forward am

Ultrafuse® PLA

Easy to print | Food safe | Low warpage

Extended TDS

Complete Technical Documentation and Testing Summary

Version 1.4

Contents

Technical Data Sheet 3

Food Contact Certification 7

Compostability Ultrafuse® PLA 8

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Technical Data Sheet

Ultrafuse® PLA is a biobased, beginner-friendly and easy to print material.

PLA is one of the most used materials for 3D printing. Ultrafuse® PLA is available in a wide range of colors. The glossy feel often attracts those who print display models or items for household use. Many appreciate the **plant-based** and **food-safe** of this raw material. When properly cooled, PLA has a high maximum printing speed and sharp printed corners. Combining this with low warping of the print makes it a popular plastic for home printers, hobbyists, prototyping and schools.

Filament Properties		
Filament Diameter	1.75 mm	2.85 mm
Average Diameter Tolerance	±0.050 mm	±0.1 mm
Average ovality	<0.050 mm	<0.050 mm
Available Spool size	750 g (Phase Out), 1.0 kg, 2.0 kg, 4.0 kg, 8.0 kg	750 g (Phase Out), 1.0 kg, 2.0 kg, 4.0 kg, 8.0 kg
Available colors:		
	Natural	N.A.
	Black	RAL ca. 9005
	White	RAL ca. 9010
	Red	RAL ca. 3020
	Blue	RAL ca. 5002
	Green	RAL ca. 6018
	Yellow	RAL ca. 1003
	Orange	RAL ca. 2008
	Grey	RAL ca. 7045

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Please contact us for further product information, like for example **REACH, RoHS, FCS, WEEE.**

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Process materials in a well-ventilated room, or use professional extraction systems.

Spool Properties					
Spool size	750 g	1.0 kg	2.0 kg	4.0 kg	8.0 kg
Outer diameter	200 mm	200 mm	300 mm	350 mm	355 mm
Inner diameter	52 mm	52 mm	51.5 mm	51.7 mm	36 mm
Width	68 mm	68 mm	103 mm	103 mm	167 mm

Recommended 3D-Print processing parameters		Used for test specimens
Printer	FFF printer	UltiMaker 3
Nozzle Temperature	210 – 230 °C	220 °C
Build Chamber Temperature	-	Closed chamber, passively heated
Bed Temperature	50 – 70 °C	60 °C
Bed Material	Glass, PEI, Magnetic Flex, Glue	Glass+3DLac
Nozzle Diameter	≥ 0.4 mm	0.4 mm
Print Speed[1)]	40 - 159 mm/s	40 mm/s
Max Volumetric Speed[2)]	12 mm^3/s	//

Please check your standard and/or high speed print profile availability for an easy start at www.forward-am.com.

Further Recommendations	
Drying recommendations to ensure printability and best mechanical properties[3)]	PLA is in a printable condition, drying is not necessary.
Support material compatibility	Single material breakaway, Ultrafuse® BVOH
Warehousing	Ultrafuse® PLA filament should be stored at 15 - 25°C in its originally sealed package in a clean and dry environment. If the recommended storage conditions are observed the products will have a minimum shelf life of 24 months.

[1] Fast printing might require an additional increase of the nozzle temperature; the stated printing speed of 159 mm/s is based on current validations. As equipment and technology continues to evolve, it is possible that even higher printing speeds may be attainable in the future.
[2] Based on Bambu Lab X1C with a nozzle diameter of 0.4 mm and 0.2 layer height.
[3] Please note: To ensure constant material properties the material should always be kept dry.

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General Properties	Standard	Average Values
Filament Density[4)]	ISO 1183-1	1252 kg/m³
Printed Part Density	ISO 1183-1	1248 kg/m³
Poisson-Number	ISO 527	0.35 (XY)

Tensile Properties[5)]	Standard	Average Values		
		XY-Direction[6)]	XZ-Direction[7)]	ZX-Direction[8)]
Tensile strength[9)]	ISO 527	34.7 MPa	-	21.2 MPa
Elongation at Break[9)]	ISO 527	4.2 %	-	1.2 %
Young's Modulus[10)]	ISO 527	2308 MPa	-	2131 MPa

Flexural Properties[6) 11)]	Standard	Average Values		
		XY-Direction	XZ-Direction	ZX-Direction
Flexural Strength	ISO 178	98 MPa	105 MPa	54.9 MPa
Flexural Modulus	ISO 178	1860 MPa	1708 MPa	1715 MPa
Flexural Elongation at Break	ISO 178	4.8 %	4.2 %	1.9 %

[4] measured on filament

[5] Samples were conditioned in standard climate (23°C, 50% RH 72h)

[6]



[7]



[8]



[9] Testing speed: 5 / 200 mm/min
[10] Testing speed: 1 mm/min
[11] Testing speed: 2 mm/min

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Impact Properties[6)]	Standard	Average Values		
		XY-Direction	XZ-Direction	ZX-Direction
Impact Strength Charpy (notched)	ISO 179-2	2.5 kJ/m²	1.9 kJ/m²	1.7 kJ/m²
Impact Strength Charpy (unnotched)	ISO 179-2	13.2 kJ/m²	14.3 kJ/m²	4.3 kJ/m²
Impact Strength Izod (notched)	ISO 180	3.3 J/m	2.1 J/m	1.6 J/m
Impact Strength Izod (unnotched)	ISO 180	11.0 J/m	9.6 J/m	4.7 J/m

For the diagrams on mechanical properties see Chapter: Mechanical Properties Diagrams

Thermal Properties[6)]	Standard	Average Values
HDT A at 1.8 MPa	ISO 75-2	55.5 °C
HDT B at 0.45 MPa	ISO 75-2	57.4 °C
Vicat softening point at 50 N	ISO 306	56.9 °C
Vicat softening point at 10 N	ISO 306	59.5 °C
Glass Transition Temperature	ISO 11357-2	61 °C
Melting Temperature	ISO 11357-3	151 °C
Melt Volume-Flow Rate (MVR)	ISO 1133	21.2 cm³/10 min (220 °C, 5 kg)

For the diagrams on thermal properties see Chapter: Thermal Properties Diagrams.

Hardness and Abrasion	Standard	Typical Values
Shore Hardness A (30s)	DIN ISO 7619-1	97
Shore Hardness D (15s)	DIN ISO 7619-1	73

Compatibility	Standard	Typical Values
Food Contact Certification (FCC)	The used raw materials comply with food contact regulations of the European Parliament and the Food and Drug Administration	EU 10/2011 FDA 21 CFR

For the statement on FFC data see Chapter Food Contact Certification.

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Food Contact Certification

FCC Ultrafuse® PLA

Date: May 13th, 2022

Version no.: 1.1

Dear customer,

At the date of issue, we can confirm that the raw materials used for the production of our PLA filaments are suitable for use in food contact applications in the European Union according to the European Plastics Regulation (EU) no. 10/2011.

Regarding the color batches used for the production we refer to Annex II of Regulation (EU) no. 10/2011. Objects produced using our PLA filaments should not release the substances listed (barium, cobalt, copper, iron, lithium, manganese, zinc, and primary aromatic amines) exceeding the specific migration limits as mentioned in Annex II.

All color batches used for the production of our colored filaments contain zinc (zinc-restriction: SML = 5 mg/kg). The following color batches used for the production of our filaments contain copper (copper-restriction: SML 5 mg/kg): Blue, Army Green, Green, Sky Blue.

Also, we can confirm that the raw materials used for the production of our PLA filaments are suitable for use in food contact applications according to the FDA (food and drug administration) Regulation 21 CFR. This excludes the following colors: Red, Orange, Orange TR, Blue TR, Ice Blue TR, Dark Green TR, Pink, Magenta, Apricot Skin and Grey.

Since Forward AM is not the manufacturer of the final (3D printed) product, the responsibility to test if the final product complies with national and international legislation rests with the user of the filament.

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Compostability Ultrafuse® PLA

Date: April 27th, 2021

Version no.: 1.0

Dear customer,

Forward-AM Ultrafuse® PLA natural is a certified industrial compostable[1] biopolymer in accordance with standards such as DIN V 54900-1, EN 13432 and ASTM D 6400.

Based on the information available to us from our raw material suppliers, and our knowledge of the products' compositions, our Ultrafuse® PLA natural meets the requirement of the below mentioned standards with limitation of a maximum thickness of 2.0 mm:

- DIN V 54900-1, is a German standard that focuses on the chemical assessment of the biodegradability of polymeric materials under controlled composting conditions.
- EN 13432, is a European standard that specifies the requirements for packaging materials and components to be considered compostable and biodegradable under aerobic conditions in industrial composting facilities.
- ASTM D6400, is and American standard to determine if a plastic will compost satisfactorily industrial facilities.

[1]Composting is a process that transforms organic waste into a valuable soil amendment. Ultrafuse® PLA natural is industrial compostable material requiring specific conditions for degradation, such as those found in dedicated municipal or industrial composting facilities. These facilities maintain precise control over factors like temperature, humidity, oxygen levels, and material composition. Without these controlled conditions, PLA will not decompose adequately. Further, colored versions of PLA have not been evaluated for compostability.

Ultrafuse® PLA biopolymer is composed of polylactic acid, which can undergo a two-step breakdown process. Initially, moisture and heat within the compost pile break down the polymer chains into smaller fragments and lactic acid. Microorganisms present in the compost then consume these fragments and lactic acid as nutrients. Since lactic acid is naturally abundant, many organisms, including fungi and bacteria, can metabolize it. The end products of this process are carbon dioxide, water, and humus, a soil-enriching substance. The rate of degradation is influenced by temperature and humidity. The mentioned regulatory guidelines and standards for composting revolve around four basic criteria: Material Characteristics, Biodegradation, Disintegration, and Ecotoxicity. The ASTM D6400 and EN 13432 specification for industrial composting defines 84 days as reasonable for fragmentation of the product, and 180 days for complete mineralization in a properly managed composting facility.

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