Material data sheet

PA 2200

1 General

Typical applications of the material are fully functional parts with high end finish right from the process, which easily withstand high mechanical and thermal load.

PA 2200 is suitable for processing on the following systems:

- EOSINT P 730, P 700
- EOSINT P 390, P 385, P 380i, P 380, with or without powder conveying system
  EOSINT P 360 with upgrade S&P, P 350/2 with upgrade 99 and upgrade S&P
- FORMIGA P 100

2 Technical data

General material properties

Average grain size	ISO 13320-11	56	µm
	Laser diffraction	2.20	mil
Bulk density	EN ISO 60	0.45	g/cm³
Density of laser-sintered part	EOS method	0.93	g/cm³
		58	lb/ft³

Mechanical properties

Tensile modulus	EN ISO 527	1700	MPa
	ASTM D638	247	ksi
Tensile strength	EN ISO 527	48	MPa
	ASTM D638	6962	psi

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Elongation at break	EN ISO 527	24	%
Elongation at break	ASTM D638	24	%
Flexural modulus	EN ISO 178	1500	MPa
	ASTM D790	217	ksi
Flexural strength	EN ISO 178	58	MPa
	ASTM D790	8412	psi
Charpy - Impact strength	EN ISO 179	53	kJ/m²
Charpy - Notched impact strength	EN ISO 179	4.8	kJ/m²
Izod – Impact strength	EN ISO 180	32.8	kJ/m²
Izod – Notched impact strength	EN ISO 180	4.4	kJ/m²
Ball indentation hardness	EN ISO 2039	78	N/mm²
Shore D - hardness	ISO 868	75	-
	ASTM D2240	75	-

The mechanical properties depend on the x-, y-, z-position and on the exposure parameters used.

Thermal properties

Melting point	EN ISO 11357-1	172 - 180	°C
Vicat softening temperature B/50	EN ISO 306	163	°C
	ASTM D1525	325	°F
Vicat softening temperature A/50	EN ISO 306	181	°C
	ASTM D1525	358	°F

The data are based on our latest knowledge and are subject to changes without notice. They do not guarantee properties for a particular part and in a particular application.

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Product Information

PA 2200

PA 2200 is a non-filled powder on basis of PA 12.

General Properties

Property	Measurement Method DIN/ISO	Units	Value
Water absorption	ISO 62 / DIN 53495		
100°C, saturation in water		%	1.93
23°C, 96% RF		%	1.33
23°C, 50% RF		%	0.52

Property	Measurement Method DIN/ISO	Unit	Value
Coefficient of linear thermal expansion	ISO 11359 / DIN 53752-A	$x10^{-4}$/K	1.09
Specific heat	DIN 51005	J/gK	2.35

Thermal properties of sintered parts

Property	Measurement Method DIN/ISO	Unit	Value
Thermal conductivity	DIN 52616		
vertical to sintered layers		W/mK	0.144
parallel to sintered layers		W/mK	0.127

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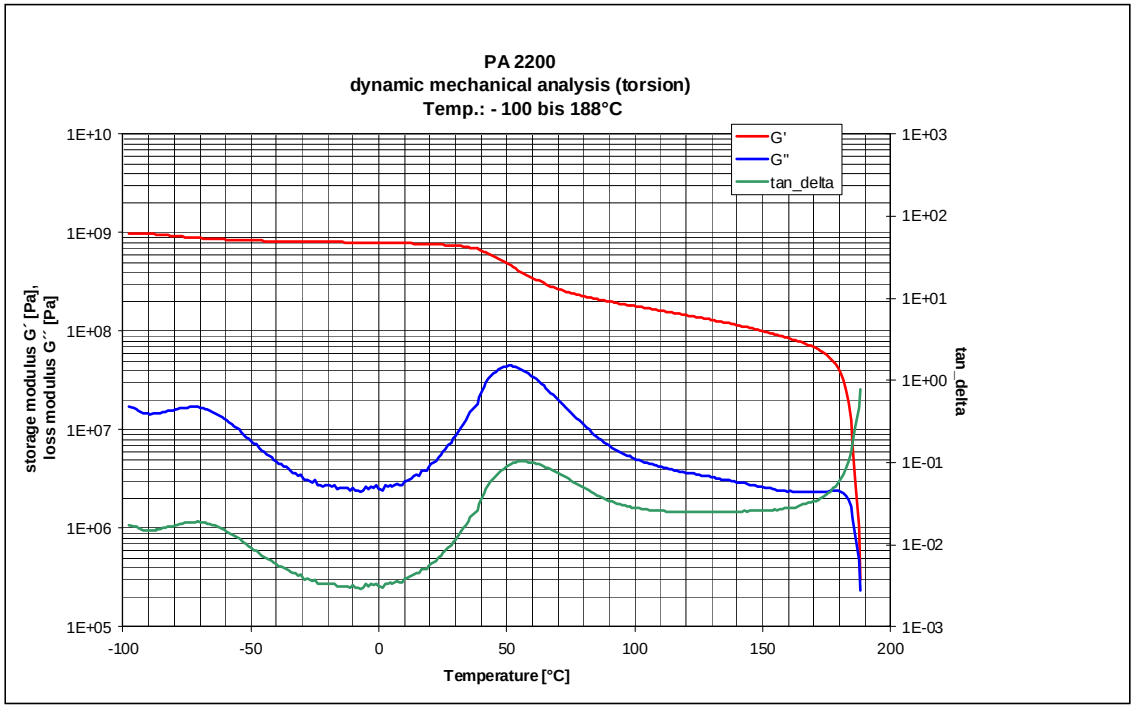
Short term influcence of temperature on mechanical properties

An overview about the temperature dependence of mechanical properties of PA 12 can be retrieved from the curves for dynamic shear modulus and loss factor as function of temperature according to ISO 537.



In general parts made of PA 12 show high mechanical strength and elasticity under steady stress in a temperature range from - 40°C till + 80°C. Short time loading of parts made of PA 12 without stress is possible up to 160°C.

Long term properties under mechanical load and temperature

In general thermoplastics have higher mechanical strength under short term load then under long term load (> 1000 h) as result of creep. This occurs mostly at higher temperatures and leads to a reduction of modulus (creep modulus). Usually the creep resistance (mechanical properties under continuous load) is determined with the uniaxial tensile creep test (DIN 53444) under different loads and temperatures.

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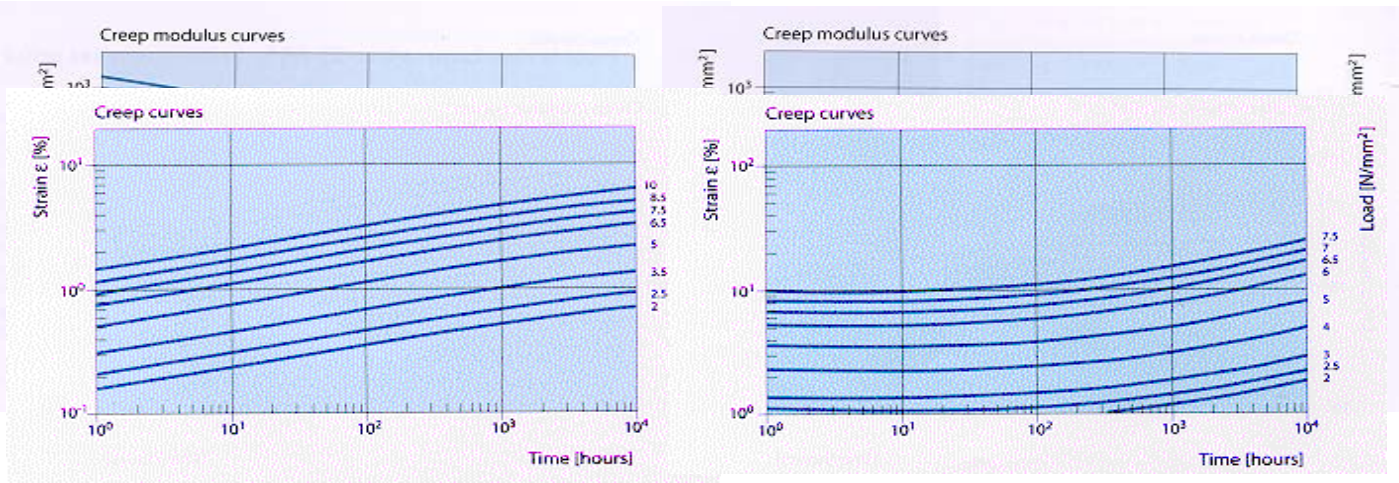
Creep modulus curces PA 12 at T = 23°/100°C



Creep elongation curves PA 12 at T = 23°C/100°C

Electrical Properties

Property	Measurement Method DIN/ISO	Unit	Value
Volume Resistance	DIN 53482 IEC-Publ. 93	Ω*cm	10^{13} –10^{15}
Surface Resistance	DIN 53482 IEC-Publ. 93	Ω	10^{13}
Relative Permittivity (1 kHz)	DIN53483 IEC-Publ. 250	10^{2} Hz	3,8
Dielectric strength	DIN 53481	KV/mm	92
Dielectric dissipation faktor (1 kHz)	DIN 53483 IEC-Publ. 250	-	0.05 – 0.09

The electrical properties depend on temperature and relative air humidity strongly. The above mentioned values charakterize polyamide 12 at following conditions: storage at 23°C, 50% air humidity up to saturation.

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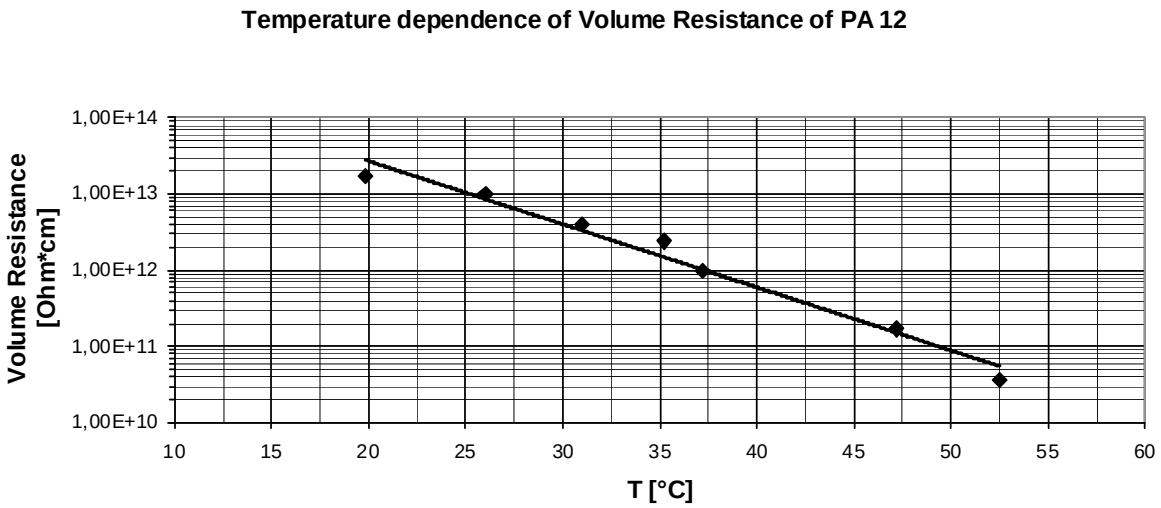
The details contained herein characterize the electrical behaviour of material and not of a specified building part. The details are based on our present state of knowledge and experience. We do, however, pass them without any warranty or property assurance.



Flammability / Burning Behaviour

The powder contains no flame retardants, parts made of PA 2200 can burn.

Property	Measurement Method DIN/ISO	Unit	Value
	IEC 60707 *		
	ISO 1210	Klasse (1,6 mm)	HB
Flammability	UL94*	Klasse (1,6 mm)	HB
			(horizontal burning)

*) flammability test as approval for electrical application

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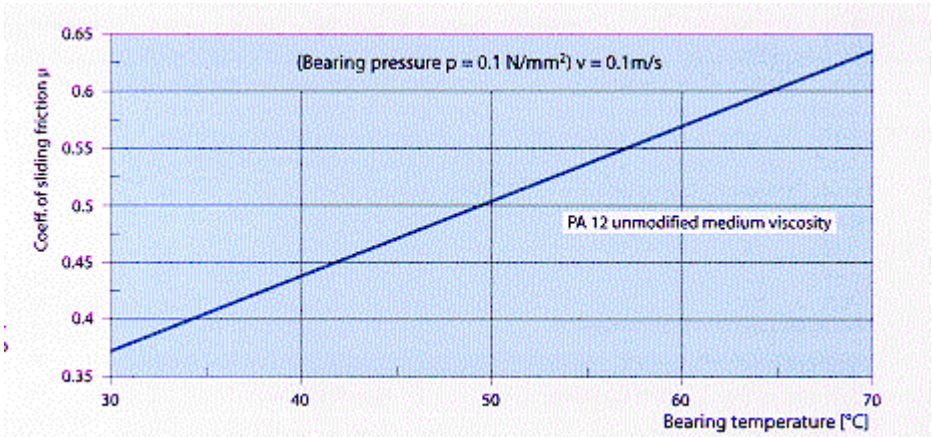
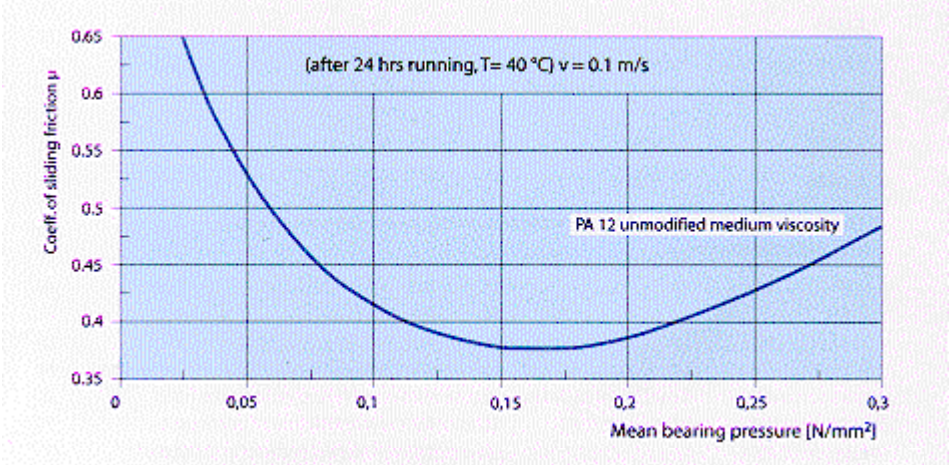
Frictional Properties, Abrasion and Wear

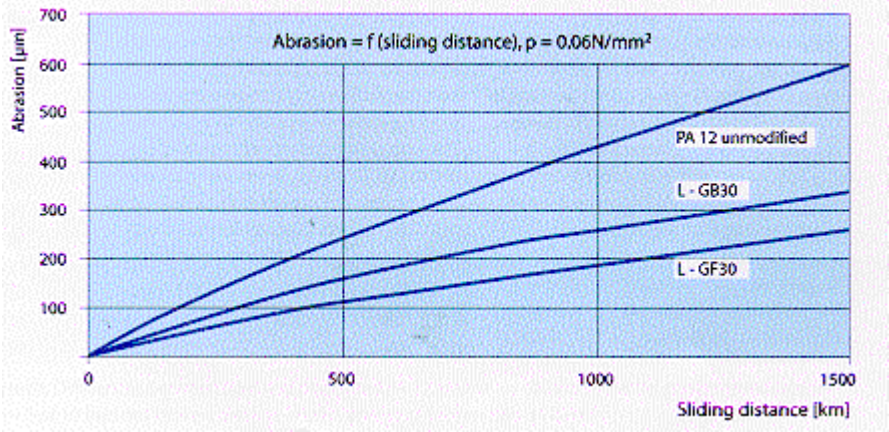
Polyamid 12 is characterized by a low coefficient of friction and by very good abrasion resistance.



Coefficient of sliding friction in dependence of bearing temperature (Lubrimeter test acc. A. Bartel)



Coefficient of sliding friction as function of pressure load (Lubrimeter test acc. A. Bartel))



Abrasion on bearing as function of the sliding distance and PA12-modification (L-GB30/glass spheres; L-GF30-glass fibres)

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Abrasion of sintered parts according to Taber-Test

Material	Measurement Method DIN/ISO	Unit	Value
PA 2200	DIN 53754	mg/2000 U	34
PA 3200 GF	DIN 53754	mg/2000 U	30

Chemical Resistance of PA 12

+ = resistant - = non-resistant ⊕ =practically resistant
O = conditional resistant ⊗ = litte resistant

Duration		6 Months	4 Weeks
Medium	**Concentration**	**20°C**	**60°C**
Aceton	100	+	+
Battery acid	10	⊗	-
Formic acid		+	O
Ammonia, aqueos solution	Conz.	+	+
Aniline	100	⊕	
Apple juice		+	+
Asphalt		+	+
Barium salts		+	+
Petrol		+	+
Benzene	100	+	O
Beer		+	
Break fluid		+	+
Butane Gas	100	+	+
Butane liquid	100	+	
Butter		+	

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Duration		6 Months	4 Weeks
Medium	**Concentration**	**20°C**	**60°C**
Chrome acid	10	-	-
Cyclohexanone	100	+	O
Dibutylphtalate (Vestinol®C)		+	+
Diethyl-Ether (Kp 35°C)	100	⊕	
Dioctylphtalate (Vestinol ®AH)		+	+
Dixan®Base	useable	+	+
Acetic acid	10	+	⊗
Ethyl-Acetate		+	⊕
Ethyl-Alkohol, denature	100	+	⊕
Fish		+	
Hydrofluoric acid	40	⊗	-
Anti freezer		+	+
Dishes cleaner		+	+
Glycerine	100	+	+
Glycol	100	+	+
Fuel Oil		+	+
coffee, drinkable		+	
Caustig	50	+	+
Potassium Chlorate aqueous solution	cold, saturated (7,3)	⊕	O
Potass. Permanganate aqueous solution	cold, saturated (6,4)	⊗	-
Linseed Oil		+	+

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Duration		6 Months	4 Weeks
Medium	**Concentration**	**20°C**	**60°C**
Methanol	100	+	⊕
Milk		+	+
Lactid Acid aqueous solution	10	⊕	O
Sodium-Chloride aqueous solution	cold saturated	+	+
Sodium-Hypochloride, aqueous solution	5	⊕	⊗
Sodium hydroxid	50	+	+
Ozone (0,5 ppm)		O	
Paraffin	100	+	+
Persil®Base	useable	+	+
Petroleum	100	+	+
Propane Gases	100	+	+
Pyridine	100	+	
Rum	40	+	+
Nitric Acid	10	-	-
Salt Acid	10	-	-
Soft Soap		+	+
Sulfur	100	+	+
Sulfur Acid	10	⊕	⊗
Sea Water		+	+
Silicon Oil		+	+
Edible Oil, animal + vegetable		+	+

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Prüfdauer		6 Monate	4 Wochen
Medium	**Konzentration**	**20°C**	**60°C**
Toluene	100	+	⊗
Tomato Juice		+	+
Trichlorethylene	100	O	⊗
Water	100	+	+
Hydrogen-Peroxide aqueous solution	30	+	
Whiskey	40	+	
Xylene	100	+	O
Citric acid aqueous solution	cold saturated	+	O
Lemon juice		+	+
Sugar solution	every	+	+

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Zertifikat , Biokompatibilität PA 2200

BIOSERVICE SCIENTIFIC LABORATORIES GMBH

BIOCOMPATIBILITY
CERTIFICATE

Testmaterial: **PA 2200**

Supplier: EOS GmbH
Pasinger Strasse 2, D-82152 Planegg

Studies performed: The following studies were performed in order to determine the biocompatiblity of the product PA 2200 according to ISO 10993-1:

CYTOTOXICITY
SENSITISATION, polar extract
SENSITISATION, non-polar extract
INTRACUTANEOUS REACTIVITY

Results: **The product did not show any adverse effects in the studies performed. Therefore, the biocompatiblity of the test material was proved.**

BSL BIOSERVICE Scientific Laboratories GmbH Munich
Behringstraße 6
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Dr. Achim Albrecht
Biological Safety Testing
Date: April 10, 2001

BIOSERVICE Scientific Laboratories GmbH GLP EN 45001

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