PA12-CF 3D Printing Filament

Technical Data Sheet

Version: 2.0 **Issue Date:** 2025-06-18 **Status:** Released

1. Product Identification

Product Name	PA12-CF 3D Printing Filament
Material Type	Carbon Fiber Reinforced Polyamide 12 (PA12-CF)
Brand	SSSray

Product Introduction

PA12-CF (Carbon Fiber Reinforced Nylon 12) represents the next generation of high-performance engineering thermoplastics, combining the exceptional moisture resistance and dimensional stability of PA12 with the superior mechanical properties of carbon fiber reinforcement. This advanced composite filament delivers outstanding tensile strength, remarkable stiffness, and excellent thermal resistance while maintaining the low moisture absorption characteristics unique to PA12.

The incorporation of high-quality carbon fibers significantly enhances the mechanical performance of PA12, providing exceptional strength-to-weight ratio, excellent dimensional stability, and reduced thermal expansion. SSSray PA12-CF demonstrates superior layer adhesion and minimal warping compared to other fiber-reinforced materials, enabling reliable printing of large and complex geometry parts. The carbon fiber reinforcement contributes to reduced thermal shrinkage and improved print consistency.

Engineered for professional engineering applications, SSSray PA12-CF filament enables the production of lightweight structural components, functional prototypes, and end-use parts requiring high strength, thermal resistance, and moisture stability. The material excels in aerospace, automotive, robotics, and industrial equipment applications where the combination of high performance and moisture resistance is essential.

2. Core Features

Exceptional Tensile Strength

Carbon fiber reinforcement delivers superior tensile strength for demanding structural applications requiring high strength-to-weight ratios.

Superior Stiffness & Modulus

Significantly increased flexural and tensile modulus provides excellent rigidity and dimensional stability in printed components.

Low Moisture Absorption

PA12 base maintains excellent moisture resistance (<0.3%), ensuring stable performance in humid environments.

Outstanding Thermal Resistance

Enhanced HDT properties enable parts to maintain structural integrity at elevated temperatures up to 145°C(dry, printed specimens).

Excellent Wear Resistance

Carbon fiber content dramatically improves abrasion resistance, ideal for gears and sliding components.

Reduced Thermal Expansion

Carbon fiber minimizes thermal expansion coefficient, ensuring dimensional accuracy in thermal environments.

Typical Application Scenarios

- ✓ Lightweight structural components and brackets
- ✓ Robotics and automation equipment components
- ✓ High-performance gears and mechanical assemblies
- ✓ Marine and outdoor applications
- ✓ Electrical insulators and structural housings
- ✓ Aerospace and automotive functional parts
- ✓ Industrial jigs, fixtures, and manufacturing aids
- ✓ Functional prototypes for engineering validation
- ✓ Sporting equipment components
- ✓ Tooling and mold insert applications

3. Printing Parameters

Parameter	Recommended Range	Optimal Value
Nozzle Temperature	260°C - 280°C	**270°C**
Hot Bed Temperature	70°C - 1 0 0°C	**85°C**
Print Speed	30 - 2 0 0 mm/s	
First Layer Speed	15 - 20 mm/s	
Layer Fan Speed	0 - 50% (Lower cooling recommended for better layer adhesion)	
Chamber Temperature	Heated chamber recommended (45°C - 65°C) for optimal results	
Nozzle Material	Hardened steel or ruby nozzle strongly recommended (carbon fiber is abrasive)	
Retraction Settings	Distance: 1 -1.5mm | Speed: 25-40 mm/s	
Drying Conditions	80°C for 4-6 hours (recommended before printing)	

Important: ***PA12■CF is highly abrasive to standard brass nozzles. Use hardened steel or ruby■tipped nozzles to prevent rapid wear. While PA12 base has low moisture absorption, drying before printing is still recommended for optimal mechanical properties.***

Note: *Carbon fiber reinforcement makes this material abrasive. Always use hardened steel or ruby nozzles for extended printer operation. A heated enclosure is recommended to minimize warping and ensure consistent mechanical properties.*

4. Physical Properties

4.1 Physical Properties

Property	Typical Value	Test Standard	Unit
Net Weight	1 kg (Other specifications available upon request)	-	kg
Density	1.07	ISO 1183 / ASTM D792	g/cm³
Melt Flow Rate (MFR)(280°C / 2.16 kg)	15 - 28	ISO 1133	g/10min
Filament Diameter	1.75 ± 0.03 / 2.85 ± 0.03	-	mm
Roundness Deviation	≤ 0.02	-	mm
Carbon Fiber Content	10	-	%

4.2 Mechanical Properties

Property	Typical Value	Test Standard	Unit
Tensile Strength (XY)	81 ± 3	ISO 527-2 / ASTM D638	MPa
Tensile Modulus (XY)	6,250	ISO 527-2 / ASTM D638	MPa
Elongation at Break	3 - 8	ISO 527-2 / ASTM D638	%
Flexural Strength (XY)	95	ISO 178 / ASTM D790	MPa
Flexural Modulus (XY)	5,000	ISO 178 / ASTM D790	MPa
Izod Impact Strength (Notched)	6 - 11	ISO 180	kJ/m²
Charpy Impact Strength	8 - 14	ISO 179-1	kJ/m²
Shore D Hardness	81	ISO 868 / ASTM D2240	-

4.3 Thermal Properties

Property	Typical Value	Test Standard	Unit
Glass Transition Temperature (Tg)	52.2	ISO 11357-2 / ASTM D3418	°C
Heat Deflection Temperature (HDT @ 0.455 MPa)	145	ISO 75-2 / ASTM D648	°C

Heat Deflection Temperature (HDT @ 1.82 MPa)	98	ISO 75-2 / ASTM D648	°C
Vicat Softening Temperature	168	ISO 306 / ASTM D1525	°C
Melting Temperature	178 - 185	ISO 11357-2 / ASTM D3418	°C

4.4 Other Properties

Property	Typical Value	Test Standard	Unit
Water Absorption (24h)	0.15 - 0.25	ISO 62	%
Continuous Use Temperature	≤ 120(depending on load / environment)	-	°C

Note: *All mechanical and thermal property values are based on 3D printed specimens printed under standard conditions (0.2mm layer height, 100% infill, XY plane orientation) unless otherwise specified. Actual performance may vary based on printing parameters, equipment calibration, and part design. Carbon fiber orientation affects anisotropic properties; mechanical performance in Z-direction may differ from XY-plane values.*

5. Storage & Handling

Storage Environment

- Store in a cool, dry environment with relative humidity below 50%
- Recommended storage temperature: 15°C - 25°C (59°F - 77°F)
- Avoid exposure to direct sunlight or UV radiation
- Keep packaging sealed until ready for use

Packaging Requirements

- Vacuum-sealed packaging with desiccant moisture absorber
- Spool wound with consistent tension to prevent tangling
- Material lot number and production date clearly marked

Desiccant Storage Recommendations

- Reuse of original packaging desiccants is not recommended
- For extended storage, use additional food-grade silica gel desiccant
- Store opened spools in airtight containers with fresh desiccant
- Filament dry boxes with integrated desiccant are strongly recommended
- PA12-CF absorbs less moisture than PA6-CF, but active drying is still beneficial

Shelf Life

Under proper storage conditions, unopened PA12-CF filament maintains optimal performance for 12-24 months from production date. Once opened, material should be used within 3-6 months for best results. PA12 base provides significantly lower moisture absorption than PA6, but proper storage will ensure optimal print quality and mechanical properties.

Moisture Absorption Indicators

Since this product ships in sealed packaging with desiccant, moisture issues typically occur only after opening. Since the packaging is sealed, if opened material shows moisture symptoms, it is clearly indicated that moisture has been absorbed. Signs of moisture absorption include:

- Excessive steam venting or popping sounds during extrusion
- Poor surface quality with bubbles, voids, or imperfections
- Inconsistent extrusion with varying line widths
- Reduced mechanical strength and increased brittleness
- Poor layer adhesion and visible delamination
- Increased stringing and oozing during travel moves

Remediation: If moisture symptoms are observed, dry the filament at 80°C for 4-6 hours in a convection oven with airflow. Alternatively, use a dedicated filament dryer at 70-80°C for 3-4 hours. Allow to cool to room temperature before loading into printer. Store in airtight container with fresh desiccant immediately after drying. PA12-CF requires shorter drying times than PA6-CF due to its lower moisture absorption rate.

6. Safety & Certifications

Certification	Status	Description
RoHS (Restriction of Hazardous Substances)	Compliant	Meets EU Directive 2015/863/EU on hazardous substance restrictions
CE Marking	Certified	Conforms to applicable EU safety and environmental directives
SDS (Safety Data Sheet)	Available	Detailed safety information available upon request
Third-Party Quality Verification	Available on Request	Independent testing reports provided as required (fees may apply)

Note: *This product is not certified for food-contact or medical applications. Please contact our technical team for information on materials suitable for specific compliance requirements.*

7. Product Positioning

7.1 Comparison with Industry Standard Materials

Property	PA12-CF	PA12	PA6-CF
Density (g/cm³)	1.07	1.02	1.17
Tensile Strength (MPa)	81 ± 3	49 ± 3	82 ± 3
Tensile Modulus (MPa)	6,250	1,850	7,850
Heat Resistance (HDT @0.455MPa,°C)	145	116	187
Water Absorption (24h %)	0.15 - 0.25	0.2 - 0.3	0.9 - 1.2
Print Difficulty	Moderate	Easy-Moderate	Moderate-High
Moisture Sensitivity	Very Low	Low	High
Abrasiveness	High	Low	High

7.2 Performance Rating

Performance Dimension	Rating	Description
Printability	★★★☆☆	Moderate - Requires hardened nozzle and heated chamber recommended
Tensile Strength	★★★★☆	Very Good - Superior mechanical performance for structural applications
Stiffness & Modulus	★★★★★	Excellent - Carbon fiber provides exceptional rigidity and dimensional stability
Heat Resistance	★★★★☆	Very Good - High HDT suitable for elevated temperature applications
Moisture Resistance	★★★★★	Excellent - PA12 base provides superior moisture stability

Target Applications: *SSSray PA12-CF is optimized for applications requiring the best combination of high strength, stiffness, thermal resistance, and moisture stability. Ideal for functional parts in humid environments where PA6-CF would absorb too much moisture.*

8. Troubleshooting Guide

Problem 1: Warping and Poor Bed Adhesion

Possible Causes: Insufficient bed temperature, inadequate enclosure heating, carbon fiber content causing increased stiffness.

Solutions: Increase bed temperature to 70-90°C. Use heated chamber at 45-65°C. Apply adhesion aids (PEI sheet, glue stick, hairspray). Use brim or raft for large flat parts. Ensure enclosure is sealed from drafts.

Problem 2: Nozzle Wear and Abrasion

Possible Causes: Carbon fiber particles are highly abrasive to standard brass nozzles.

Solutions: Immediately replace brass nozzles with hardened steel or ruby-tipped nozzles. Inspect nozzles regularly for wear. Monitor extrusion consistency for signs of nozzle diameter increase. Consider using abrasive-resistant nozzles specifically designed for carbon fiber materials.

Problem 3: Steam Venting and Poor Extrusion

Possible Causes: Excessive moisture in filament from inadequate drying.

Solutions: Dry filament at 80°C for 4-6 hours before printing. Use fresh desiccant in storage containers. Consider heated dry box during printing. Never print wet filament as steam will cause extrusion failures and compromised mechanical properties.

Problem 4: Stringing and Oozing

Possible Causes: Temperature too high, insufficient retraction, moisture contamination.

Solutions: Reduce nozzle temperature by 5°C increments. Increase retraction distance to 4-7mm and speed to 25-40 mm/s. Dry filament thoroughly if moisture suspected. Use coasting and wipe settings in slicer.

Problem 5: Poor Layer Adhesion

Possible Causes: Temperature too low, excessive cooling, moisture, insufficient overlap.

Solutions: Increase nozzle temperature by 5°C increments up to 270°C. Reduce or disable cooling fan. Ensure filament is thoroughly dried. Increase print temperature within recommended range. Use enclosed heated chamber to maintain consistent ambient temperature.

Problem 6: Brittleness and Surface Imperfections

Possible Causes: Filament absorbed moisture, thermal degradation from excessive temperature, carbon fiber brittleness.

Solutions: Ensure filament is properly dried before printing. Reduce nozzle temperature if degradation suspected. Cool printed parts slowly in enclosed chamber. Verify no moisture re-absorption during storage. Adjust cooling settings to reduce thermal stresses.

9. Disclaimer & Limitation of Liability

DISCLAIMER & LIMITATION OF LIABILITY

The typical values presented in this datasheet are intended for reference and comparison purposes only. They should not be used for design specifications or quality control purposes. Actual values may vary significantly with printing conditions,

equipment calibration, environmental factors, and part design.

End-use performance of printed parts depends not only on material properties, but also on part design, wall thickness, print orientation, environmental conditions, printing parameters, and post-processing methods. Users should conduct their own testing to verify suitability for specific applications.

Product specifications are subject to change without notice. SSSray reserves the right to modify formulations and specifications to improve product quality or performance.

Each user is responsible for determining the safety, lawfulness, technical suitability, and disposal/recycling practices of SSSray materials for the intended application. SSSray makes no warranty of any kind, unless announced separately, as to the fitness for any particular use or application. SSSray shall not be held liable for any damage, injury, or loss induced from the use of SSSray materials in any application.

This document does not constitute technical advice. For technical support or custom formulation inquiries, please contact our technical team.

10. Document Revision History

Version	Issue Date	Author	Description
v2.0	2025-06-18	SSSray Technical	Product iteration - Updated specifications and formatting
v1.0	2024-01-15	SSSray Technical	Initial release

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