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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 <sup>3</sup>	ASTM D1895
		0.015 lb/in <sup>3</sup>	
	Density of parts	1.01 g/cm <sup>3</sup>	ASTM D792
0.036 lb/in <sup>3</sup>			
	Crystallization temperature <sup>1</sup>	149.6°C / 301.28°F	ASTM D3417
Reusability	Refresh ratio for stable performance	20%	
Environmental conditions	Recommended relative humidity	50-70% RH	

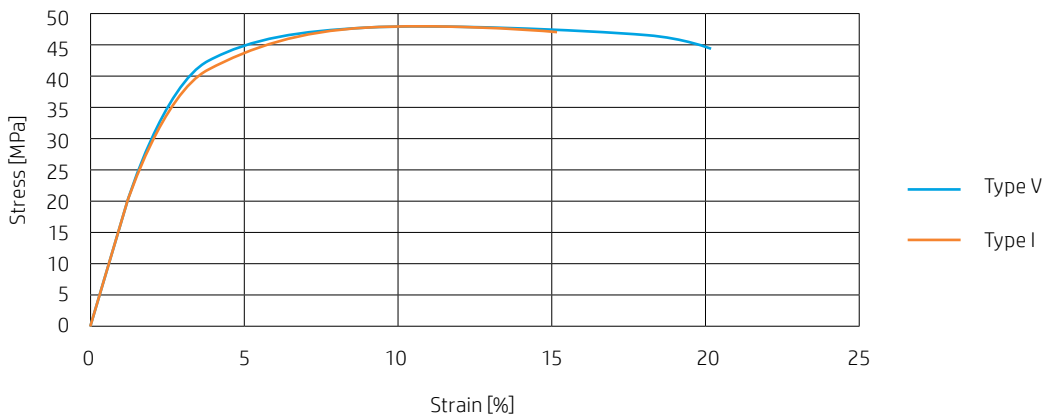
### Balanced print mode

#### Technical specifications<sup>2</sup>

Category	Measurement	Specimen	Value	Method
Mechanical properties	Tensile strength, max load, <sup>3</sup> XY	Type V	48 MPa/6960 psi	ASTM D638
		Type I	48 MPa/6960 psi	ASTM D638
	Tensile strength, max load, <sup>3</sup> Z	Type V	48 MPa/6960 psi	ASTM D638
		Type I	48 MPa/6960 psi	ASTM D638
	Tensile modulus, <sup>3</sup> XY	Type V	1800 MPa/261 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Tensile modulus, <sup>3</sup> Z	Type V	1800 MPa/261 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Elongation at break, <sup>3</sup> XY	Type V	20%	ASTM D638
		Type I	15%	ASTM D638
	Elongation at break, <sup>3</sup> Z	Type V	15%	ASTM D638
		Type I	12%	ASTM D638
	Elongation at yied, <sup>3</sup> XY	Type V	11%	ASTM D638
		Type I	11%	ASTM D638
	Elongation at yied, <sup>3</sup> Z	Type V	10%	ASTM D638
		Type I	10%	ASTM D638
	Poisson ratio, <sup>3</sup> XY	Type I	0.47	ASTM D638
	Poisson ratio, <sup>3</sup> Z	Type I	0.43	ASTM D638
	Flexural modulus, <sup>4</sup> XY		1730 MPa/251 ksi	ASTM D790
	Flexural modulus, <sup>4</sup> Z		1730 MPa/251 ksi	ASTM D790
	Flexural strength (@ 5%), <sup>4</sup> XY		65 MPa/9425 psi	ASTM D790
	Flexural strength (@ 5%), <sup>4</sup> Z		70 MPa/10150 psi	ASTM D790
	Charpy impact notched (@23°C/73.4°F), XY		2.8 kJ/m <sup>2</sup>	ISO 179-1/1eA
	Charpy impact notched (-20°C/-4°F), XY		2.3 kJ/m <sup>2</sup>	ISO 179-1/1eA
	Charpy impact notched (-40°C/-40°F), XY		2.2 kJ/m <sup>2</sup>	ISO 179-1/1eA
	Charpy impact notched (@23°C/73.4°F), Z		2.8 kJ/m <sup>2</sup>	ISO 179-1/1eA
	Charpy impact notched (-20°C/-4°F), Z		2.3 kJ/m <sup>2</sup>	ISO 179-1/1eA
	Charpy impact notched (-40°C/-40°F), Z		2.2 kJ/m <sup>2</sup>	ISO 179-1/1eA
	Izod impact notched (@3.2 mm, 23°C/73.4°F), XY		3.5 kJ/m <sup>2</sup>	ASTM D256 Test Method A
	Izod impact notched (@3.2 mm, -20°C/-4°F), XY		2.9 kJ/m <sup>2</sup>	ASTM D256 Test Method A
	Izod impact notched (@3.2 mm, -40°C/-40°F), XY		2.7 kJ/m <sup>2</sup>	ASTM D256 Test Method A
	Izod impact notched (@3.2 mm, 23°C/73.4°F), Z		3.5 kJ/m <sup>2</sup>	ASTM D256 Test Method A
	Izod impact notched (@3.2 mm, -20°C/-4°F), Z		2.9 kJ/m <sup>2</sup>	ASTM D256 Test Method A
Izod impact notched (@3.2 mm, -40°C/-40°F), Z		2.7 kJ/m <sup>2</sup>	ASTM D256 Test Method A	
Izod impact notched (@10 mm, 23°C/73.4°F), XY		2.4 kJ/m <sup>2</sup>	ASTM D256 Test Method A	
Izod impact notched (@10 mm, 23°C/73.4°F), Z		2.4 kJ/m <sup>2</sup>	ASTM D256 Test Method A	
Thermal properties	Heat deflection temperature (@0.45 MPa, 66 psi), XY		175°C/347°F	ASTM D648 Test Method A
	Heat deflection temperature (@0.45 MPa, 66 psi), Z		175°C/347°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), XY		95°C/203°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), Z		95°C/203°F	ASTM D648 Test Method A

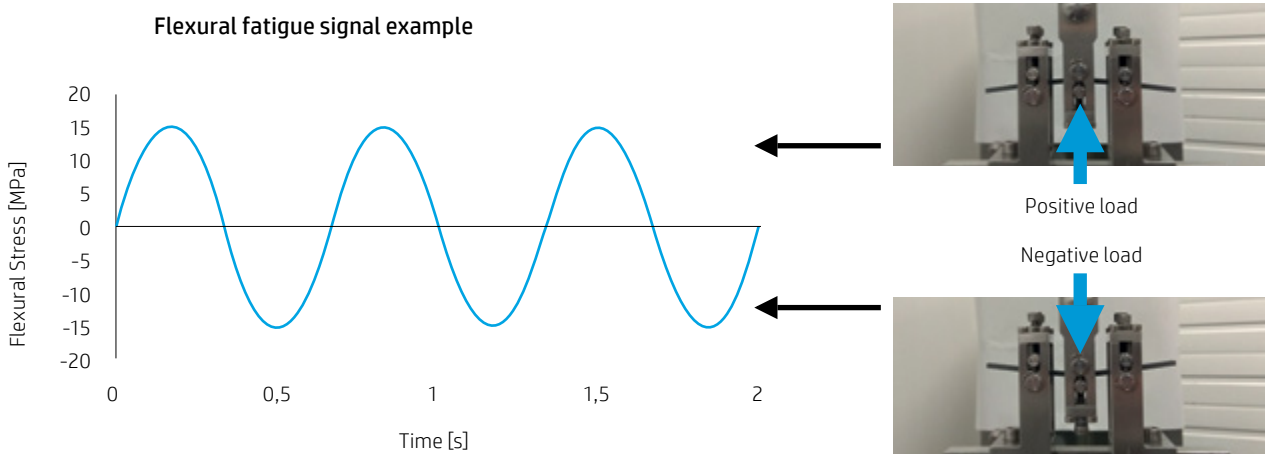
## Stress - strain curve (XY)<sup>2</sup>

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

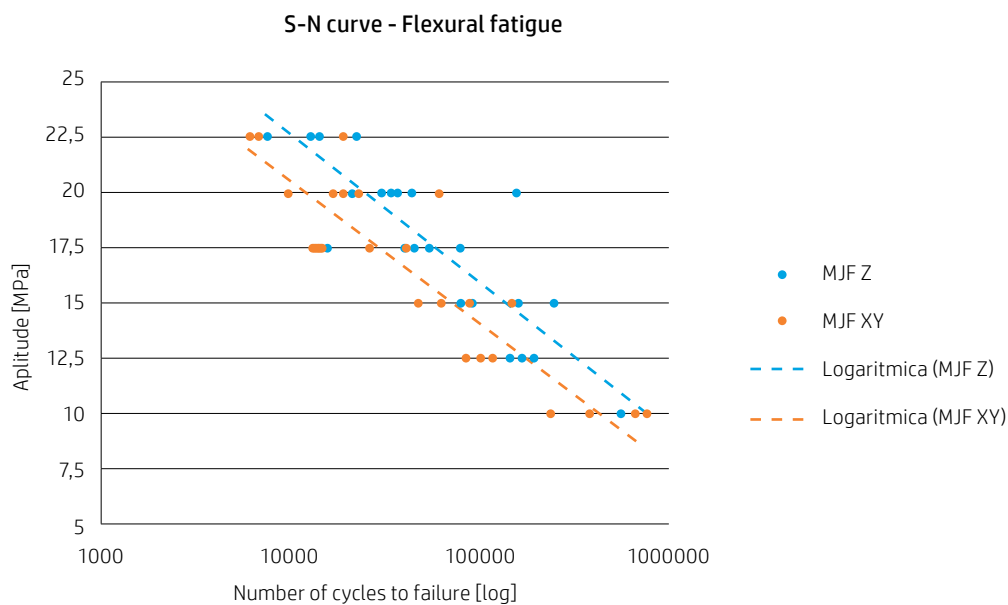


## Flexural fatigue

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:



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

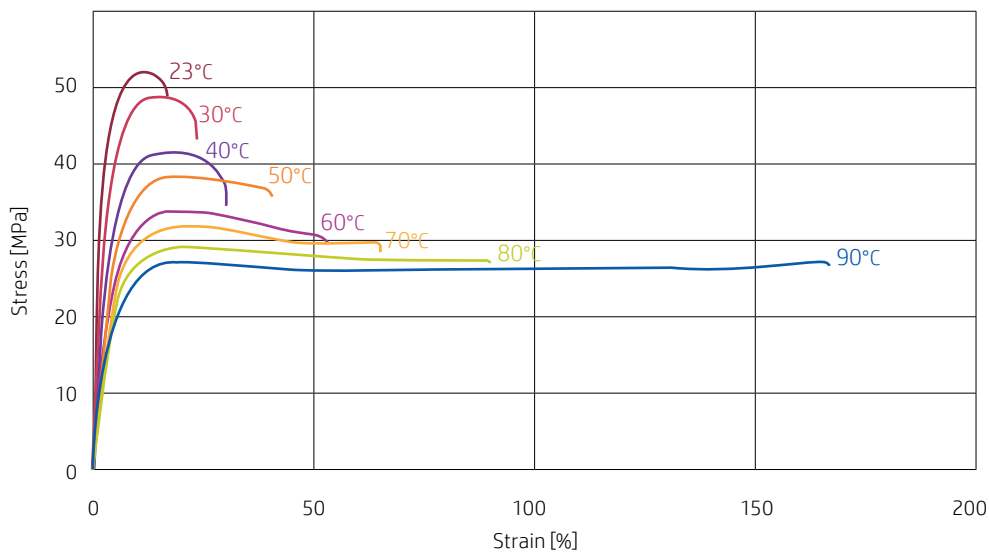
Cycles	Amplitude [MPa]	
	XY	Z
1000	27.0	29.4
5000	22.5	24.7
10000	20.6	22.7
50000	16.1	18.0
100000	14.1	15.9
500000	9.6	11.2
1000000	7.7	9.2

### Influence of temperature on Mechanical Properties<sup>2</sup>

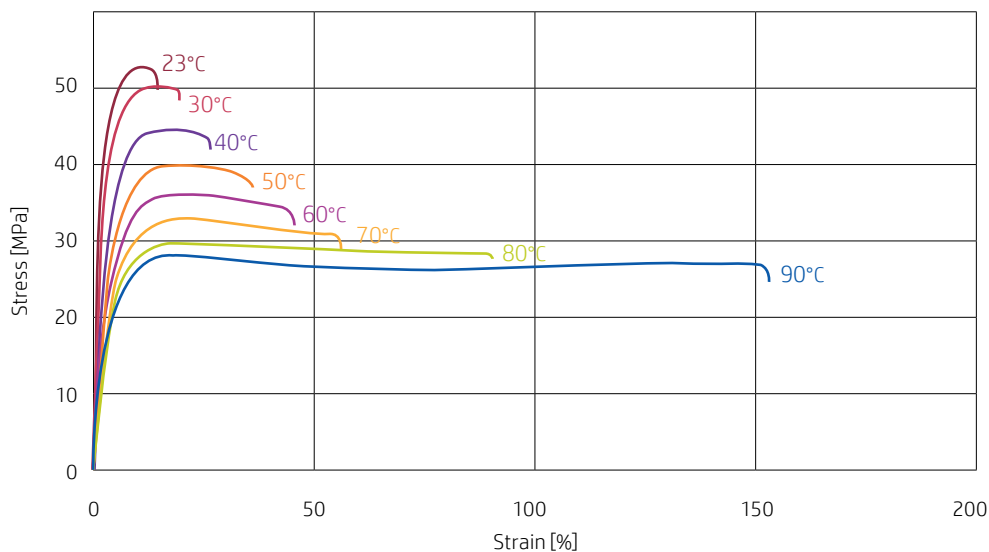
This test has been done by exposing type I specimens at different temperatures for 3 hours in an environmental chamber. A group of type I tensile bars has been exposed to each of the temperatures. The results displayed are the average values of the specimens tested.

#### Stress-strain curves at different temperatures

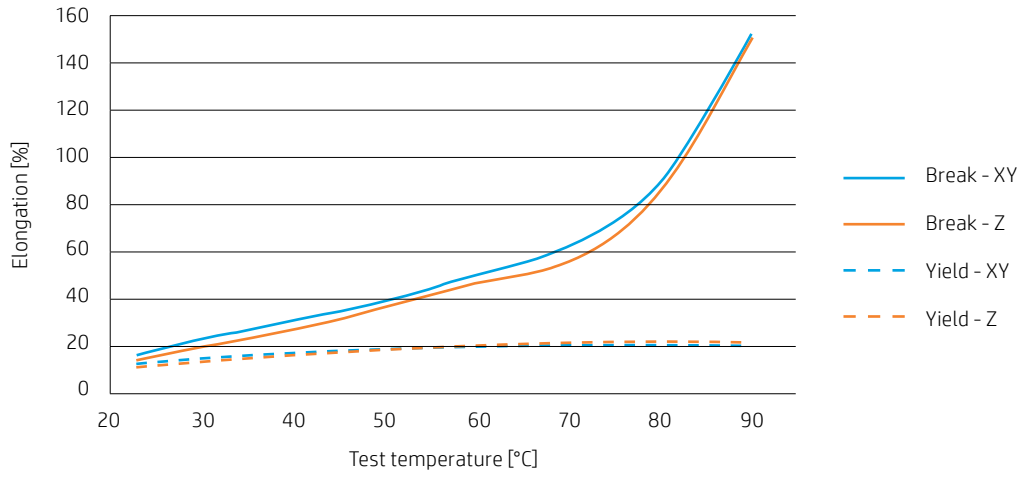
XY orientations:



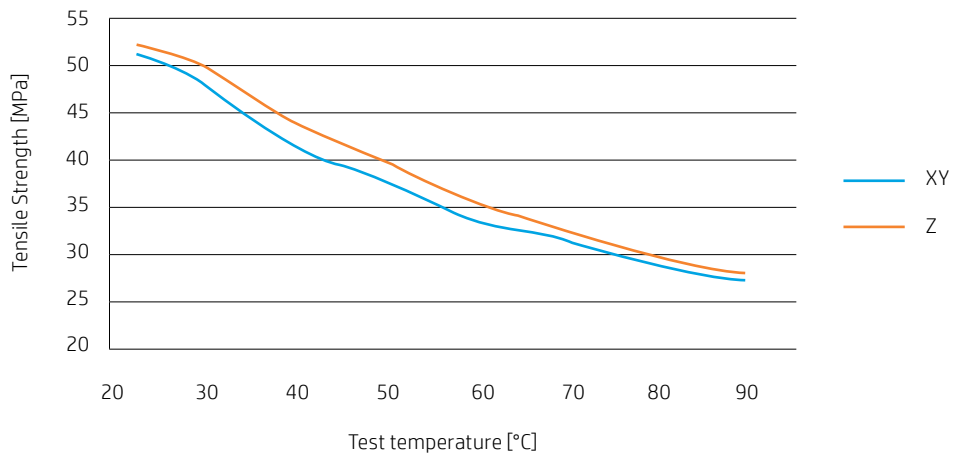
Z orientations:



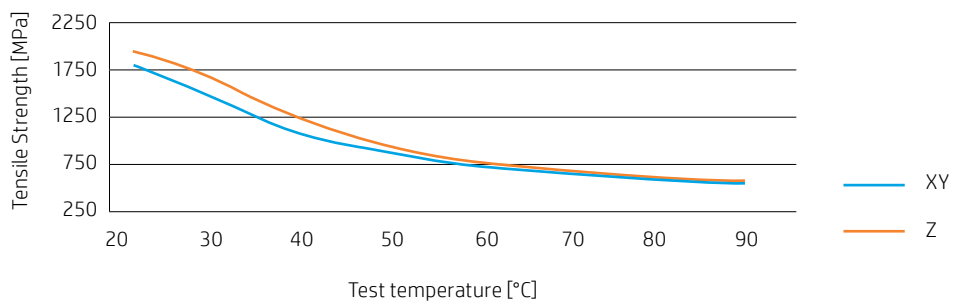
Elongation at Yield and Elongation at Break at different temperatures



Tensile strength at different temperatures



Tensile modulus at different temperatures



## Mechanical print mode

### Technical specifications<sup>2</sup>

Category	Measurement	Specimen	Value	Method
Mechanical properties	Tensile strength, max load, <sup>3</sup> XY	Type V	52 MPa/7541 psi	ASTM D638
		Type I	52 MPa/7541 psi	ASTM D638
	Tensile strength, max load, <sup>3</sup> Z	Type V	52 MPa/7541 psi	ASTM D638
		Type I	52 MPa/7541 psi	ASTM D638
	Tensile modulus, <sup>3</sup> XY	Type V	1800 MPa/261 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Tensile modulus, <sup>3</sup> Z	Type V	1800 MPa/261 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Elongation at break, <sup>3</sup> XY	Type V	22%	ASTM D638
		Type I	18%	ASTM D638
	Elongation at break, <sup>3</sup> Z	Type V	17%	ASTM D638
		Type I	15%	ASTM D638
	Elongation at yield, <sup>3</sup> XY	Type V	11%	ASTM D638
		Type I	11%	ASTM D638
	Elongation at yield, <sup>3</sup> Z	Type V	10%	ASTM D638
		Type I	10%	ASTM D638
	Flexural modulus, <sup>4</sup> XY		1740 MPa/252 ksi	ASTM D790
	Flexural modulus, <sup>4</sup> Z		1740 MPa/252 ksi	ASTM D790
	Flexural strength (@ 5%), <sup>4</sup> XY		65 MPa/9427 psi	ASTM D790
	Flexural strength (@ 5%), <sup>4</sup> Z		70 MPa/10150 psi	ASTM D790
Charpy impact notched (@23°C/73.4°F), XY		4.0 kJ/m <sup>2</sup>	ISO 179-1/1eA	
Charpy impact notched (@23°C/73.4°F), Z		4.0 kJ/m <sup>2</sup>	ISO 179-1/1eA	
Izod impact notched (@3.2 mm, 23°C/73.4°F), XY		3.6 kJ/m <sup>2</sup>	ASTM D256 Test Method A	
Izod impact notched (@3.2 mm, 23°C/73.4°F), Z		3.6 kJ/m <sup>2</sup>	ASTM D256 Test Method A	
Izod impact notched (@10 mm, 23°C/73.4°F), XY		2.6 kJ/m <sup>2</sup>	ASTM D256 Test Method A	
Izod impact notched (@10 mm, 23°C/73.4°F), Z		2.6 kJ/m <sup>2</sup>	ASTM D256 Test Method A	
Thermal properties	Heat deflection temperature (@0.45 MPa, 66 psi), XY		175°C/347°F	ASTM D648 Test Method A
	Heat deflection temperature (@0.45 MPa, 66 psi), Z		177°C/350°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), XY		90°C/194°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), Z		80°C/176°F	ASTM D648 Test Method A

## Fast print mode

### Technical specifications<sup>2</sup>

Category	Measurement	Specimen	Value	Method
Mechanical properties	Tensile strength, max load, <sup>3</sup> XY	Type V	48 MPa/6960 psi	ASTM D638
		Type I	48 MPa/6960 psi	ASTM D638
	Tensile strength, max load, <sup>3</sup> Z	Type V	40 MPa/5800 psi	ASTM D638
		Type I	48 MPa/6960 psi	ASTM D638
	Tensile modulus, <sup>3</sup> XY	Type V	1700 MPa/247 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Tensile modulus, <sup>3</sup> Z	Type V	1700 MPa/247 ksi	ASTM D638
		Type I	1800 MPa/261 ksi	ASTM D638
	Elongation at break, <sup>3</sup> XY	Type V	15%	ASTM D638
		Type I	12%	ASTM D638
	Elongation at break, <sup>3</sup> Z	Type V	5%	ASTM D638
		Type I	5%	ASTM D638
	Elongation at yield, <sup>3</sup> XY	Type V	10%	ASTM D638
		Type I	10%	ASTM D638
	Elongation at yield, <sup>3</sup> Z	Type V	5%	ASTM D638
		Type I	5%	ASTM D638
	Flexural modulus, <sup>4</sup> XY		1730 MPa/251 ksi	ASTM D790
	Flexural modulus, <sup>4</sup> Z		1730 MPa/251 ksi	ASTM D790
	Flexural strength (@ 5%), <sup>4</sup> XY		65 MPa/9427 psi	ASTM D790
	Flexural strength (@ 5%), <sup>4</sup> Z		70 MPa/10152 psi	ASTM D790
Charpy impact notched (@23°C/73.4°F), XY		3.4 kJ/m <sup>2</sup>	ISO 179-1/1eA	
Charpy impact notched (@23°C/73.4°F), Z		2.1 kJ/m <sup>2</sup>	ISO 179-1/1eA	
Izod impact notched (@3.2 mm/0.126 in, 23°C/73.4°F), XY		3.9 kJ/m <sup>2</sup>	ASTM D256 Test Method A	
Izod impact notched (@3.2 mm/0.126 in, 23°C/73.4°F), Z		2.8 kJ/m <sup>2</sup>	ASTM D256 Test Method A	
Izod impact notched (@10 mm/0.394 in, 23°C/73.4°F), XY		3.4 kJ/m <sup>2</sup>	ASTM D256 Test Method A	
Izod impact notched (@10 mm/0.394 in, 23°C/73.4°F), Z		2.5 kJ/m <sup>2</sup>	ASTM D256 Test Method A	
Thermal properties	Heat deflection temperature (@0.45 MPa, 66 psi), XY		173°C/343°F	ASTM D648 Test Method A
	Heat deflection temperature (@0.45 MPa, 66 psi), Z		176°C/349°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), XY		90°C/194°F	ASTM D648 Test Method A
	Heat deflection temperature (@1.82 MPa, 264 psi), Z		70°C/158°F	ASTM D648 Test Method A

## Cosmetic print mode

### Technical specifications<sup>2</sup>

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

# Print modes comparison table

## Profiles based on average XYZ values

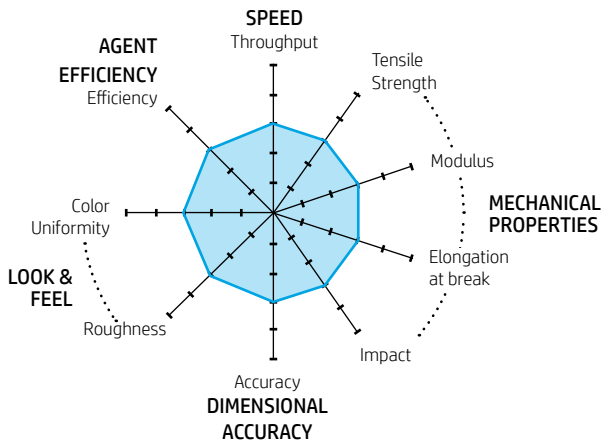
	Speed	Mechanical properties	Dimensional accuracy	Look & feel	Agent efficiency
Balanced	=	=	=	=	=
Fast	↑	↓	=	↓	↑
Mechanical	=	↑	↓	↓	=
Cosmetic	=	↓	↑	↑	=

# Print mode profiles

## Profiles based on average XYZ values

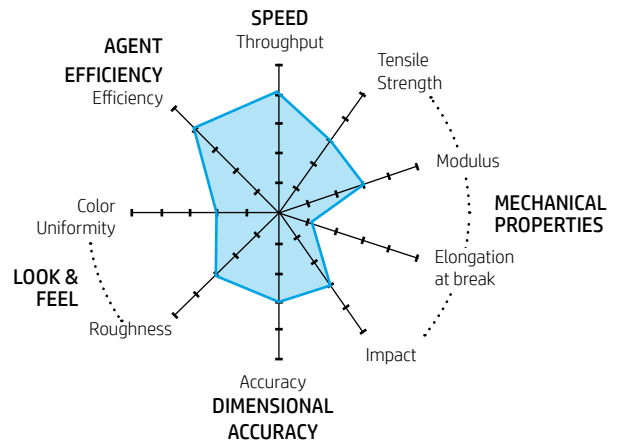
### Balanced PA 12

Default mode delivering balanced properties



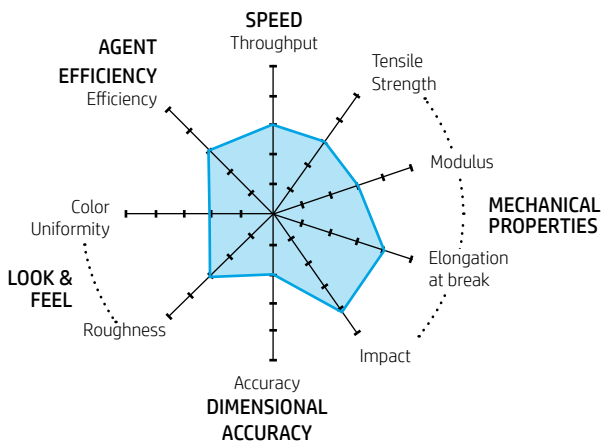
### FAST PA 12

Increased speed for any job



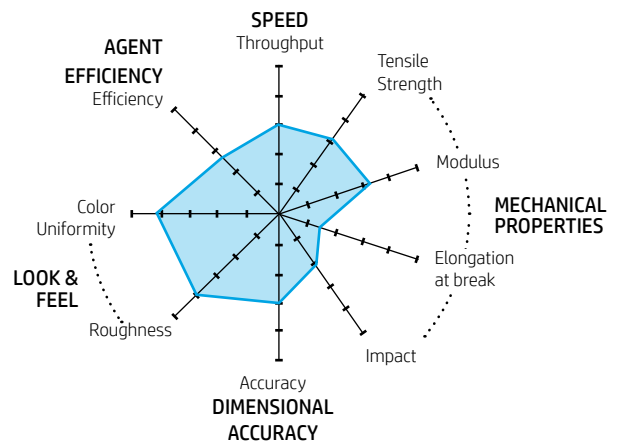
### Mechanical PA 12

Superior strain mechanical properties



### Cosmetic PA 12

Improvement in sinks and bubbles



## Chemical resistance

Fluid	Chemical resistance
Diluted alkalies	Good
Concentrated alkalies	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

**For more information, please visit**  
[hp.com/go/3DMaterials](http://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 BD7 and have been obtained from a sample of specimens printed in plots with 6% packing density. Separation between specimens in the plot was 10 mm. Modulus has been calculated using the slope of the regression line between 0.05% and 0.25% strain measured 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.
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.

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