

Product information

PA 2241 FR

1 General

PA 2241 FR is a flame-retardant polyamide 12 for processing in laser sintering systems. It contains a halogen-based flame retardant. Mainly due to its recyclability the material is economical, enabling low-cost part production.

Typical application

- aviation (interior like air ducts and air outlet valves)

2 Technical data

Mechanical properties depending on temperature

Tensile property	Test method	Build orientation acc. to ISO/ASTM 52921	Test temperature	Sample measurements*
Tensile modulus	ISO 527-1/-2 ISO 527-2/1A/1	XYZ	-55 °C	2183 MPa
			23 °C	1860 MPa
			60 °C	674 MPa
			85 °C	478 MPa
	XZY	-55 °C	2055 MPa	
			23 °C	1780 MPa
			60 °C	613 MPa
			85 °C	462 MPa
	ZXY	-55 °C	2171 MPa	
			23 °C	1870 MPa
			60 °C	687 MPa
			85 °C	552 MPa

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Tensile property	Test method	Build orientation acc. to ISO/ASTM 52921	Test temperature	Sample measurements*
Strength	ISO 527-1/-2 ISO 527-2/1A/5	XYZ	-55 °C	69.7 MPa
			23 °C	44.7 MPa
			60 °C	30.3 MPa
			85 °C	24.1 MPa
		XZY	-55 °C	70.7 MPa
			23 °C	44.3 MPa
			60 °C	28.5 MPa
			85 °C	24.4 MPa
		ZXY	-55 °C	58.9 MPa
			23 °C	42.6 MPa
			60 °C	29.9 MPa
			85 °C	24.1 MPa
Strain at break	ISO 527-1/-2 ISO 527-2/1A/5	XYZ	-55 °C	7.6 %
			23 °C	19.2 %
			60 °C	57.2 %
			85 °C	113.4 %
		XZY	-55 °C	8.5 %
			23 °C	26.7 %
			60 °C	134.5 %
			85 °C	157.3 %
		ZXY	-55 °C	4.4 %
			23 °C	9.3 %
			60 °C	24.9 %
			85 °C	34.0 %

Test specimens were vacuum-packed for storage. Before determination of tensile properties, test specimens were conditioned at $(23 \pm 2) \text{ °C}$ and $(50 \pm 10) \text{ \% RH}$ for $(24 - 48) \text{ h}$.

*Sample measurements at 23 °C can deviate from typical values given in the Material Data Sheet.

Product information

Mechanical properties after immersion in liquids according to ISO 175

Immersion conditions	Tensile property	Test method	Sample measurements
Test liquid: De-ionized water	Tensile modulus	ISO 527-1/-2 ISO 527-2/1A/1	1260 MPa
Immersion temperature: (70 ±2) °C			
Immersion time : (336 ±2) h	Strength	ISO 527-1/-2 ISO 527-2/1A/5	38.9 MPa
Drying after removal: at (50 ±2) °C for (24 ±1) h			
Reconditioning after drying: at 23/50 acc. to ISO 291 for (72 ±2) h	Strain at break	ISO 527-1/-2 ISO 527-2/1A/5	24.3 %

Build orientation acc. to ISO/ASTM 52921: XYZ

Ageing Behavior

Exposure conditions	Tensile property	Test method	Sample measurements
Properties after exposure to heat	Tensile modulus	ISO 527-1/-2 ISO 527-2/1A/1	1900 MPa
Exposure temperature: (85 ±2) °C			
Duration of exposure: (1500 ±2) h	Strength	ISO 527-1/-2 ISO 527-2/1A/5	46.0 MPa
Conditioning after exposure: at 23 °C for 24 h			
	Strain at break	ISO 527-1/-2 ISO 527-2/1A/5	17.2 %
Properties after exposure to humidity	Tensile modulus	ISO 527-1/-2 ISO 527-2/1A/1	1320 MPa
Exposure temperature: (70 ±2) °C			
Humidity : (85 ±5) % RH	Strength	ISO 527-1/-2 ISO 527-2/1A/5	39.3 MPa
Duration of exposure: (1000 ±2) h			
Conditioning after exposure: at 23 °C for 72 h	Strain at break	ISO 527-1/-2 ISO 527-2/1A/5	17.7 %

Build orientation acc. to ISO/ASTM 52921: XYZ

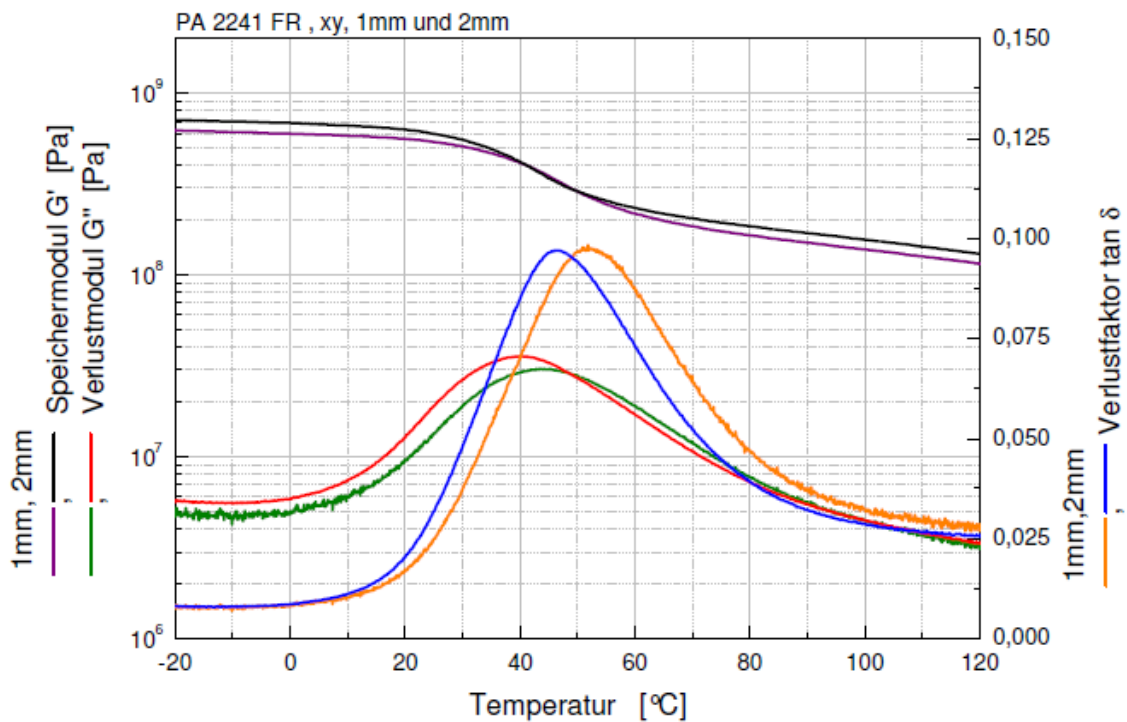
Product information

Short term influence of temperature on mechanical properties

Dynamic Mechanical Thermal Analysis (DMTA):

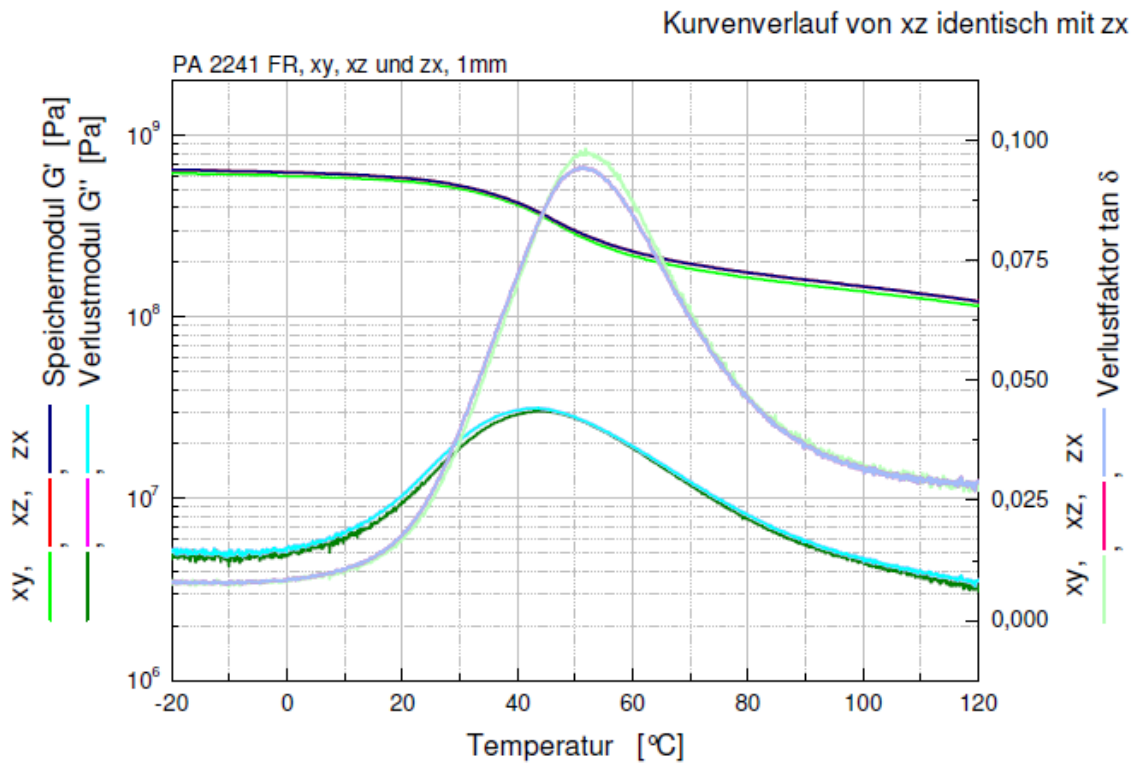
Dynamic modulus (*Speichermodul G'*),
 loss modulus (*Verlustmodul G''*) and
 loss factor (*Verlustfaktor $\tan \delta$*) as a function of temperature.

Influence of the wall-thickness



Product information

Influence of the orientation in the building room



Thermal properties

Heat Distortion Temperature

- HDT A	ISO 75	84	°C
- HDT B	ISO 75	154	°C

Melting temperature (virgin powder)	ISO 11357-1/-3	185	°C
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Decomposition temperature	ISO 11358	> 330	°C
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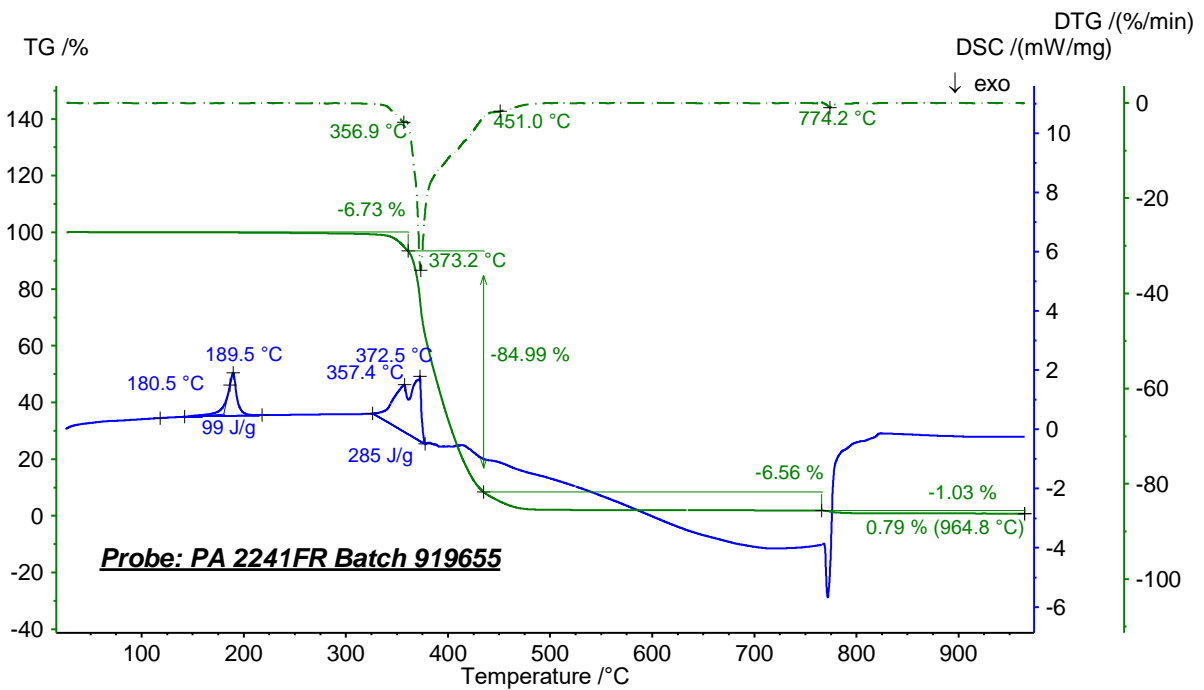
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Thermo Gravimetric Analysis TGA / Differential Scanning Calorimetry DSC

[Rate of mass change](#)

[Change in mass](#)

[Differential Scanning Calorimetry](#)



Change in test atmosphere from N₂ to air at 770 °C.

Product information

Burning behaviours

Property	Standard / Test method / Requirement	Thickness	Unit
Flammability	Vertical Bunsen Burner Test, 12 s ignition time Fire Testing Handbook, DOT/FAA/AR-00/12, Chapter 1 & AITM2-0002 B CS/FAR Part 25 §25.853(a) & App. F, Part I, §(a)(1)(i) Amdt.24/Amdt.25-116 & ABD0031 XYZ Build orientation acc. to ISO/ASTM 52921	1.0 / 1.5 / 2.0 / 3.0	mm
Flammability	Vertical Bunsen Burner Test, 60 s ignition time Fire Testing Handbook, DOT/FAA/AR-00/12, Chapter 1 & AITM2-0002 A CS/FAR Part 25 §25.853(a) & App. F, Part I, §(a)(1)(i) Amdt.24/Amdt.25-116 & ABD0031 XYZ Build orientation acc. to ISO/ASTM 52921	1.0 / 1.5 / 2.0 / 3.0	mm
Smoke density	ABD 0031 (Issue: F), method: AITM 2.0007, Flaming mode XYZ Build orientation acc. to ISO/ASTM 52921	1.0 / 1.5 / 2.0 / 3.0	mm
Toxicity	ABD 0031 (Issue: F), method: AITM 3.0005 XYZ Build orientation acc. to ISO/ASTM 52921	1.0 / 1.5 / 2.0 / 3.0	mm

Conversion of units: 1.0 mm is equivalent to 0.03937 inches

Fungus resistance

Plastics – evaluation of action of microorganisms	ISO 846, procedure A	Growth intensity: 0 (0,0,0,0,0) 0 = no growth, not even microscopically detectable
<ul style="list-style-type: none"> • Aspergillus niger • Penicillium funiculosum • Paecilomyces variotii • Gliocladium virens • Chaetomium globosum 		

Product information

Fluids susceptibility

Environmental Conditions and Test Procedures for Airborne Equipment
RTCA DO-160G

Class of fluid	Test fluid	Test fluid temperature	Visual inspection
Solvent and Cleaning Fluids	Isopropyl alcohol	(55 ±3) °C	no visual degradation and/or physical changes of material
Solvent and Cleaning Fluids	Honey Bee 90	(55 ±3) °C	slight discoloration from liquid
Insecticide	Callington 1 Shot	(30 ±3) °C	no visual degradation and/or physical changes of material
Drinks	Soda	(5 ±3) °C	no visual degradation and/or physical changes of material
Drinks	Coffee	(40 ±3) °C	slight discoloration from liquid
Disinfectant	Calla 1452	(55 ±3) °C	no visual degradation and/or physical changes of material

All test specimens were built with refreshed powder, refresh factor 50 % on an EOS P 396 laser sintering system, default-job: PA2241FR_150_0xx

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