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Ultrasint® PA11 Black

Supertough | bio-based | Easy to use

Extended TDS

Complete Technical Documentation and Testing Summary

Version 1.2

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Are you looking for an updated TDS version? Check out the latest online version here.

Technical Data Sheet

Bio-based performance alternative to PA12 with enhanced toughness and ductility, compatible with many SLS machines including desktop machines with diode lasers and high-speed machines with fiber lasers

General Properties	Method	Typical Values
Appearance	-	Black
Density (printed part)	DIN EN ISO 1183-1	1.03 g/cm³
Density (Bulk Density)	DIN EN ISO 60	0.54 g/cm³
Mean Particle Size d50	ISO 13320	40-50 µm
Melting Temperature	ISO 11357 (10 K/min)	203°C
Crystallization Temperature	ISO 11357 (10 K/min)	165°C
Melting Volume Flow Rate	ISO 1133 (220°C, 2.16 kg)	18 cm³/10min

Tensile Properties	Method	Typical Values X-Direction		Typical Values Z-Direction	
		Dry[1)]	Cond[2)]	Dry[1)]	Cond[2)]
E Modulus	ISO 527-2, 23°C	1750 MPa	1150 MPa	1700 MPa	1200 MPa
Ultimate Tensile Strength	ISO 527-2, 23°C	52 MPa	45 MPa	52 MPa	45 MPa
Elongation at Break	ISO 527-2, 23°C	26%	42%	27%	34%
E Modulus	ISO 527-2, 80°C	390 MPa	330 MPa	360 MPa	300 MPa
Ultimate Tensile Strength	ISO 527-2, 80°C	32 MPa	28 MPa	28 MPa	26 MPa
Elongation at Break	ISO 527-2, 80°C	26%	42%	27%	34%

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Flexural Properties	Method	Typical Values X-Direction		Typical Values Z-Direction	
		Dry[1)]	Cond[2)]	Dry[1)]	Cond[2)]
Flexural Modulus	DIN EN ISO 178	1750 MPa	1300 MPa	1700 MPa	1300 MPa

Impact Properties	Method	Typical Values X-Direction		Typical Values Z-Direction	
		Dry[1)]	Cond[2)]	Dry[1)]	Cond[2)]
Charpy Notched, 23°C	DIN EN ISO 179-1	7.6 kJ/m²	11 kJ/m²	7.7 kJ/m²	11 kJ/m²
Charpy Unnotched, 23°C	DIN EN ISO 179-1	193 kJ/m²	No break	56 kJ/m²	75 kJ/m²
Izod Notched, 23°C	ISO 180	7.9 kJ/m²	9.3 kJ/m²	8 kJ/m²	9.9 kJ/m²
Izod Unnotched, 23°C	ISO 180	No break	No break	48 kJ/m²	63 kJ/m²

Thermal Properties	Method	Typical Values
HDT/A (1.8 MPa)	ISO 75-2	62°C
HDT/B (0.45 MPa)	ISO 75-2	177°C
Vicat/A (10 N)	DIN EN ISO 306	192°C
Vicat/A (10 N)	DIN EN ISO 306	175°C

Fire, Smoke, Toxicity (FST) properties	Method	Typical Values
Flammability	UL 94	HB (0.9 -3.2mm)

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Electrical Properties	Method	Typical Values	
		X-Direction	Z-Direction
Dielectric Strength	IEC 60243-1	27 kV/mm (1 mm)	27 kV/mm (1 mm)
Volume Resistivity	IEC 62631-3-1	$3.5 \bullet 10^{14}$ Ωcm	$3.5 \bullet 10^{14}$ Ωcm
Specific Surface resistivity	IEC 62631-3-2	$>10^{16}$ Ω	$>10^{16}$ Ω

Mechanical properties overview

1) Measured after drying 14 days at 80°C / vacuum. Water content is about 0.02% acc. to DIN EN ISO 15512
2) Measured after conditioning 14 days at 70°C / 62% r.h. Water content is about 0.8% acc. to DIN EN ISO 15512
3) If not noted otherwise, all specimens are 3D printed. Samples were tested at room temperature, 23°C. All values measured with virgin material.

Printing Performance

The combination of 3D printer and material has a huge impact on the quality of the parts produced.

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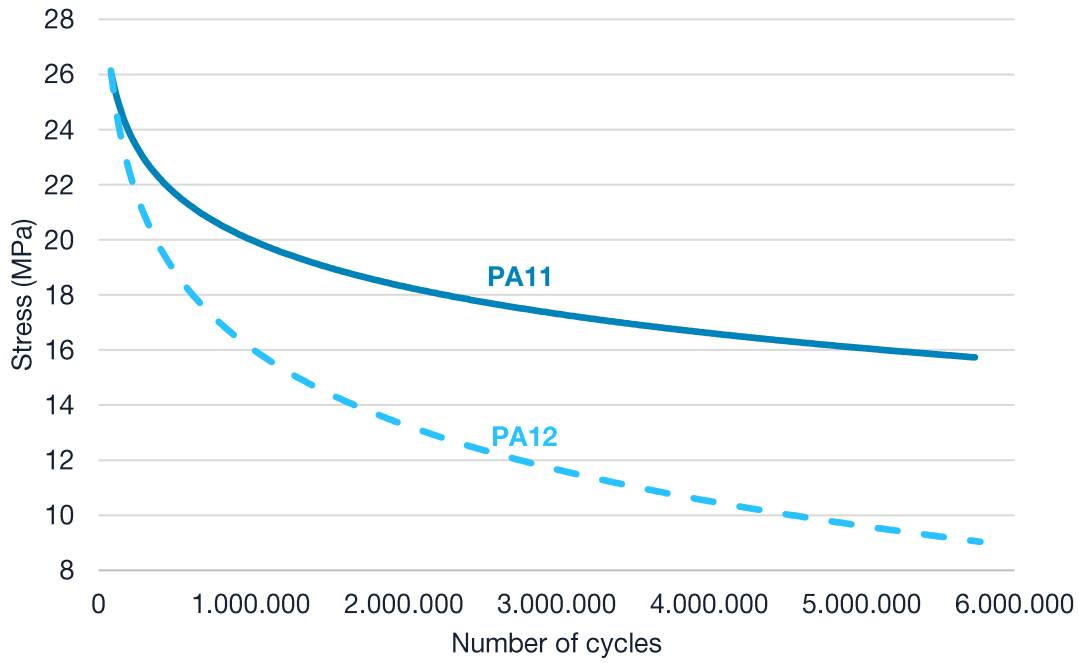
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Fatigue resistance

Fatigue refers to the progressive weakening or failure of a material caused by repeated or fluctuating stresses over time. In polymers, this phenomenon occurs as microscopic cracks accumulate and propagate under cyclic loading, leading to eventual material failure. The rate and extent of fatigue damage depend on factors such as the frequency, magnitude of stress, and environmental conditions.

Understanding fatigue is crucial for industrial applications involving polymer materials, as it directly impacts their performance, longevity, and safety. Components exposed to repetitive forces, such as seals, gaskets, or structural parts, must be engineered to resist fatigue failure to ensure reliability and reduce maintenance costs. Assessing fatigue resistance is vital for selecting appropriate polymers for demanding applications and optimizing material design to extend product lifespan.



Fatigue curve at 23°C and 5 Hz direction Z (ISO 527 1B notched 0.7 mm)

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Industrial Chemical Resistance

In general, Ultrasint® PA11 Black has good resistance to inorganic salts, alkalis, most solvents, and organic acids. Greater caution must be observed in applications involving inorganic acids, phenols and certain chlorinated solvents. In such cases, please contact MAM technical staff for assessment, specifying the practical problem involved: e.g nature of metal to be protected and the temperature and chemical composition of the liquid

Resistance	20°C	40°C	60°C	90°C
Inorganic bases				
Ammonium hydroxide (concentrated)	G	G	G	G
Ammonia (liquid or gas)	G	G		
Lime-wash	G	G	G	
Potassium hydroxide (50%)	G	L	P	P
Sodium hydroxide (5%)	G	G	L	
Sodium hydroxide (10%)	G	L	L	
Sodium hydroxide (50%)	G	L	P	P
Inorganic acids				
Chromic acid (10%)	P	P	P	P
Hydrochloric acid (1%)	G	L	P	P
Hydrochloric acid (10%)	G	L	P	P
Nitric acid (all concentrations)	P	P	P	P
Phosphoric acid (50%)	G	L	P	P
Sulphuric acid (1%)	G	L	L	P
Sulphuric acid (10%)	G	L	P	P
Sulphuric trioxide	L	P	P	P

Condition after 18 months contact:
G: Good - L: Limited - P: Poor

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Resistance	20°C	40°C	60°C	90°C
Inorganic salts				
Alum	G	G	G	
Aluminum sulphate	G	G	G	G
Ammonium nitrate	G	G	G	
Ammonium sulphate	G	G	L	
Chlorides (barium/ calcium /saturated sodium)	G	G	G	G
Calcium arsenate	G	G	G	
Calcium sulphate	G	G	L	
Copper sulphate	G	G	G	G
Diammonium phosphate	G	G	L	
Magnesium chloride (50%)	G	G	G	G
Potassium ferrocyanide	G	G	G	
Potassium nitrate	G[4)]	G[4)]	P	P
Potassium sulphate	G	G	G	G
Sodium carbonate	G	G	L	P
Sodium silicate	G	G	G	
Sodium sulfide	G	L	L	
Trisodium phosphate	G	G	G	G

Condition after 18 months contact:

G: Good - L: Limited - P: Poor

4) Slight yellowing

Resistance	20°C	40°C	60°C	90°C
Other inorganic products				
Agricultural sprays	G	G		
Bleach solution	L	P	P	P
Bromine / chlorine / fluorine	P	P	P	P
Hydrogen	G	G	G	G
Hydrogen peroxide (20 vol)	G	L	P	P
Mercury	G	G	G	G
Oxygen	G	G	L	P
Ozone	L	P	P	P
Potassium permanganate (5%)	P	P		
Sea water	G	G	G	
Soda water	G	G	G	G
Sulphur	G	G		
Hydrocarbons				
Acetylene	G	G	G	G
Alkanes (methane, propane, butane, hexane)	G	G	G	
Benzene	G	G[5)]	L	
Cyclohexane	G	G	L	
Decalin	G	G	L	
HFA	G			
Naphthalene	G	G	G	L
Styrene / toluene / xylene	G	G[6)]	L	L

Condition after 18 months contact:

G: Good - L: Limited - P: Poor

4) Slight yellowing
5) Yellowing
6) Swelling action

Resistance	20°C	40°C	60°C	90°C
Various products				
Beer, cider, fruit juices, milk, mustard, vinegar, wine	G			
Crude petroleum, high-octane petrol, kerosene (paraffin), normal petrol, solvent naphta, town gas	G	G	G[6]	
Greases	G	G	G	G
Oils	G	G	G	G
Solutions or emulsions D.D.T. or lindane	G	G		
Hydroxyquinoline (agricultural sprays)	G			
Soap solution	G			
Stearin	G	G	G	
Turpentine	G	G	G[6]	
Organic acids and anhydrides				
Acetic acid	L	P	P	P
Acetic anhydride	L	P	P	P
Citric acid	G	G	L	P
Formic acid	P	P	P	P
Lactic acid	G	G	G	L
Oleic / stearic acid	G	G	G	L
Oxalic acid	G	G	L	P
Picric acid	L	P	P	P
Tartaric acid (saturated solution)	G	G	G	L
Uric acid	G	G	G	L

Condition after 18 months contact:

G: Good - L: Limited - P: Poor

4) Slight yellowing
5) Yellowing
6) Swelling action

Resistance	20°C	40°C	60°C	90°C
Various organic compounds				
Anethole	G			
Carbon disulfide	G[6)]			
Diacetone alcohol	G	G[6)]	L	
Dimethyl formamide	G	G	L	
Ethylene chlorohydrin	P	P		
Ethylene oxide	G	G	L	P
Furfural	G	G[6)]	L	P
Glucose	G	G	G	G
Tetraethyl lead	G			
Tetrahydrofuran	G	G	L	
Phenols	P	P	P	P
Organic bases				
Aniline (pure)	L	P	P	P
Diethanolamine (20%)	G	G[6)]	G[6)]	L
Pyridine (pure)	L	P	P	P
Urea	G	G	L	L

Condition after 18 months contact:

G: Good - L: Limited - P: Poor

4) Slight yellowing
5) Yellowing
6) Swelling action

Resistance	20°C	40°C	60°C	90°C
Salts, esters, ethers				
Acetate esters (amyl, butyl, methyl)	G	G	G	L
Phosphate esters (dioctyl, tributyl, tricesyl)	G	G	G	L
Diethyl ether	G			
Dioctyl phthalate	G	G	G	L
Fatty acid esters	G	G	G	G
Methyl sulfate	G	L		
Alcohols				
Benzyl alcohol	L	P	P	P
Butanol	G[6)]	L	P	P
Ethanol (pure)	G[6)]	G[6)]	L	
Glycerin (pure)	G	G	L	P
Glycol	G	G	G	P
Methanol (pure)	G[6)]	L	P	
Chlorinated solvents				
Carbon tetrachloride	P	P		
Methyl bromide	G	P		
Methyl chloride	G	P		
Perchloroethylene	G	G	L	
Trichloroethane	L	P		
Trichloroethylene	G	L		

Condition after 18 months contact:

G: Good - L: Limited - P: Poor

4) Slight yellowing
5) Yellowing
6) Swelling action

Resistance	20°C	40°C	60°C	90°C
Aldehydes and ketones				
Aldehydes (acetaldehyde / benzaldehyde / formaldehyde)	G	L	P	
Acetone (pure)	G	G	L	P
Cyclohexanone	G	L	P	
Methylethylketone (MEK) Methyl Isobutyl Ketone (MIBK)	G	G	L	P

Condition after 18 months contact:

G: Good - L: Limited - P: Poor

4) Slight yellowing
5) Yellowing
6) Swelling action

Long-term UV

Durability is a key feature for components across many industries. The materials used in automotive or consumer applications for instance, must be put through a variety of severe tests to ensure that they can withstand years of exposure to the elements. Plastics are chemically degraded by the effect of UV radiation. The degree of ageing depends on duration and intensity.

Test method and specimens

The UV resistance was examined both for outdoor weathering condition use and indoor use applying conventional accelerated weathering tests as per the Norm ISO 4892-2:2013 Method A and ISO 4892-2:2013 Method B, using ISO 527-2:2012 tensile bars and ISO 179-1for charpy notched.

Cycle No.	UV exposure	Exposure period	Black standard temperature in °C	Chamber temperature in °C	Relative humidity in %
1	Daylight filters	102 min dry 18 min water spray	65 ± 3	38 ± 3	50 ± 10

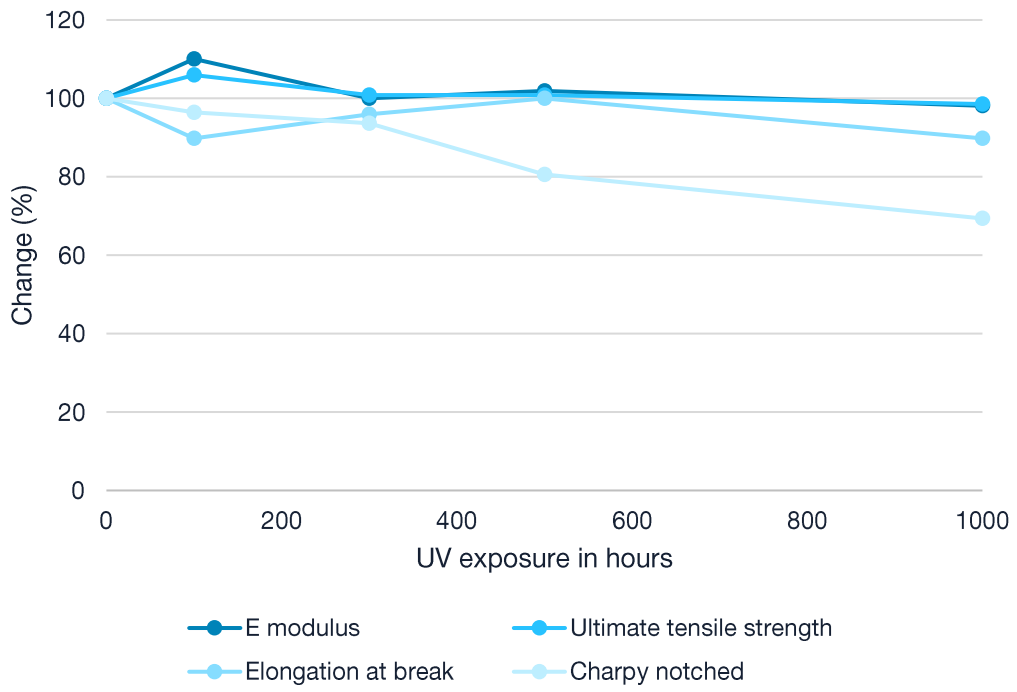
Testing conditions for ISO 4892-2 method A, cycle 1 (Weathering; Example: Outdoor conditions)

Cycle No.	UV exposure	Exposure period	Black standard temperature in °C	Chamber temperature in °C	Relative humidity in %
3	Window glass filters	Continuously dry	100 ± 3	65 ± 3	20 ± 10

Testing conditions for ISO 4892-2 method B, cycle 3 (UV exposure; Example: Car dashboard)

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Mechanical Testing



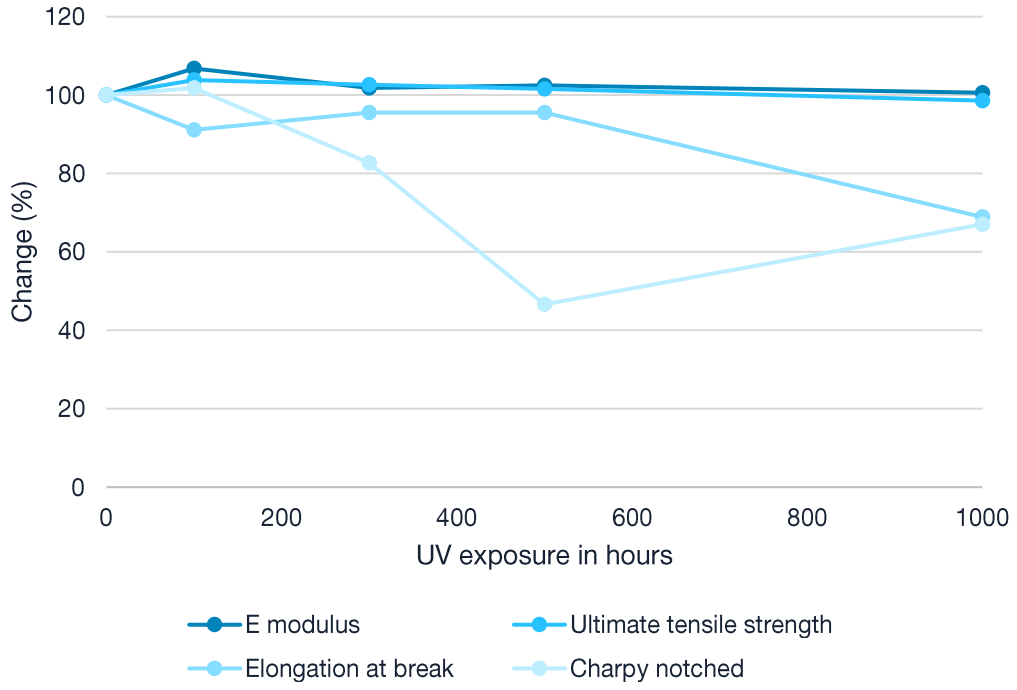
Change in mechanical properties after accelerated weathering (ISO 4892-2 method A)

The final values after 1000 hours of long-term UV exposure can be found below.

Property	Before long-term UV exposure	After 1000 hours of UV exposure
E modulus	1590 MPa	1560 MPa
Ultimate tensile strength	49 MPa	48 MPa
Elongation at break	49%	44%
Charpy notched	6.8 kJ/m²	4.7 kJ/m²

Mechanical properties before and after 1000 hours of UV exposure as per ISO 4892-2 method A

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Change in mechanical properties after accelerated weathering (ISO 4892-2 method B)

The final values after 1000 hours of long-term UV exposure can be found below.

Property	Before long-term UV exposure	After 1000 hours of UV exposure
E modulus	1620 MPa	1630 MPa
Ultimate tensile strength	49 MPa	49 MPa
Elongation at break	45%	31%
Charpy notched	6.7 kJ/m²	4.5 kJ/m²

Mechanical properties before and after 1000 hours of UV exposure as per ISO 4892-2 method B

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Flammability

Ultrasint® PA11 Black does not contain any flame retardants and passes UL94 “HB” rating down to a wall thickness of 0.9 mm.

***** Flame testing *****
Flammability HB acc. to UL 94 : 2021

Information about test procedure and test specimens

M 0 0321			Measurements & observations after application of flame (30 s)					Flame class
Dimensions of test specimens 127 * 12,7 * d mm³			Flame front ceases before 25mm mark	Flame front ceases before 100mm mark	Damaged length beyond 25mm mark [mm]	Burning time beyond 25mm mark [s]	Burning rate [mm/min]	
Requirements	for d < 3 mm		---	---	---	>= 60	<= 75	= HB
	for d >= 3 mm		---	---	---	>= 112,5	<= 40	= HB
Pre-conditioning	Spec. no.	Thickn. [mm]						
Conditioning	1	0.89	No	No	75	110	41	HB
(2d / 23°C / 50%)	2	0.92	No	No	75	97	46	HB
	3	1.00	No	No	75	122	37	HB
Comments			First test	2022-02-04 8:16 - 2022-02-04 8:28				
Conditioning	1							
(2d / 23°C / 50%)	2							
	3							
Comments			Repeated test	-				HB @0.9mm

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Bio-based content statement

Product: Ultrasint® PA11 Black

Revision: 05th of December 2023

This is to confirm that the bio-based content of Ultrasint® PA 11 Black amounts to 96%.

The above-mentioned information has been provided by our raw material suppliers. The bio-based content is of vegetal origin and has been calculated according to ASTM D6866-12 and based on the composition of the raw materials used during manufacturing.

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