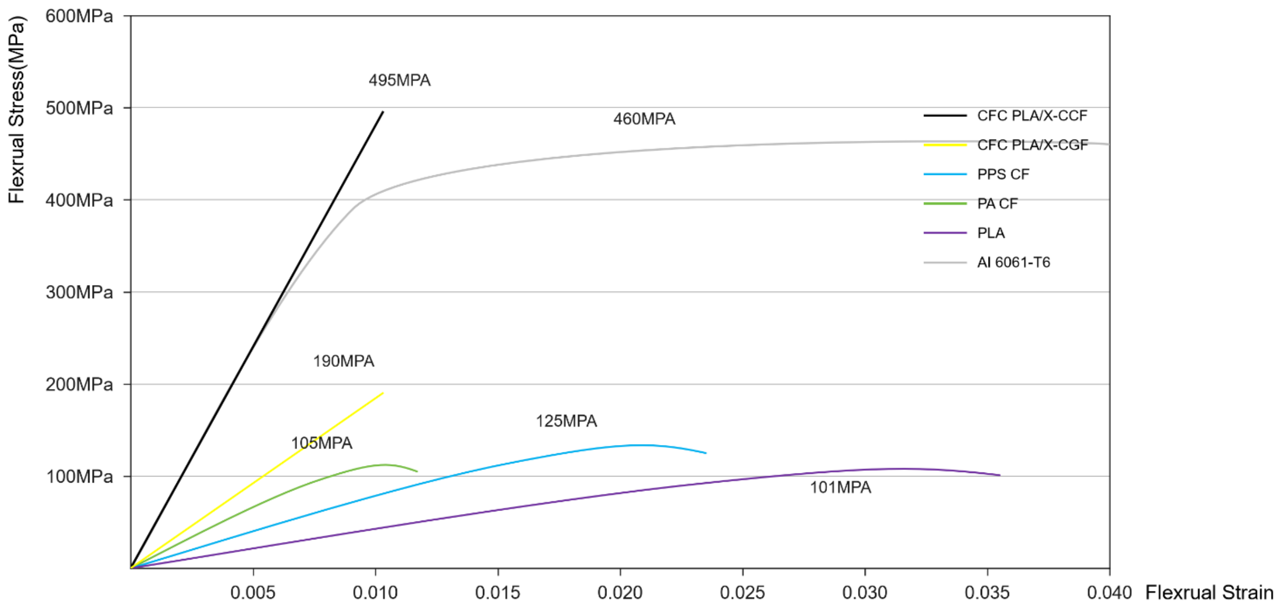

Figure 1 Bending Stress-Strain Comparison of CFC Composites, Engineering Plastics and Al 6061-T6

Flexural stress-strain curves demonstrate that continuous fiber composites possess better flexural performance than conventional printed thermoplastics and aluminum alloys. The X-CCF continuous carbon fiber composite reaches an ultimate flexural stress of 495 MPa and boasts the highest flexural modulus among all test samples. Its stiffness and flexural load-bearing capacity surpass those of 6061-T6 aluminum alloy (460 MPa). Continuous carbon fiber composites can reach or exceed metal-level flexural strength while remaining drastically lighter. Thanks to their high stiffness and low mass, they are perfect structural materials for components bearing large bending loads.

Tensile Strength

Conventional FDM plastics (neat PLA, short-carbon-fiber PA, short-carbon-fiber PPS) range 30–135 MPa in tensile strength, while 6061 aluminum alloy reaches 290 MPa. In contrast, X-CGF glass fiber composite hits 714 MPa and X-CCF carbon fiber composite hits 883 MPa. Their tensile strength is 2–3 times stronger than aluminum and dozens of times stronger than ordinary short-fiber materials. By transferring stress through unbroken continuous fibers, CFC technology overcomes the performance limits of standard short-fiber filaments for lightweight, high-load parts.

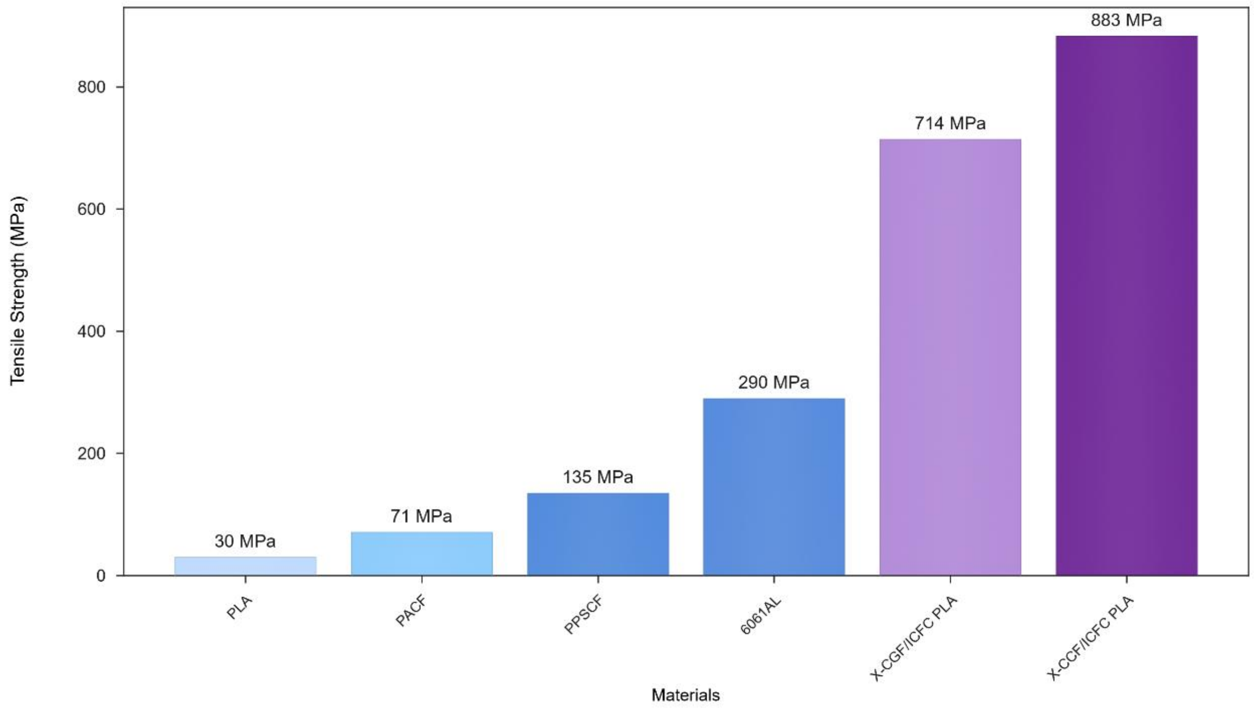

Figure 2 Tensile Strength Comparison of Various Materials

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Specimen Testing

Standard

ASTM D3039: Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials, see Astm D3039 PDF | PDF for details.

ASTM D6641: Standard Test Method for Compressive Properties of Polymer Matrix Composite Materials, see ASTM D6641 PDF | PDF for details.

ASTM D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials (3-Point Bending), see ASTM D790 PDF | PDF for details.

Method

Test equipment: UTM5504X-F Universal Testing Machine

Load Sensor: 50 kN

Fixture: Hydraulic fixture for tensile testing

Strain Measurement:

- Extensometer with 50 mm gauge length
- Transverse extensometer with 25 mm gauge length
- Deflectometer with 20 mm gauge length

Tensile loading rate: 2 mm/min;

Compressive loading rate: 1.3 mm/min;

Flexural loading rate: 1.37 mm/min

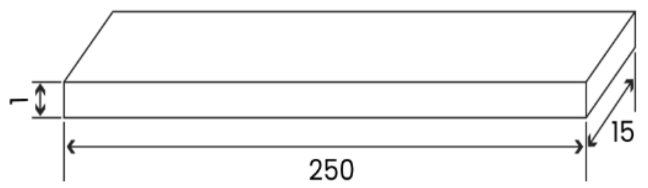
Specimen Dimensions

Tensile Specimen: 250 mm (Length) × 15 mm (Width) × 1 mm (Thickness)

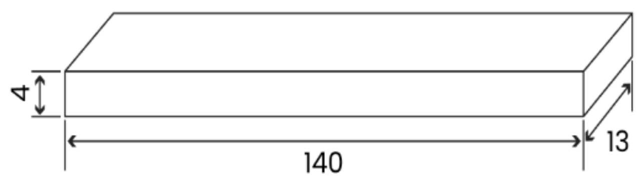
Compression Specimen: 140 mm (Length) × 13 mm (Width) × 4 mm (Thickness)

3-Point Bending Specimen: 127 mm (Length) × 12.7 mm (Width) × 3.2 mm (Thickness)

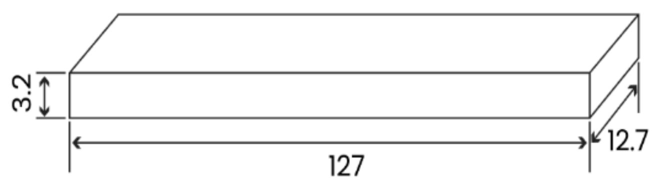
Dimensions of Tensile Specimen
(Unit: mm)



Dimensions of Compression Specimen
(Unit: mm)



Dimensions of 3 - Point Bending Specimen
(Unit: mm)



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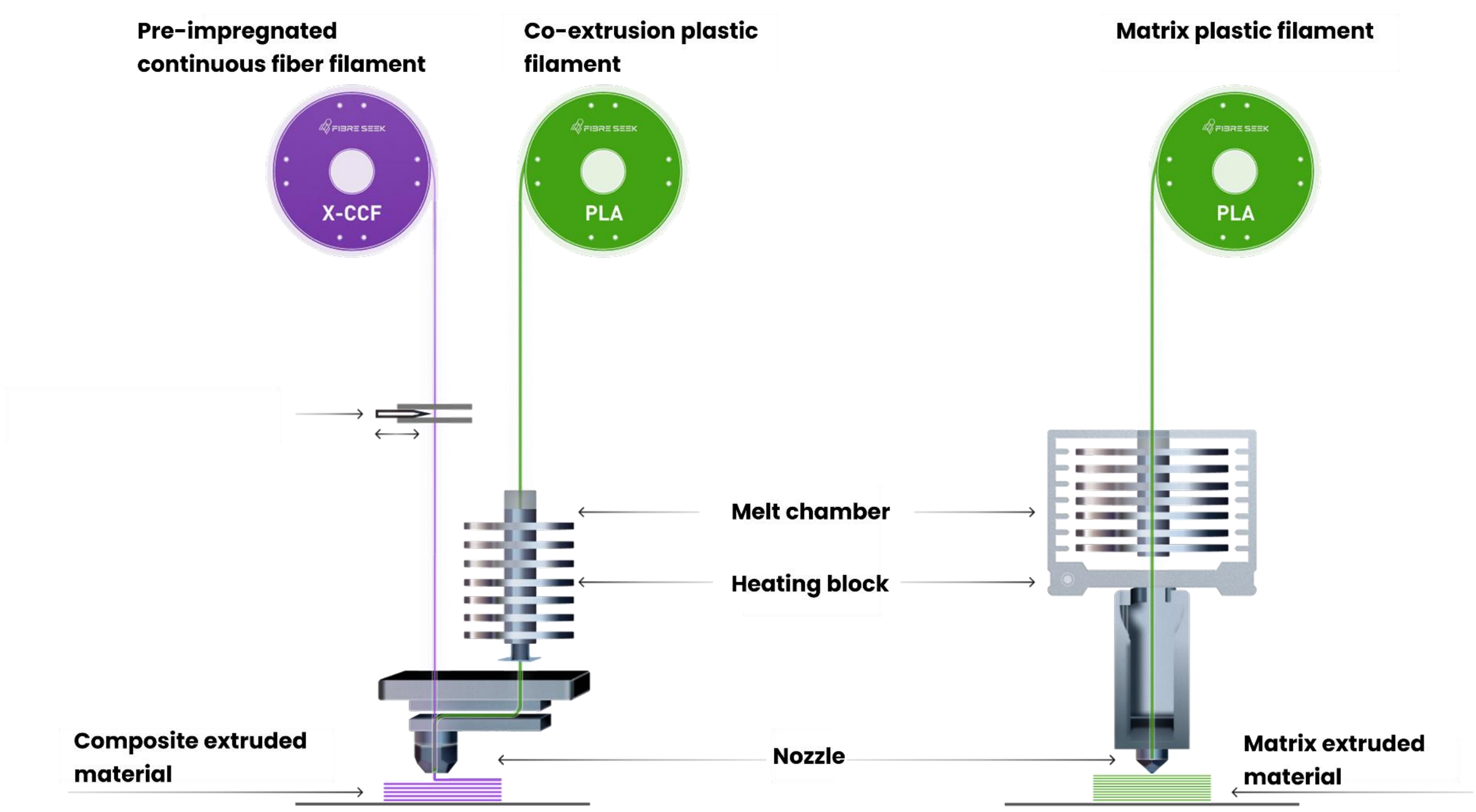
CFC Technology

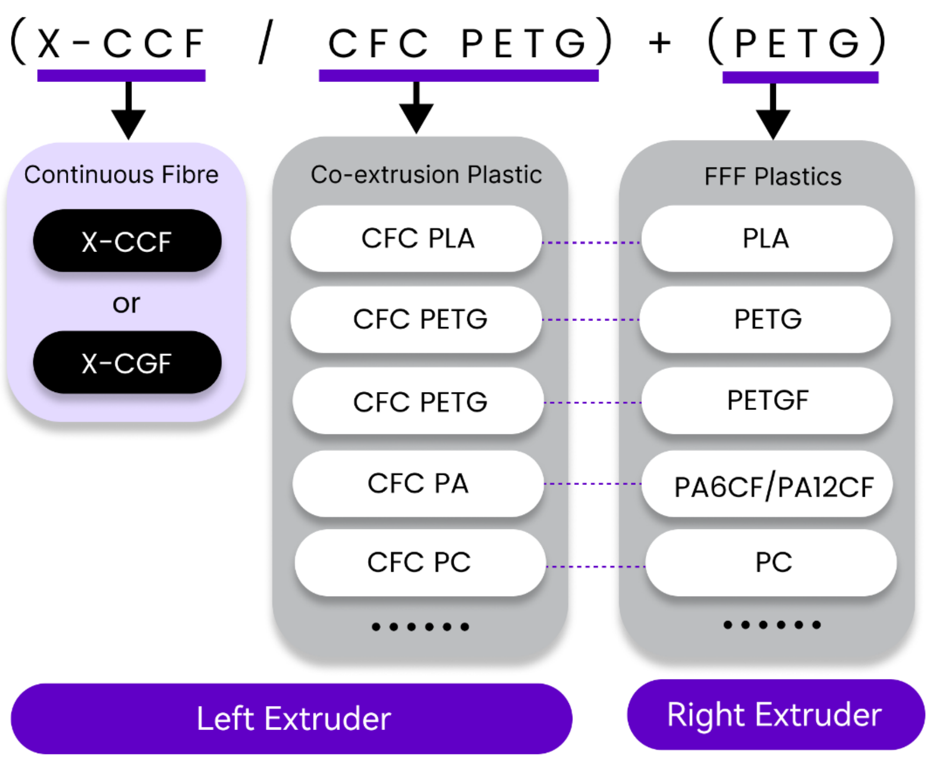
CFC (Composite Fiber Co-extrusion) is Anisoprint's proprietary core additive manufacturing technology. It was originally developed by the founding team in 2015 and specially optimized for fabricating high-performance composite components. It relies on a dual-printhead system. The composite co-extrusion printhead extrudes molten thermoplastic matrix alongside continuous reinforcing filaments (carbon fiber /glass fiber) in one pass to form an internal load-bearing skeleton. The second printhead prints pure base resin simultaneously to form the outer surface, guaranteeing premium surface finish and full structural integrity of finished parts.



Introduction to Composites

X-CCF and X-CGF are continuous fiber-reinforced filaments pre-impregnated with thermosetting resin. They cannot be printed independently and must be co-extruded with matrix plastics such as CFC PLA, CFC PETG and CFC PA.

The complete material system enables composite manufacturing based on the Continuous Fiber Co-extrusion (CFC) technology. The figure on the right elaborates the naming rule and combined molding principle of this material series.



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