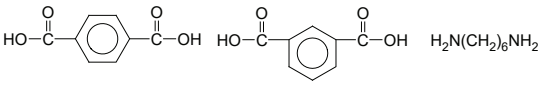
PPA polyphthalamide

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	polyphthalamide	
CAS name	-	1,3-benzenedicarboxylic acid, polymer with 1,4-benzenedicarboxylic acid and 1,6-hexanediamine (25750-23-6); 1,3-benzenedicarboxylic acid, polymer with 1,4-benzenedicarboxylic acid, 1,6-hexanediamine and hexanedioic acid (27135-32-6)	
Acronym	-	PPA	
CAS number	-	25750-23-6; 27135-32-6	
HISTORY			
Date	-	1991	
Details	-	commercialization	
SYNTHESIS			
Monomer(s) structure	-		
Monomer(s) CAS number(s)	-	100-21-0+121-91-5; 124-09-4	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	166.13; 116.21	
Mass average molecular weight, M_w	dalton, g/mol, amu	11,000-13,700	Singletary, N; Bates, R B; Jacobsen, N; Lee, A K; Lin, G; Somogyi, A; Streeter, M J; Hall, H K, Macromolecules, 42, 2336-43, 2009.
STRUCTURE			
Crystallinity	%	33-45	Moyak, D M, Antec, 3505-10, 1996.
COMMERCIAL POLYMERS			
Some manufacturers	-	Desco; EMS; Solvay	
Trade names	-	Destron; Grivory; Amodel	
PHYSICAL PROPERTIES			
Density at 20°C	g cm^{-3}	1.18-1.19; 1.48-1.59 (33-45% glass fiber)	
Refractive index, 20°C	-	1.57-1.59	
Odor		nearly odorless	
Melting temperature, DSC	°C	294-335	
Thermal expansion coefficient, 23-80°C	$°C^{-1}$	8E-5; 1.8-2.4E-5 (33-45% glass fiber)	
Thermal conductivity, melt	W m^{-1} K^{-1}	0.289-0.372 15-45% glass fiber)	
Glass transition temperature	°C	121-138	Pini, N; Zaniboni, C; Busato, S; Ermanni, P, J. Thermoplast. Composite Mater., 19, 207-16, 2006.
Specific heat capacity	J K^{-1} kg^{-1}	1,500-2,400 (23°C); 4,200-6,000 (melt)	
Long term service temperature	°C	260	
Temperature index (50% tensile strength loss after 20,000 h/5000 h)	°C	160	Padey, D; Walling, J; Wood A, Polymers in Defence and Aerospace 2007, Rapra, 2007, paper 15.

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PARAMETER	UNIT	VALUE	REFERENCES
Heat deflection temperature at 1.8 MPa	°C	120; 285-300 (33-45% glass fiber)	
Vicat temperature VST/A/50	°C	301-314 (33-45% glass fiber)	
Enthalpy of melting	J g^{-1}	54.1 (*in situ* polymerized); 40.7 (melt-crystallized)	Pini, N; Zaniboni, C; Busato, S; Ermanni, P, J. Thermoplast. Composite Mater., 19, 207-16, 2006.
Dielectric constant at 100 Hz/1 MHz	-	4.6-5.1/3.6-4.2 (33-45% glass fiber)	
Dissipation factor at 60 Hz	E-4	40-50	
Dissipation factor at 1 MHz	E-4	12-17	
Volume resistivity	ohm-m	1E14 (33-45% glass fiber)	
Surface resistivity	ohm	1E15 (33-45% glass fiber)	
Electric strength K20/P50, d=3.2 mm	kV mm^{-1}	21-23 (33-45% glass fiber)	
Comparative tracking index, CTI, test liquid A	-	550 (33-45% glass fiber)	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	90; 200-259 (33-45% glass fiber)	
Tensile modulus	MPa	13,100-17,200 (33-45% glass fiber)	
Elongation	%	6; 1.9-2.6 (33-45% glass fiber)	
Flexural strength	MPa	290-363 (33-45% glass fiber)	
Flexural modulus	MPa	11.0-13.8 (33-45% glass fiber)	
Compressive strength	MPa	148-194 (33-45% glass fiber)	
Young's modulus	MPa	2,500-3,500	
Charpy impact strength, unnotched, 23°C	kJ m^{-2}	60-93 (33-45% glass fiber)	
Charpy impact strength, notched, 23°C	kJ m^{-2}	9.2-10.7 (33-45% glass fiber)	
Izod impact strength, unnotched, 23°C	J m^{-1}	770-1105 (33-45% glass fiber)	
Izod impact strength, notched, -30°C	J m^{-1}	80-110 (33-45% glass fiber)	
Shear strength	MPa	88-108 (33-45% glass fiber)	
Poisson's ratio	-	0.39-0.41 (33-45% glass fiber)	
Shrinkage	%	0.18-1.0; 0.2-1.0 (33-45% glass fiber)	
Intrinsic viscosity, 25°C	dl g^{-1}	0.85-1.06	
Moisture absorption, 24h 23°C/50% RH	%	0.1-0.3	
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	good to very good	
Alcohols	-	good	
Alkalis	-	good to very good	
Aliphatic hydrocarbons	-	good	
Greases & oils	-	good to very good	
FLAMMABILITY			
NBS smoke chamber, Ds, 4 min	-	3-12	

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PARAMETER	UNIT	VALUE	REFERENCES
UL 94 rating	-	HB (33-45% glass fiber)	
TOXICITY			
NFPA: Health, Flammability, Reactivity rating	-	1/1/0	
PROCESSING			
Typical processing methods	-	electroplating, injection molding	
Processing temperature	°C	330-350	
Processing pressure	MPa	4-5 (hold)	
Applications	-	metal replacement	
Outstanding properties	-	dimensional stability, heat resistance, chemical and moisture resistance	