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HP 3D High Reusability PA 12

Materials Technical Fact Sheet

General Properties

Common information for all print modes

Category	Measurement	Value	Method
General Properties	Powder melting point (DSC)	187°C/369°F	ASTM D3418
	Particle size	60 µm	ASTM D3451
	Bulk density of powder	0.425 g/cm ³	ASTM D1895
		0.015 lb/in ³	
	Density of parts	1.01 g/cm ³	ASTM D792
0.036 lb/in ³			
Crystallization temperature ¹	149.6°C / 301.28°F	ASTM D3417	
Reusability	Refresh ratio for stable performance	20%	
Environmental conditions	Recommended relative humidity	50-70% RH	

Balanced print mode

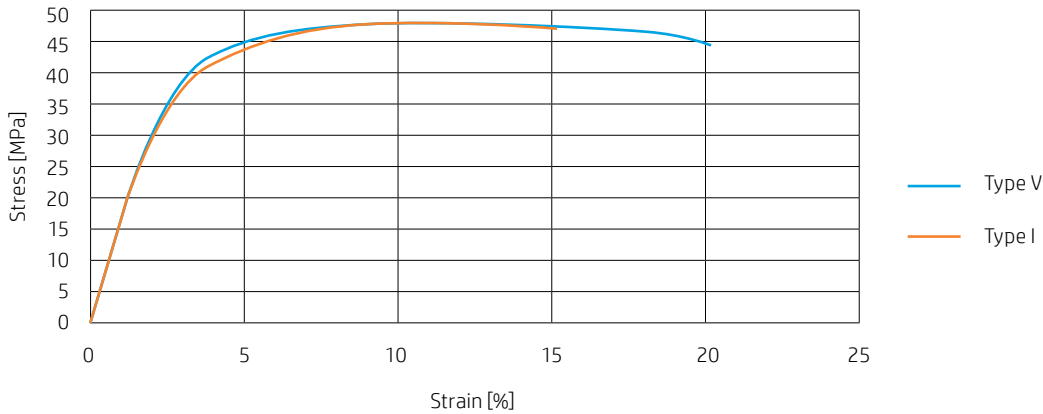
Technical specifications²

Category	Measurement	Specimen	Value	Method
Mechanical properties	Tensile strength, max load, ³ XY, XZ, YX, YZ	Type V	48 MPa/6960 psi	ASTM D638
		Type I	48 MPa/6960 psi	ASTM D638
	Tensile strength, max load, ³ ZX, ZY	Type V	48 MPa/6960 psi	ASTM D638
		Type I	48 MPa/6960 psi	ASTM D638
	Tensile modulus, ³ XY, XZ, YX, YZ	Type V	1800 MPa/261 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Tensile modulus, ³ ZX, ZY	Type V	1800 MPa/261 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Elongation at break, ³ XY, XZ, YX, YZ	Type V	20%	ASTM D638
		Type I	15%	ASTM D638
	Elongation at break, ³ ZX, ZY	Type V	15%	ASTM D638
		Type I	12%	ASTM D638
	Elongation at yied, ³ XY, XZ, YX, YZ	Type V	11%	ASTM D638
		Type I	11%	ASTM D638
	Elongation at yied, ³ ZX, ZY	Type V	10%	ASTM D638
		Type I	10%	ASTM D638
	Poisson ratio, ³ XY, XZ, YX, YZ	Type I	0.47	ASTM D638
	Poisson ratio, ³ ZX, ZY	Type I	0.43	ASTM D638
	Flexural modulus, ⁴ XY, XZ, YX, YZ		1800 MPa/261 ksi	ASTM D790
	Flexural modulus, ⁴ ZX, ZY		1800 MPa/261 ksi	ASTM D790
	Flexural strength (@ 5%), ⁴ XY, XZ, YX, YZ		70 MPa/10150 psi	ASTM D790
	Flexural strength (@ 5%), ⁴ ZX, ZY		70 MPa/10150 psi	ASTM D790
	Charpy impact notched (@23°C/73.4°F), XY, XZ, YX, YZ		2.8 kJ/m ²	ISO 179-1/1eA
	Charpy impact notched (@-20°C/-4°F), XY, XZ, YX, YZ		2.3 kJ/m ²	ISO 179-1/1eA
	Charpy impact notched (@-40°C/-40°F), XY, XZ, YX, YZ		2.2 kJ/m ²	ISO 179-1/1eA
	Charpy impact notched (@23°C/73.4°F), ZX, ZY		2.8 kJ/m ²	ISO 179-1/1eA
	Charpy impact notched (@-20°C/-4°F), ZX, ZY		2.3 kJ/m ²	ISO 179-1/1eA
	Charpy impact notched (@-40°C/-40°F), ZX, ZY		2.2 kJ/m ²	ISO 179-1/1eA
	Charpy Impact unnotched (@23°C/73.4°F), XY, XZ, YX, YZ		35 kJ/m ²	ISO 179-1/1eU
	Charpy Impact unnotched (@23°C/73.4°F), ZX, ZY		20 kJ/m ²	ISO 179-1/1eU
	Izod impact notched (@3.2 mm, 23°C/73.4°F), XY, XZ, YX, YZ		3.6 kJ/m ²	ASTM D256 Test Method A
	Izod impact notched (@3.2 mm, -20°C/-4°F), XY, XZ, YX, YZ		2.9 kJ/m ²	ASTM D256 Test Method A
	Izod impact notched (@3.2 mm, -40°C/-40°F), XY, XZ, YX, YZ		2.7 kJ/m ²	ASTM D256 Test Method A
	Izod impact notched (@3.2 mm, 23°C/73.4°F), ZX, ZY		3.5 kJ/m ²	ASTM D256 Test Method A
	Izod impact notched (@3.2 mm, -20°C/-4°F), ZX, ZY		2.9 kJ/m ²	ASTM D256 Test Method A
	Izod impact notched (@3.2 mm, -40°C/-40°F), ZX, ZY		2.7 kJ/m ²	ASTM D256 Test Method A
	Izod Impact unnotched (@3.2mm, 23°C/73.4°F), XY, XZ, YX, YZ		35 kJ/m ²	ASTM D256 Test Method A
	Izod Impact unnotched (@3.2mm, 23°C/73.4°F), ZX, ZY		20 kJ/m ²	ASTM D256 Test Method A
	Izod impact notched (@10 mm, 23°C/73.4°F), XY, XZ, YX, YZ		2.4 kJ/m ²	ASTM D256 Test Method A
	Izod impact notched (@10 mm, 23°C/73.4°F), ZX, ZY		2.4 kJ/m ²	ASTM D256 Test Method A
	Izod Impact unnotched (@10mm, 23°C/73.4°F), XY, XZ, YX, YZ		35 kJ/m ²	ASTM D256 Test Method A
	Izod Impact unnotched (@10mm, 23°C/73.4°F), ZX, ZY		20 kJ/m ²	ASTM D256 Test Method A
	Compression modulus ⁵ , XY, XZ, YX, YZ, ZX, ZY		1500 MPa / 218 ksi	ASTM D695
	Compression strength ⁵ (@ 10%) ⁴ , XY, XZ, YX, YZ, ZX, ZY		65 Mpa / 9427 psi	ASTM D695
	Rockwell – Ball Indentation Hardness (@100kg, Scale E), XY, XZ, YX, YZ, ZX, ZY		70	ASTM D785
	Shore Hardness D, XY, XZ, YX, YZ, ZX, ZY		80	ASTM D2240
	Roughness, XY, XZ, YX, YZ, ZX, ZY		7 µm	ASTM D7127

Category	Measurement	Specimen	Value	Method
Thermal properties	Heat deflection temperature (@0.45 MPa, 66 psi), XY, XZ, YX, YZ		175°C/347°F	ASTM D648 Test Method A
	Heat deflection temperature (@0.45 MPa, 66 psi), ZX, ZY		175°C/347°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), XY, XZ, YX, YZ		95°C/203°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), ZX, ZY		95°C/203°F	ASTM D648 Test Method A
	Vicat softening temperature (@A-10N), XY, XZ, YX, YZ, ZX, ZY		175°C/347°F	ASTM D1525 Test rate A
	Vicat softening temperature (@A-50N), XY, XZ, YX, YZ, ZX, ZY		165°C/329°F	ASTM D1525 Test rate A
Electrical properties	Surface resistivity, XY, XZ, YX, YZ, ZX, ZY		1.5 * 10 ¹¹ ohm	ASTM D257

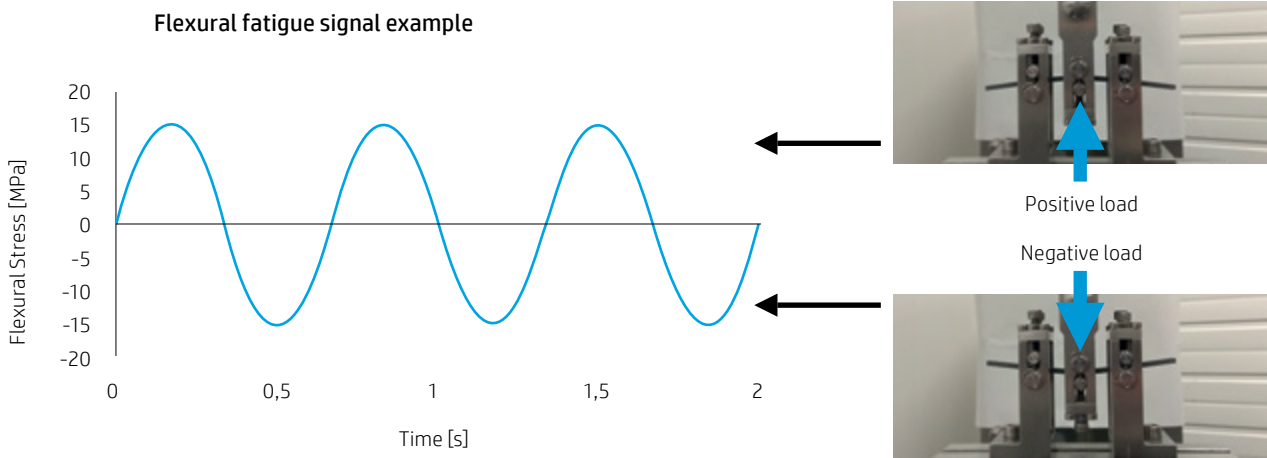
Stress - strain curve (XY)²

ASTM D638: Stress-Strain Curve at Room Temperature (23°C/73°F) Type I vs V

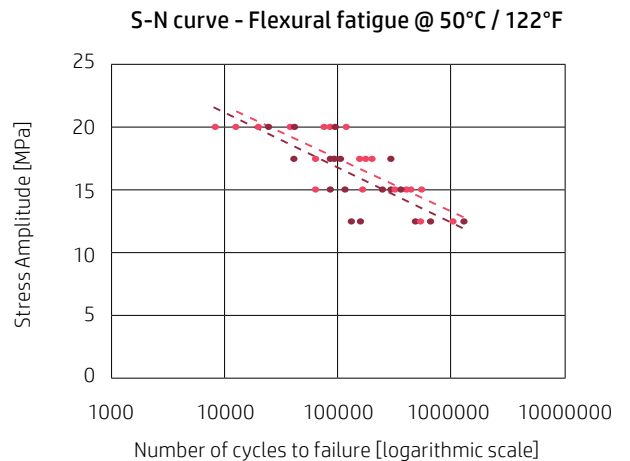
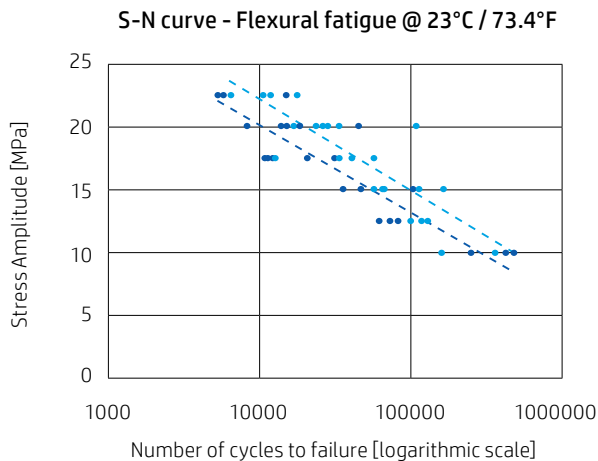


Flexural fatigue

Flexural fatigue tested according to ASTM D7774 using a 3-point bending support with 60 mm span. Specimens of 127 x 12.7 x 3.2 mm were cycled applying a sinusoidal signal with a determined positive and negative load as peaks. This signal was applied at a frequency of 1.5 Hz until the specimen fails:



For each orientation, the number of cycles to failure, in logarithmic axis, has been plotted in function of the signal's stress amplitude:



● ZX, ZY -23°C ● XY, XZ, YX, YZ -23°C - - - Log. (ZX, ZY -23°C) - - - Log. (XY, XZ, YX, YZ -23°C) ● ZX, ZY -50°C ● XY, XZ, YX, YZ -50°C - - - Log. (ZX, ZY -50°C) - - - Log. (XY, XZ, YX, YZ -50°C)

Using the trendline for each orientation, an average amplitude value is obtained to failure at some specific number of cycles:

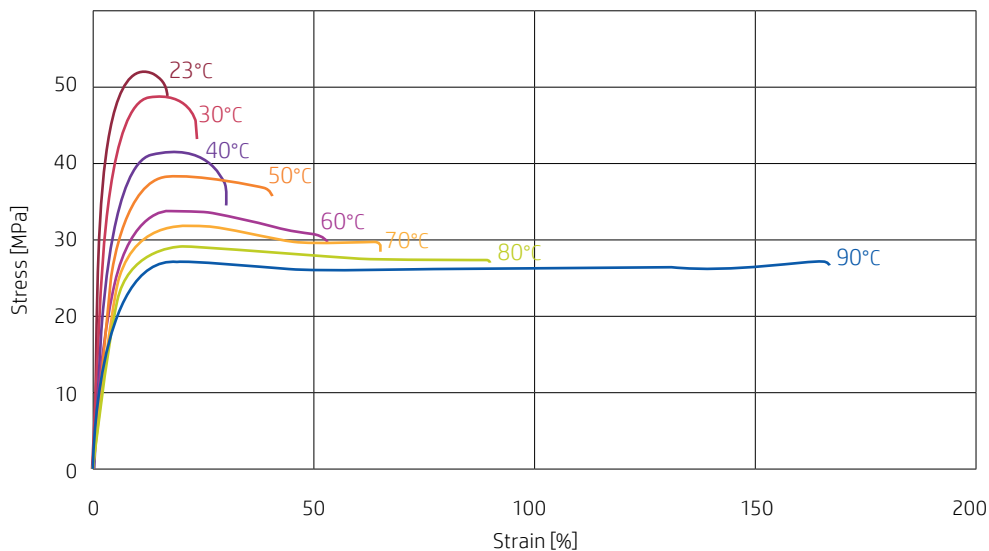
	Stress Amplitude [MPa]			
	23°C / 73.4°F		50°C / 122°F	
Cycles	XY. XZ. YX. YZ	ZX. ZY	XY. XZ. YX. YZ	ZX. ZY
5000	± 22.5	± 24.7	± 22.5	± 22.9
10000	± 20.6	± 22.7	± 21.2	± 21.6
50000	± 16.1	± 18.0	± 18.1	± 18.8
100000	± 14.1	± 15.9	± 16.8	± 17.5
500000	± 9.6	± 11.2	± 13.8	± 14.6
1000000	± 7.7	± 9.2	± 12.5	± 13.4

Influence of temperature on Mechanical Properties²

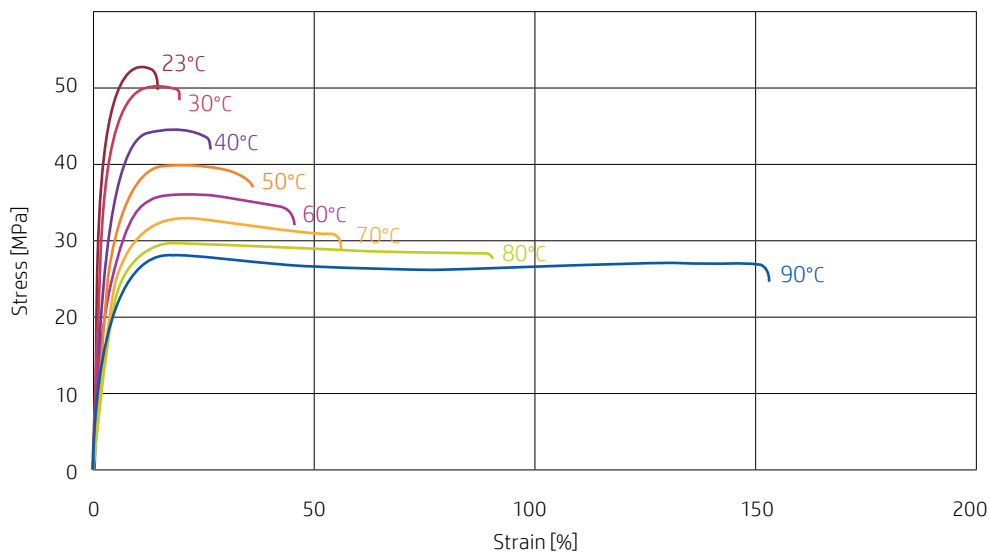
This test has been done by exposing type I specimens at different temperatures for 3 hours in an environmental chamber. A group of type I tensile bars has been exposed to each of the temperatures. The results displayed are the average values of the specimens tested.

Stress-strain curves at different temperatures

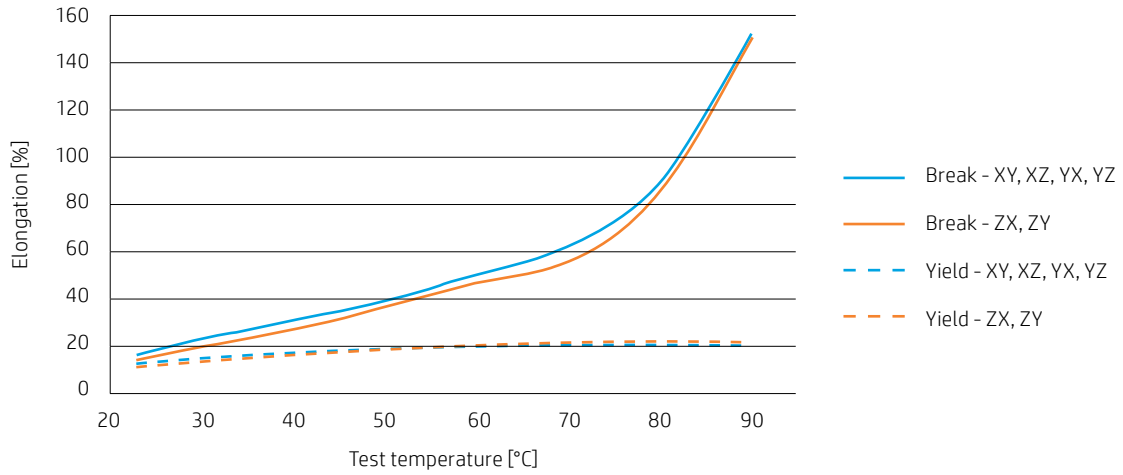
XY, XZ, YX, YZ orientations:



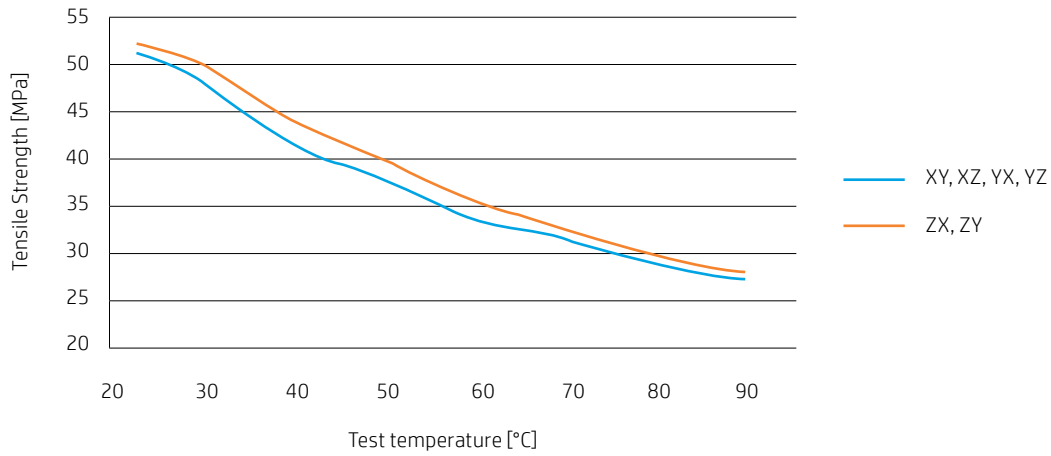
ZX, ZY orientations:



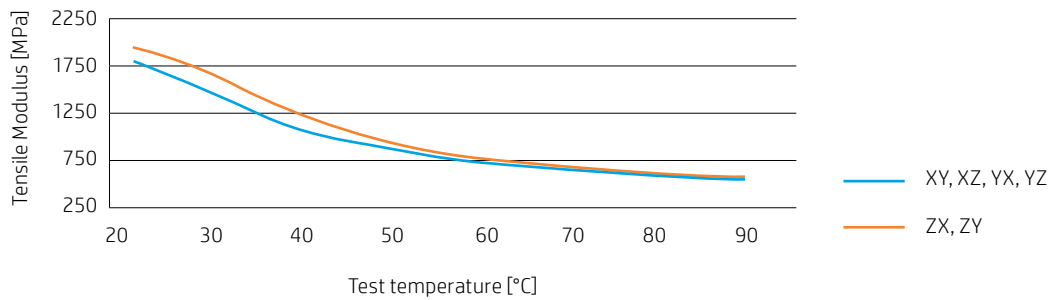
Elongation at Yield and Elongation at Break at different temperatures



Tensile strength at different temperatures

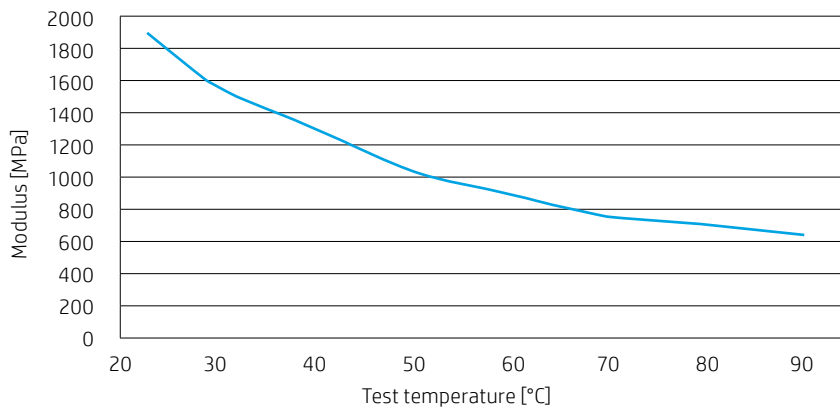


Tensile modulus at different temperatures

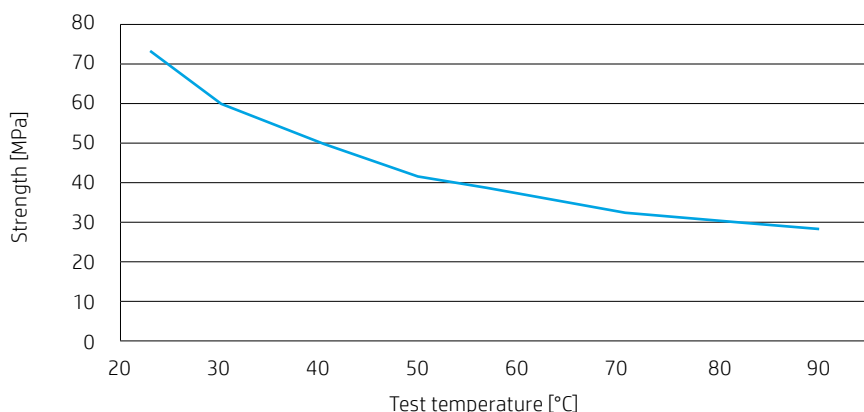


Flexural properties at different temperatures

Flexural Modulus at different temperatures. All orientations



Flexural strength @5% at different temperatures. All orientations



Coefficient of Linear Thermal Expansion (Test Method ASTM E831)

Coefficient thermal expansion [$\mu\text{m}/(\text{m } ^\circ\text{C})$]		
Orientation	Measurement zone	
XY, XZ, YX, YZ	Below Tg	135
	Above Tg	185
ZX, ZY	Below Tg	110
	Above Tg	150

Tg temperature: 50°C / 122°F

Mechanical print mode

Technical specifications²

Category	Measurement	Specimen	Value	Method	
Mechanical properties	Tensile strength, max load, ³ XY, XZ, YX, YZ	Type V	52 MPa/7541 psi	ASTM D638	
		Type I	52 MPa/7541 psi	ASTM D638	
	Tensile strength, max load, ³ ZX, ZY	Type V	52 MPa/7541 psi	ASTM D638	
		Type I	52 MPa/7541 psi	ASTM D638	
	Tensile modulus, ³ XY, XZ, YX, YZ	Type V	1800 MPa/261 ksi	ASTM D638	
		Type I	1800 MPa/261 ksi	ASTM D638	
	Tensile modulus, ³ ZX, ZY	Type V	1800 MPa/261 ksi	ASTM D638	
		Type I	1800 MPa/261 ksi	ASTM D638	
	Elongation at break, ³ XY, XZ, YX, YZ	Type V	22%	ASTM D638	
		Type I	18%	ASTM D638	
	Elongation at break, ³ ZX, ZY	Type V	17%	ASTM D638	
		Type I	15%	ASTM D638	
	Elongation at yield, ³ XY, XZ, YX, YZ	Type V	11%	ASTM D638	
		Type I	11%	ASTM D638	
	Elongation at yield, ³ ZX, ZY	Type V	10%	ASTM D638	
		Type I	10%	ASTM D638	
	Flexural modulus, ⁴ XY, XZ, YX, YZ			1800 MPa/261 ksi	ASTM D790
				1800 MPa/261 ksi	ASTM D790
Flexural strength (@ 5%), ⁴ XY, XZ, YX, YZ			70 MPa/10150 psi	ASTM D790	
			70 MPa/10150 psi	ASTM D790	
Charpy impact notched (@23°C/73.4°F), XY, XZ, YX, YZ			4.0 kJ/m ²	ISO 179-1/1eA	
			3.2 kJ/m ²	ISO 179-1/1eA	
	Izod impact notched (@3.2 mm, 23°C/73.4°F), XY, XZ, YX, YZ			4.0 kJ/m ²	ASTM D256 Test Method A
				4.0 kJ/m ²	ASTM D256 Test Method A
	Izod impact notched (@10 mm, 23°C/73.4°F), XY, XZ, YX, YZ			2.6 kJ/m ²	ASTM D256 Test Method A
				2.6 kJ/m ²	ASTM D256 Test Method A
Thermal properties	Heat deflection temperature (@0.45 MPa, 66 psi), XY, XZ, YX, YZ		175°C/347°F	ASTM D648 Test Method A	
	Heat deflection temperature (@0.45 MPa, 66 psi), ZX, ZY		175°C/347°F	ASTM D648 Test Method A	
	Heat deflection temperature (@1.82 MPa, 264 psi), XY, XZ, YX, YZ		90°C/194°F	ASTM D648 Test Method A	
	Heat deflection temperature (@1.82 MPa, 264 psi), ZX, ZY		90°C/194°F	ASTM D648 Test Method A	

Fast print mode

Technical specifications²

Category	Measurement	Specimen	Value	Method
Mechanical properties	Tensile strength, max load, ³ XY, XZ, YX, YZ	Type V	48 MPa/6960 psi	ASTM D638
		Type I	48 MPa/6960 psi	ASTM D638
	Tensile strength, max load, ³ ZX, ZY	Type V	40 MPa/5800 psi	ASTM D638
		Type I	48 MPa/6960 psi	ASTM D638
	Tensile modulus, ³ XY, XZ, YX, YZ	Type V	1800 MPa/261 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Tensile modulus, ³ ZX, ZY	Type V	1800 MPa/261 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Elongation at break, ³ XY, XZ, YX, YZ	Type V	15%	ASTM D638
		Type I	12%	ASTM D638
	Elongation at break, ³ ZX, ZY	Type V	5%	ASTM D638
		Type I	5%	ASTM D638
	Elongation at yield, ³ XY, XZ, YX, YZ	Type V	10%	ASTM D638
		Type I	10%	ASTM D638
	Elongation at yield, ³ ZX, ZY	Type V	5%	ASTM D638
		Type I	5%	ASTM D638
	Flexural modulus, ⁴ XY, XZ, YX, YZ		1800 MPa/261 ksi	ASTM D790
	Flexural modulus, ⁴ ZX, ZY		1800 MPa/261 ksi	ASTM D790
	Flexural strength (@ 5%), ⁴ XY, XZ, YX, YZ		70 MPa/10152 psi	ASTM D790
	Flexural strength (@ 5%), ⁴ ZX, ZY		70 MPa/10152 psi	ASTM D790
Charpy impact notched (@23°C/73.4°F), XY, XZ, YX, YZ		3.4 kJ/m ²	ISO 179-1/1eA	
Charpy impact notched (@23°C/73.4°F), ZX, ZY		2.1 kJ/m ²	ISO 179-1/1eA	
Izod impact notched (@3.2 mm/0.126 in, 23°C/73.4°F), XY, XZ, YX, YZ		3.9 kJ/m ²	ASTM D256 Test Method A	
Izod impact notched (@3.2 mm/0.126 in, 23°C/73.4°F), ZX, ZY		2.8 kJ/m ²	ASTM D256 Test Method A	
Izod impact notched (@10 mm/0.394 in, 23°C/73.4°F), XY, XZ, YX, YZ		3.4 kJ/m ²	ASTM D256 Test Method A	
Izod impact notched (@10 mm/0.394 in, 23°C/73.4°F), ZX, ZY		2.5 kJ/m ²	ASTM D256 Test Method A	
Thermal properties	Heat deflection temperature (@0.45 MPa, 66 psi), XY, XZ, YX, YZ		175°C/347°F	ASTM D648 Test Method A
	Heat deflection temperature (@0.45 MPa, 66 psi), ZX, ZY		175°C/347°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), XY, XZ, YX, YZ		90°C/194°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), ZX, ZY		90°C/194°F	ASTM D648 Test Method A

Cosmetic print mode

Technical specifications²

Category	Measurement	Specimen	Value	Method
Mechanical properties	Tensile strength, max load, ³ XY, XZ, YX, YZ	Type V	48 MPa/6962 psi	ASTM D638
		Type I	45 MPa/6527 psi	ASTM D638
	Tensile strength, max load, ³ ZX, ZY	Type V	48 MPa/6962 psi	ASTM D638
		Type I	48 MPa/6962 psi	ASTM D638
	Tensile modulus, ³ XY, XZ, YX, YZ	Type V	1800 MPa/261 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Tensile modulus, ³ ZX, ZY	Type V	1800 MPa/261 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Elongation at break, ³ XY, XZ, YX, YZ	Type V	20%	ASTM D638
		Type I	10%	ASTM D638
	Elongation at break, ³ ZX, ZY	Type V	15%	ASTM D638
		Type I	10%	ASTM D638
	Elongation at yield, ³ XY, XZ, YX, YZ	Type V	11%	ASTM D638
		Type I	10%	ASTM D638
	Elongation at yield, ³ ZX, ZY	Type V	10%	ASTM D638
		Type I	10%	ASTM D638
	Flexural modulus, ⁴ XY, XZ, YX, YZ		1300 MPa/189 ksi	ASTM D790
	Flexural modulus, ⁴ ZX, ZY		1730 MPa/251 ksi	ASTM D790
	Flexural strength (@ 5%), ⁴ XY, XZ, YX, YZ		50 MPa/7252 psi	ASTM D790
	Flexural strength (@ 5%), ⁴ ZX, ZY		70 MPa/10153 psi	ASTM D790
Charpy impact notched (@23°C/73.4°F), XY, XZ, YX, YZ		2.4 kJ/m ²	ISO 179-1/1eA	
Charpy impact notched (@23°C/73.4°F), ZX, ZY		2.4 kJ/m ²	ISO 179-1/1eA	
Izod impact notched (@3.2 mm/0.126 in, 23°C/73.4°F), XY, XZ, YX, YZ		3.5 kJ/m ²	ASTM D256 Test Method A	
Izod impact notched (@3.2 mm/0.126 in, 23°C/73.4°F), ZX, ZY		3.5 kJ/m ²	ASTM D256 Test Method A	
Izod impact notched (@10 mm/0.394 in, 23°C/73.4°F), XY, XZ, YX, YZ		3.0 kJ/m ²	ASTM D256 Test Method A	
Izod impact notched (@10 mm/0.394 in, 23°C/73.4°F), ZX, ZY		2.0 kJ/m ²	ASTM D256 Test Method A	
Thermal properties	Heat deflection temperature (@0.45 MPa, 66 psi), XY, XZ, YX, YZ		170°C/338°F	ASTM D648 Test Method A
	Heat deflection temperature (@0.45 MPa, 66 psi), ZX, ZY		170°C/338°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), XY, XZ, YX, YZ		70°C/158°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), ZX, ZY		90°C/194°F	ASTM D648 Test Method A

Print modes comparison table

Profiles based on average XYZ values

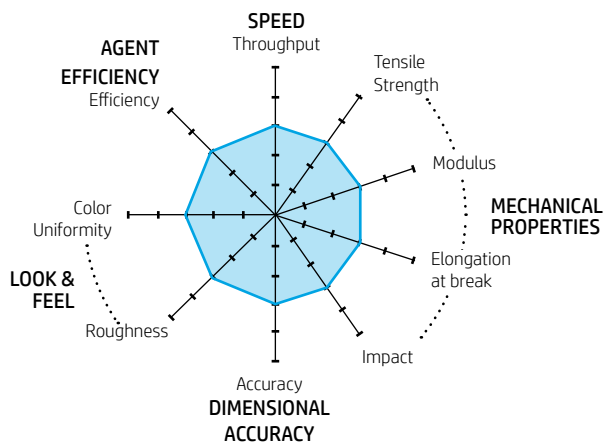
	Speed	Mechanical properties	Dimensional accuracy	Look & feel	Agent efficiency
Balanced	=	=	=	=	=
Fast	↑	↓	=	↓	↑
Mechanical	=	↑	↓	↓	=
Cosmetic	=	↓	↑	↑	=

Print mode profiles

Profiles based on average XYZ values

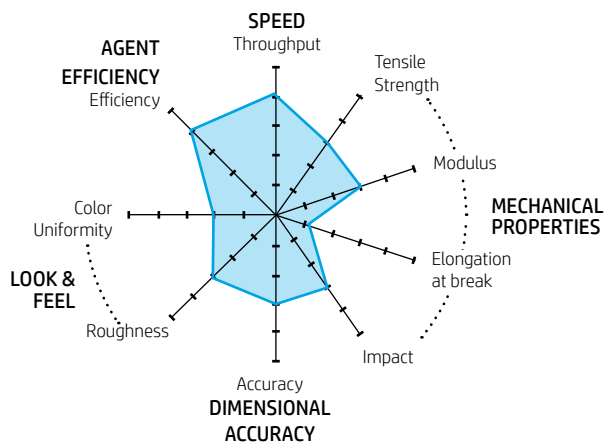
Balanced PA 12

Default mode delivering balanced properties



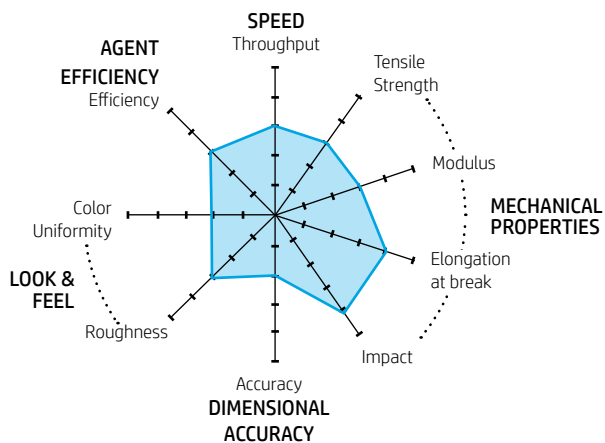
FAST PA 12

Increased speed for any job



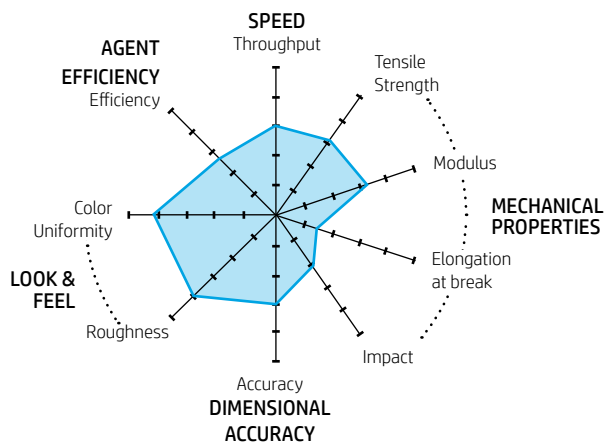
Mechanical PA 12

Superior strain mechanical properties



Cosmetic PA 12

Improvement in sinks and bubbles



Chemical resistance

Fluid	Chemical resistance
Diluted alkalis	Good
Concentrated alkalis	Good
Hot water	Neutral
Chlorine salts	Good
Alcohol	Good
Esters	Good
Ethers	Good
Ketones	Good
Aliphatic hydrocarbons	Good
Motor oil	Good
Aromatic hydrocarbons	Good
Toluene	Good
Unleaded petrol	Good
Dot 3 brake fluid	Good
Chlorinated hydrocarbons	Neutral
Trichloroethylene	Neutral

Certifications

- [USP Class I-VI](#)
- [US FDA guidance for Intact Skin Surface Devices](#)
- [RoHS⁶](#)
- [EU REACH](#)
- [PAHs](#)
- [UL 94](#)
- [UL 746A](#)

Dynamic security enabled printer. Only intended to be used with cartridges using an HP original chip. Cartridges using a non-HP chip may not work, and those that work today may not work in the future. More at: hp.com/go/learnaboutsupplies.

For more information, please visit
hp.com/go/3DMaterials

1. Results obtained with a DSC at 10°C/min or 50°F/min.
2. The following technical information should be considered representative of averages or typical values and should not be used for specification purposes. These values are with FW TATDAG_15_18_11.69 and have been obtained from a sample of specimens printed in plots with 6% packing density. Minimum separation between specimens in the plot was 10 mm. Tensile and Flexural Modulus have been calculated using the slope of the regression line between 0.05% and 0.25% strain. Compression Modulus has been calculated using the slope of the regression line between 0.5% and 1% strain. In both cases the measurement was done with an automatic extensometer during the entire test. Cross-section dimension measures are done using a micrometer with round ends. Conditioning according to ASTM D618 Procedure A: 48 hours after printing and unpacking of the parts at 23°C / 73°F and 50% RH. Orientations defined according to ASTM F2971.
3. Tested following the ASTM D638 with a test rate of 50mm/min and 10 mm/min for type I and type V, respectively.
4. Tested following the ASTM D790 Procedure B at a test rate of 13.55 mm/min.
5. Tested according to ASTM D695 at a test rate of 1.3 mm/min. Specimens of Ø12,7mm x 25.4 mm for compression strength and Ø12.7 mm x 50.8 mm for compression modulus.
6. RoHS certification for EU, Bosnia-Herzegovina, China, India, Japan, Jordan, Korea, Serbia, Singapore, Turkey, Ukraine, Vietnam.

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