forward am

Ultrafuse® PET

Strong | easy to handle | amorphous

Extended TDS

Complete Technical Documentation and Testing Summary

Version 1.0

Contents

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Technical Data Sheet

Easy to print as PLA material, with good layer adhesion.

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, 2.0 kg, 4.0 kg, 8.0 kg	750 g, 2.0 kg, 4.0 kg, 8.0 kg
Available colors	natural, white, black, …	

Spool Properties				
Spool size	750 g	2.0 kg	4.0 kg	8.0 kg
Outer diameter	200 mm	300 mm	350 mm	355 mm
Inner diameter	50.5 mm	51.5 mm	51.7 mm	36 mm
Width	55 mm	103 mm	103 mm	167 mm

Recommended 3D-Print processing parameters		Used for test specimens
Printer	FFF printer	Ultimaker S5
Nozzle Temperature[1)]	220 – 260 °C	275 °C
Build Chamber Temperature	-	-
Bed Temperature	60 – 80 °C	65 °C
Bed Material	Glass	glass
Nozzle Diameter	≥ 0.4 mm	0.4 mm
Print Speed	40 - 80 mm/s	45 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.

[1] Fast printing might require an additional increase of the nozzle temperature; the stated printing speed of 300 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 XX mm

Further Recommendations	
Drying recommendations to ensure printability and best mechanical properties[3)]	60 °C in a hot air dryer or vacuum oven for 4 to 16 hours
Support material compatibility	Single material breakaway, Ultrafuse® BVOH

General Properties	Standard	Average Values
Filament Density[4)]	ISO 1183-1	987 kg/m^3
Poisson-Number	ISO 527	0.42

[3] Please note: To ensure constant material properties the material should always be kept dry.
[4] measured on filament

Tensile Properties[5]	Standard	Average Values		
		XY-Direction[6]	XZ-Direction[7]	ZX-Direction[8]
Tensile strength[9]	ISO 527	33.4 MPa	-	17.2 MPa
Elongation at Break[9]	ISO 527	2.7 %	-	1.1 %
Young's Modulus[10]	ISO 527	1933 MPa	-	1665 MPa

Flexural Properties[6] [11]	Standard	Average Values		
		XY-Direction	XZ-Direction	ZX-Direction
Flexural Strength	ISO 178	66.7 MPa	76.1 MPa	54.4 MPa
Flexural Modulus	ISO 178	2063 MPa	1840 MPa	1826 MPa
Flexural Elongation at Break	ISO 178	4.6 %	4.6 %	3.0 %

Impact Properties[6]	Standard	Average Values		
		XY-Direction	XZ-Direction	ZX-Direction
Impact Strength Charpy (notched)	ISO 179-2	1.6 kJ/m²	1.4 kJ/m²	1.2 kJ/m²
Impact Strength Charpy (unnotched)	ISO 179-2	18.4 kJ/m²	9.7 kJ/m²	4.6 kJ/m²
Impact Strength Izod (notched)	ISO 180	2.1 kJ/m²	1.9 kJ/m²	1.8 kJ/m²
Impact Strength Izod (unnotched)	ISO 180	12.3 kJ/m²	7.7 kJ/m²	4.1 kJ/m²

[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
Measured on milled specimens

The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, these data do not relieve processors from carrying out their own investigations and tests; neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose. Any descriptions, drawings, photographs, data, proportions, weights etc. given herein may change without prior information and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed. Values in this document are average values, measured and calculated according to the instructions in the listed standards. The used specimens are produced with the Fused Filament Fabrication method. Measured values can vary depending on used print orientation and print parameters.

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

The safety data given in this publication is for informational purposes only and does not constitute a legally binding MSDS. The relevant MSDS can be obtained upon request from your supplier or you may contact Forward AM Technologies GmbH directly at sales@forward-am.com.

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

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	64 °C
HDT B at 0.45 MPa	ISO 75-2	66 °C
Vicat softening point at 50 N	ISO 306	64 °C
Vicat softening point at 10 N	ISO 306	67 °C
Glass Transition Temperature	ISO 11357-2	71 °C
Melt Volume-Flow Rate (MVR)	ISO 1133	16.3 cm^3/10 min (220 °C, 2.16 kg)

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

Certification	Standard	
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[12]

For the statement on Biocompatibility data see Chapter Biocompatibility.

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

[12] excludes the following colors: Grey, Orange, Red, and White

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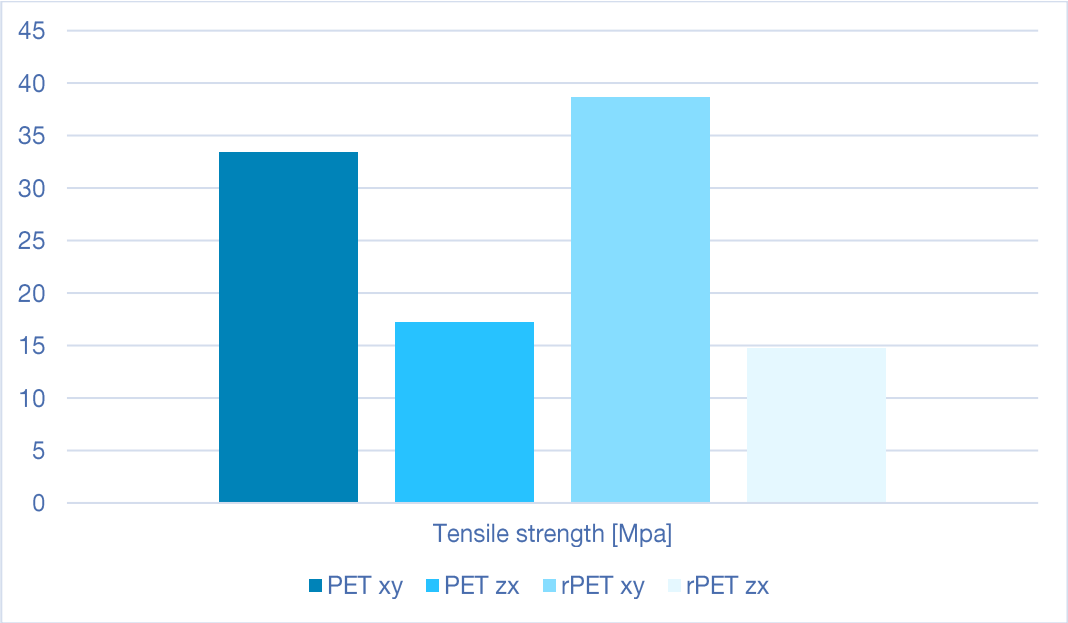
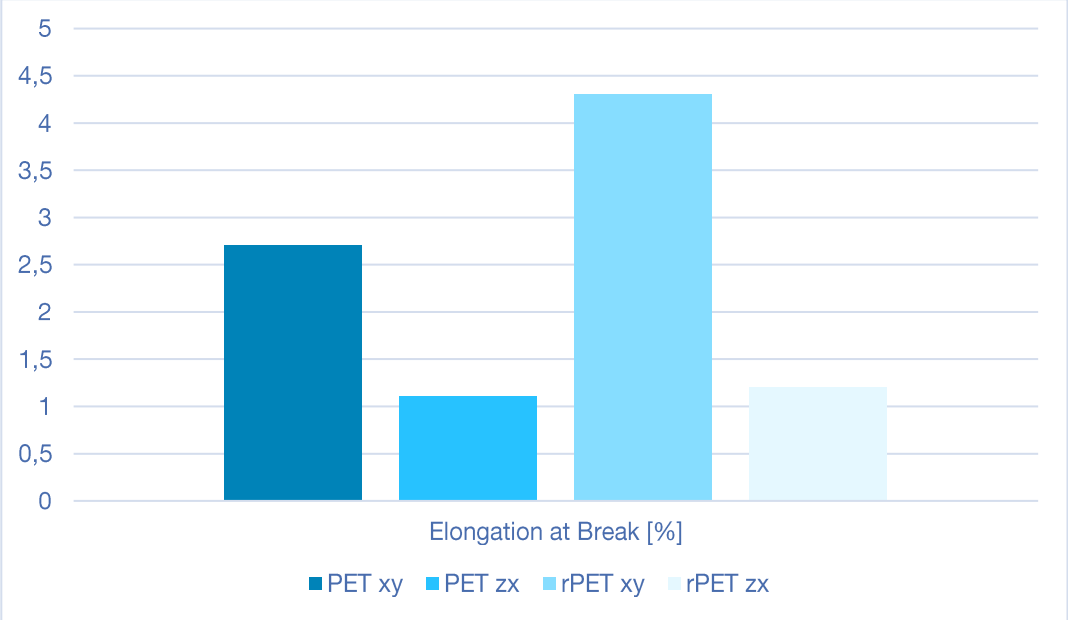
Process materials in a well-ventilated room, or use professional extraction systems.

Mechanical Propertie Diagrams

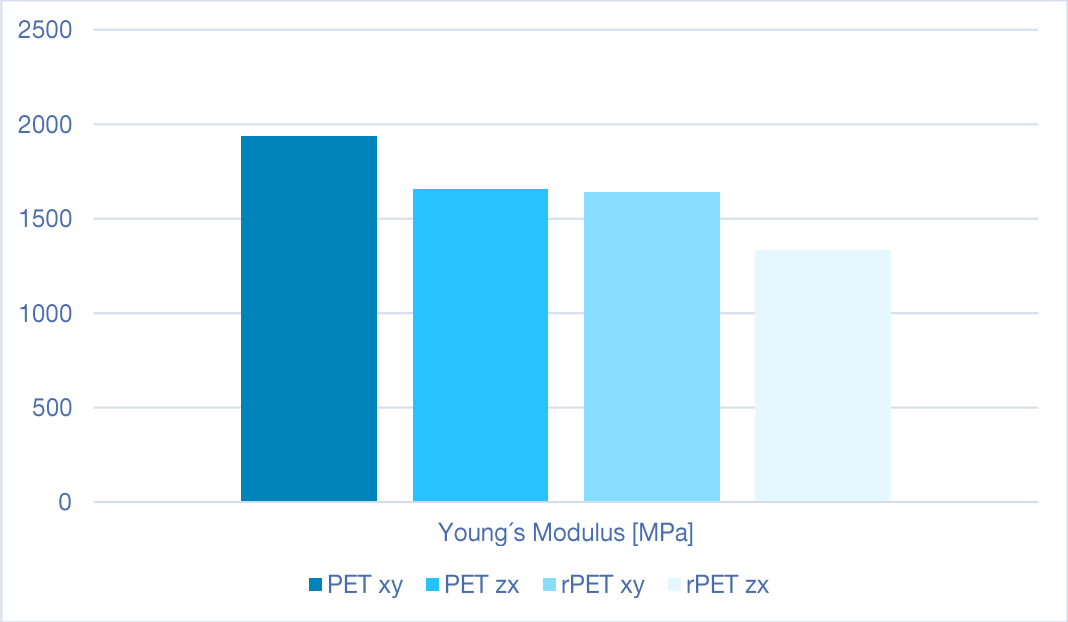
Comparison Ultrafuse® PET and Ultrafuse® rPET



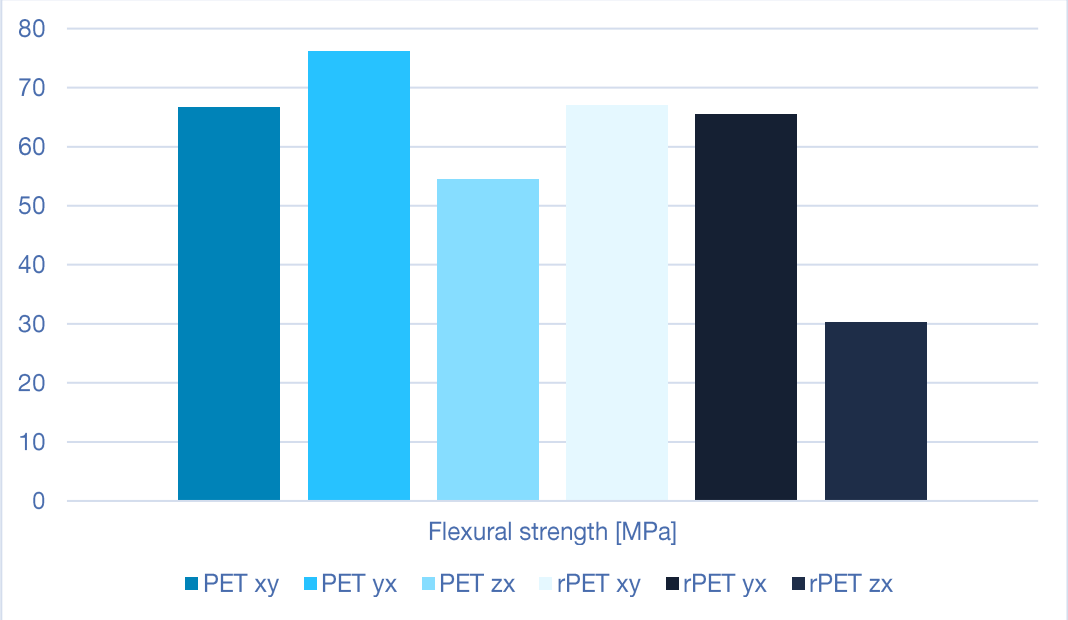
Tensile strength comparison Ultrafuse® PET and Ultrafuse® rPET



Elongation at Break comparison Ultrafuse® PET and Ultrafuse® rPET



Young´s modulus comparison Ultrafuse® PET and Ultrafuse® rPET



Flexural strength comparison Ultrafuse® PET and Ultrafuse® rPET

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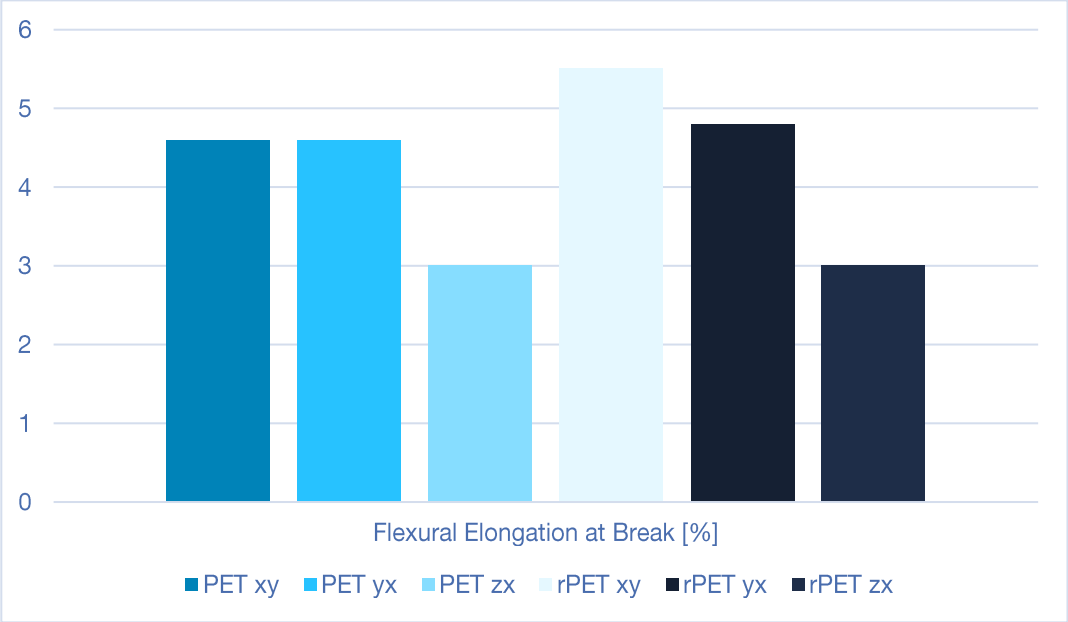
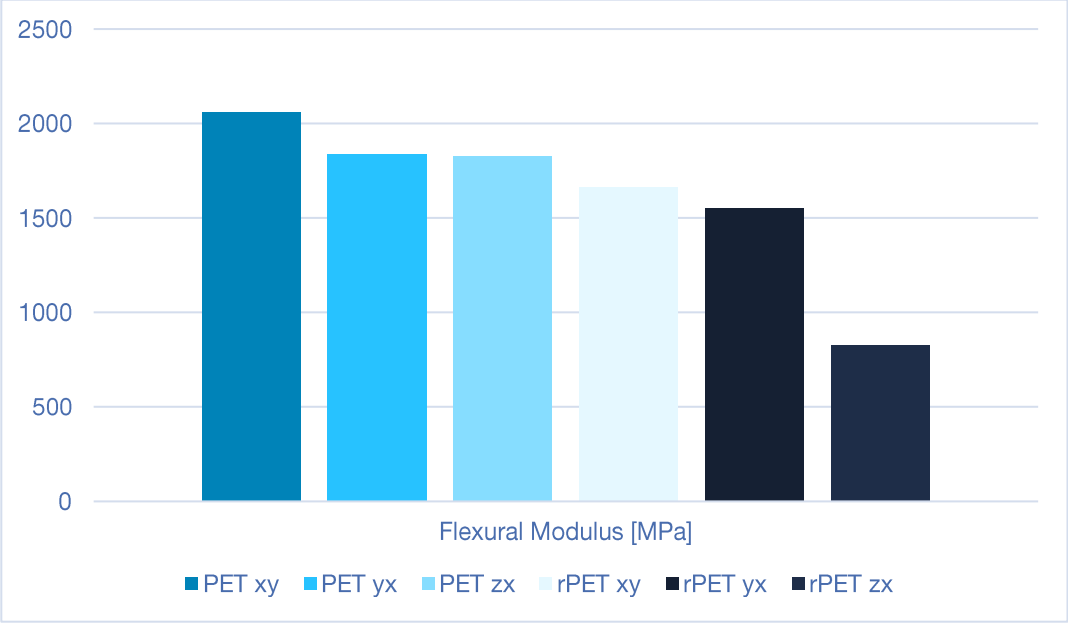


Flexural Elongation at Break comparison Ultrafuse® PET and Ultrafuse® rPET



Flexural Modulus comparison Ultrafuse® PET and Ultrafuse® rPET

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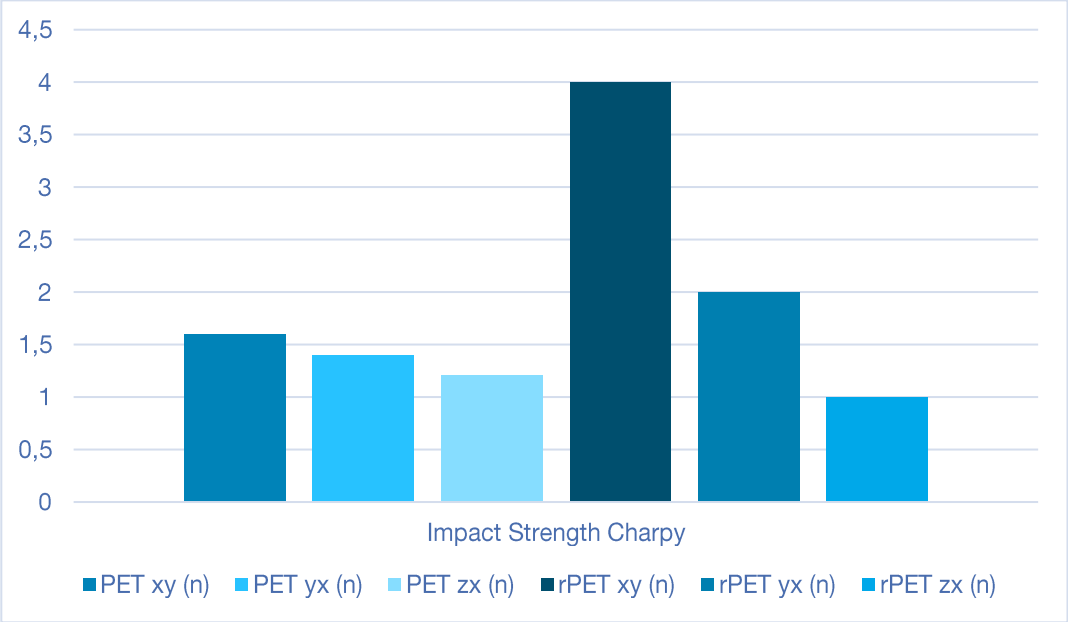
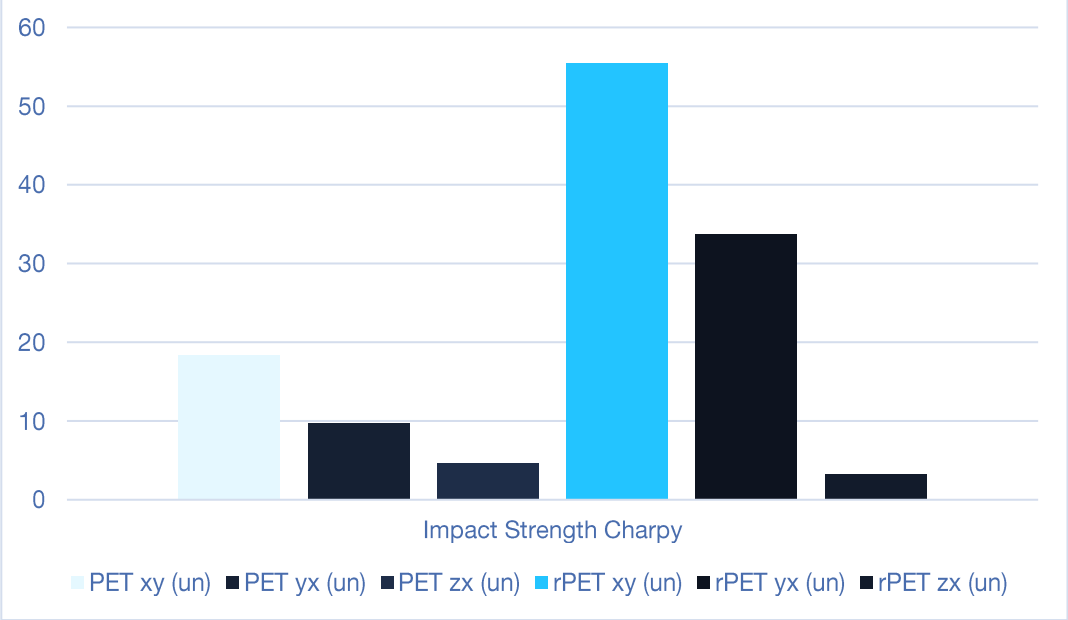


Impact Strength Charpy notched comparison Ultrafuse® PET and Ultrafuse® rPET



Impact Strength Charpy unnotched comparison Ultrafuse® PET and Ultrafuse® rPET

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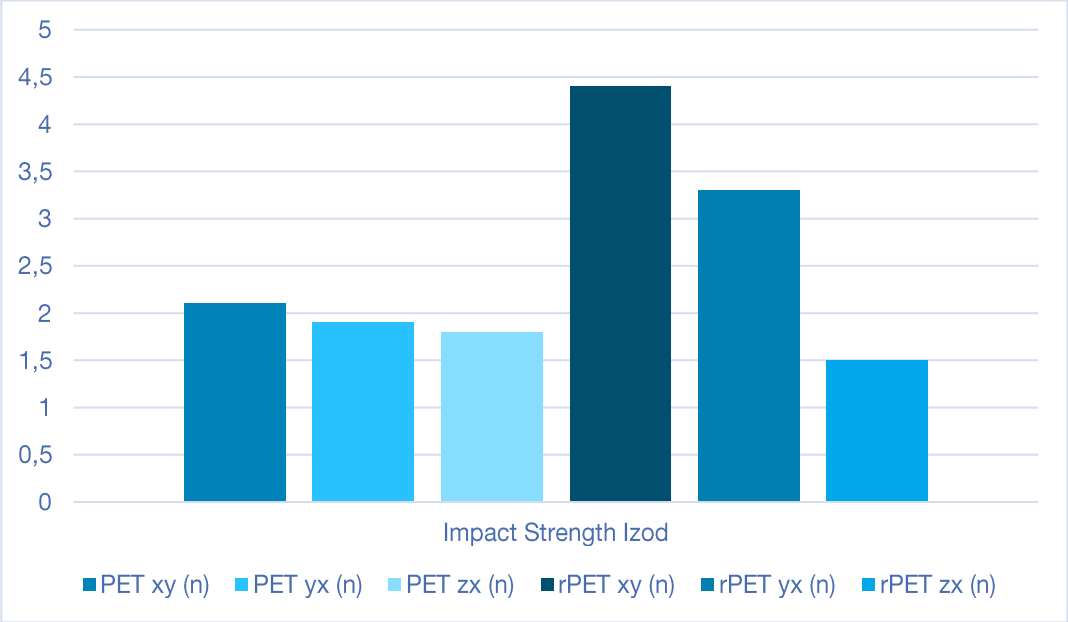
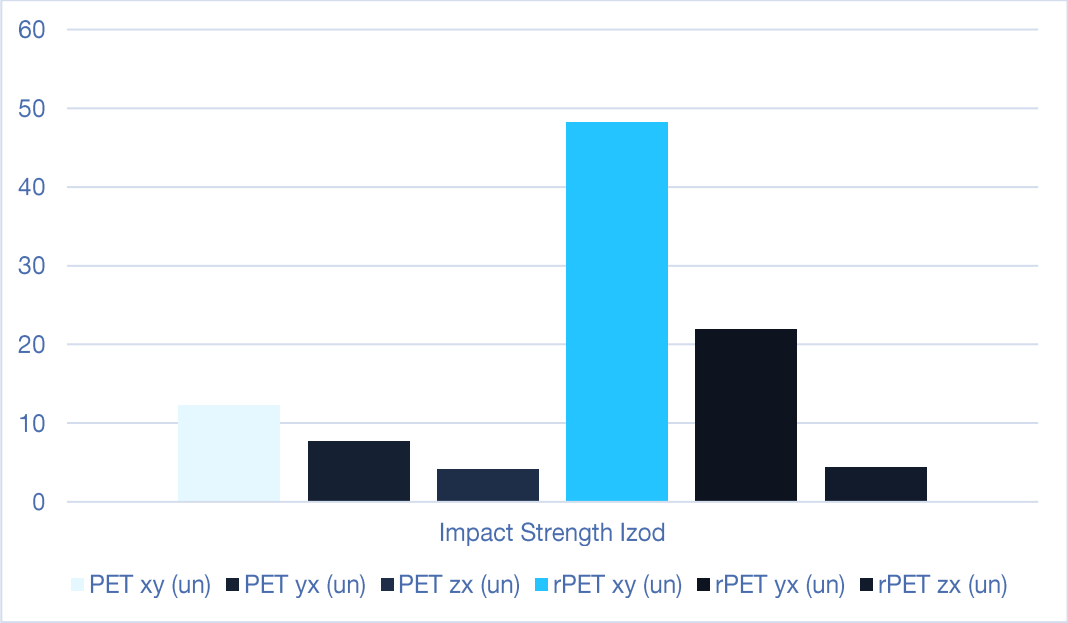


Impact Strength Izod notched comparison Ultrafuse® PET and Ultrafuse® rPET



Impact Strength Izod unnotched comparison Ultrafuse® PET and Ultrafuse® rPET

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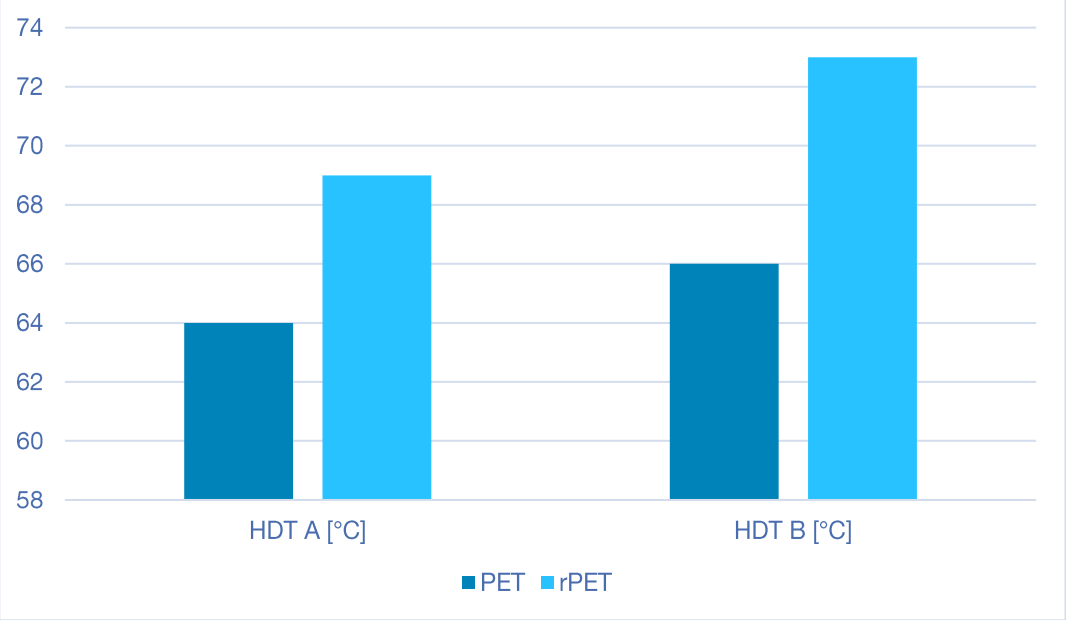
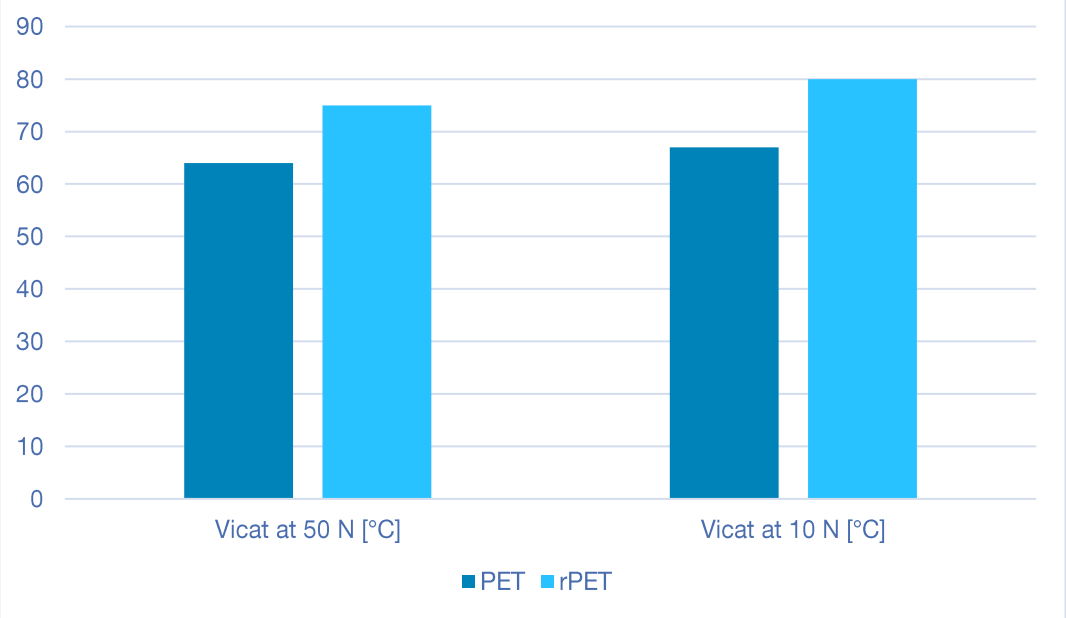
Thermal Properties Diagrams

Comparison Ultrafuse® PET and Ultrafuse® rPET



HDT comparison Ultrafuse® PET and Ultrafuse® rPET



Vicat comparison Ultrafuse® PET and Ultrafuse® rPET

Biocompatibility

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Biocompatibility product Information

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Product: Ultrafuse® PET
Revision: 12/3/2014

Version: 1.0

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Ultrafuse® PET material is 3D printed as test specimens and successfully passed the requirements of the stated tests below:

- **Cytotoxicity XTT Test - Neutral red** (ISO 10993-5:2009)
  The extract of the product Ultrafuse® PET resulted in a cell vitality of more than 70% in comparison to the negative control and can therefore be considered to be not cytotoxic.
- **Skin Irritation Test** (OECD 439, ISO 10993-1 2018, ISO 10993-12:2012)
  All human skin models EpiDermsTM have values which are above the threshold for irritance when exposed to Ultrafuse® PET for 18hr under experimental conditions. Therefore, Ultrafuse® PET is not irritant to skin according to UN GHS and EU CLP regulation.
- **Skin Sensitisation Test - Local Lymph Node Assay** (OECD 429, EC B.42, ISO 10993-1:2018, ISO 10993-10:2010, ISO 10993-12:2012)
  The extracts of the product Ultrafuse® PET resulted in Stimulation Indices (S.I.) of 1.1 and 1.3 in the Local Lymph Node Assay (LLNA) with non-polar and polar extracts. As the S.I. is lower or equal than 3.0 respectively, the product is assessed as non-sensitizing.

The biocompatibility tests were recorded on test specimen of the referenced product to show compatibility of the material in general. The biocompatibility tests listed are not part of any continuous production protocol. The test assessments reflect only the test specimen and have to be retested on the final product. It remains the responsibility of the de-vice manufacturers and /or end-users to deter-mine the suitability of all printed parts for their respective application.

For notice:
We give no warranties, expressed or implied, concerning the suitability of mentioned pro-duct for use in any medical device and pharmaceutical applications.
All information contained in this document is given in good faith and is based on sources believed to be reliable and accurate at the date of publication of this document.
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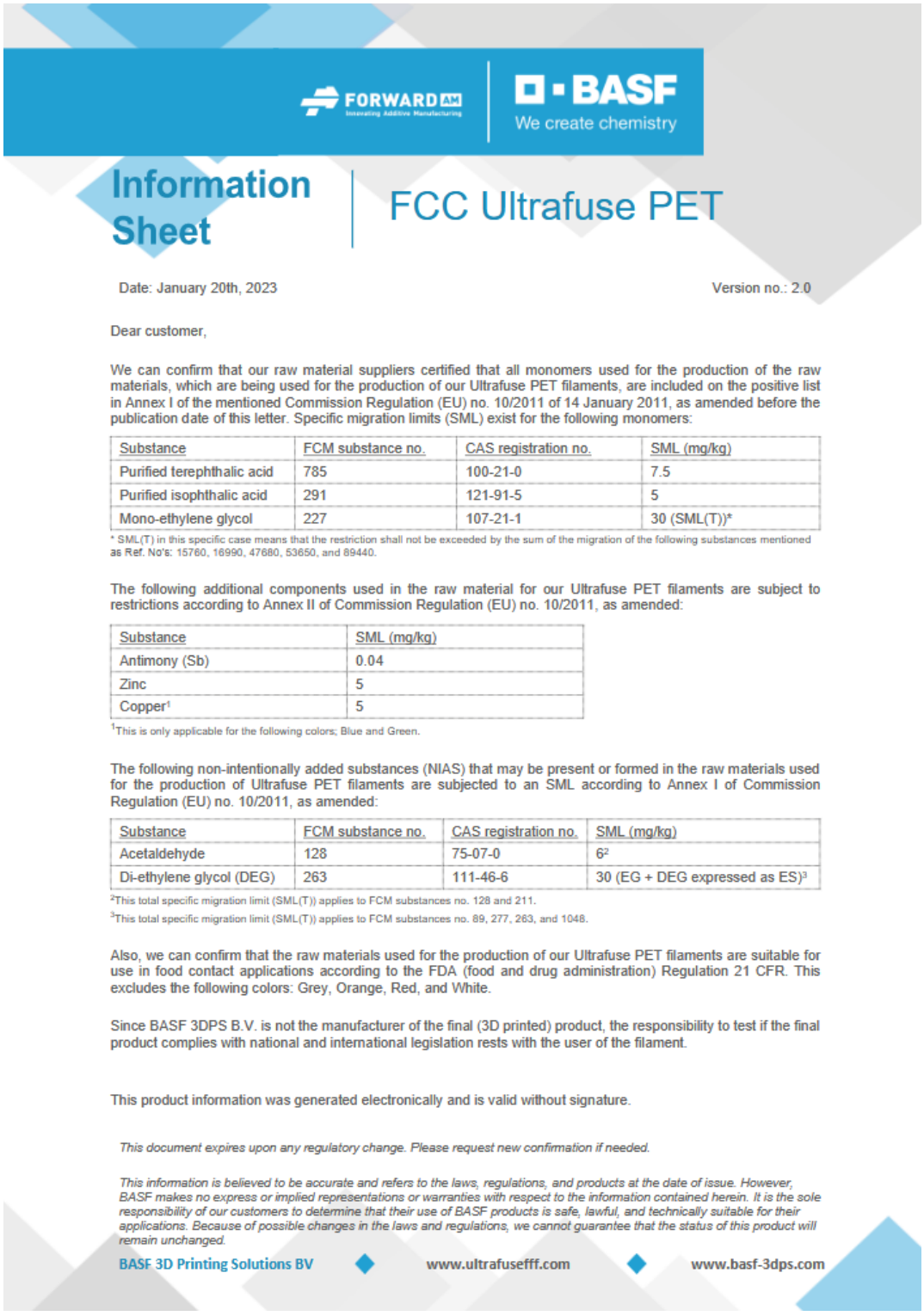
Food Contact Certification



FORWARD AM
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Information Sheet | FCC Ultrafuse PET

Date: January 20th, 2023 Version no.: 2.0

Dear customer,

We can confirm that our raw material suppliers certified that all monomers used for the production of the raw materials, which are being used for the production of our Ultrafuse PET filaments, are included on the positive list in Annex I of the mentioned Commission Regulation (EU) no. 10/2011 of 14 January 2011, as amended before the publication date of this letter. Specific migration limits (SML) exist for the following monomers:

Substance	FCM substance no.	CAS registration no.	SML (mg/kg)
Purified terephthalic acid	785	100-21-0	7.5
Purified isophthalic acid	291	121-91-5	5
Mono-ethylene glycol	227	107-21-1	30 (SML(T))*

* SML(T) in this specific case means that the restriction shall not be exceeded by the sum of the migration of the following substances mentioned as Ref. No's: 15760, 16990, 47680, 53650, and 89440.

The following additional components used in the raw material for our Ultrafuse PET filaments are subject to restrictions according to Annex II of Commission Regulation (EU) no. 10/2011, as amended:

Substance	SML (mg/kg)
Antimony (Sb)	0.04
Zinc	5
Copper[1]	5

[1]This is only applicable for the following colors; Blue and Green.

The following non-intentionally added substances (NIAS) that may be present or formed in the raw materials used for the production of Ultrafuse PET filaments are subjected to an SML according to Annex I of Commission Regulation (EU) no. 10/2011, as amended:

Substance	FCM substance no.	CAS registration no.	SML (mg/kg)
Acetaldehyde	128	75-07-0	6[2]
Di-ethylene glycol (DEG)	263	111-46-6	30 (EG + DEG expressed as ES)[3]

[2]This total specific migration limit (SML(T)) applies to FCM substances no. 128 and 211.

[3]This total specific migration limit (SML(T)) applies to FCM substances no. 89, 277, 263, and 1048.

Also, we can confirm that the raw materials used for the production of our Ultrafuse PET 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: Grey, Orange, Red, and White.

Since BASF 3DPS B.V. 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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This document expires upon any regulatory change. Please request new confirmation if needed.

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