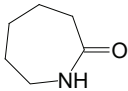


PA-6,66 polyamide-6,66

PARAMETER	UNIT	VALUE	REFERENCES
GENERAL			
Common name	-	polyamide-6,66, nylon-6,66, poly(hexamethylene adipamide-co-caprolactam)	
Acronym	-	PA-6,66	
CAS number	-	24993-04-2	
HISTORY			
Person to discover	-	Owens, J K; Scroggie, A G, 1940. Owens, J K; Scroggie, A G, 1941	Owens, J K; Scroggie, A G, US Patent 2,201,741, DuPont, May 21, 1940; Joyce, R M; Ritter, D M, US Patent 2,251,519, DuPont, Aug. 5, 1941.
Date	-	1940; 1941	
Details	-	PA6,66 with improved resistance to carbon arc; catalytic conversion of monomers	
SYNTHESIS			
Monomer(s) structure	-	$\text{H}_2\text{NC}(=\text{O})(\text{CH}_2)_4\text{C}(=\text{O})\text{NH}_2$ 	
Monomer(s) CAS number(s)	-	628-94-4; 105-60-2	
Monomer(s) molecular weight(s)	dalton, g/mol, amu	144.17; 113.16	
Monomer ratio	-	4:1	
STRUCTURE			
Crystallinity	%	29	
Cell type (lattice)	-	pseudo-hexagonal	
Spacing between crystalline planes	nm	0.37-0.44	Men, Y; Rieger, J, Eur. Polym. J., 40, 2629-35, 2004.
Polymorphs	-	α , γ (also called phases); hydrogen bonds formed between antiparallel chains in α phase and parallel chains in γ phase	Men, Y; Rieger, J, Eur. Polym. J., 40, 2629-35, 2004.
COMMERCIAL POLYMERS			
Some manufacturers	-	BASF, EMS	
Trade names	-	Ultramid; Grilon	
PHYSICAL PROPERTIES			
Density at 20°C	g cm ⁻³	1.12-1.15; 1.2-1.72 (15-50% glass fiber)	
Bulk density at 20°C	g cm ⁻³	0.7	
Melting temperature, DSC	°C	189-199	
Thermal expansion coefficient, 23-80°C	10 ⁻⁴ °C ⁻¹	0.6-0.8 (parallel); 0.9-1.2 (normal); 0.2 (15-50% glass fiber, parallel); 1.1 (15-50% glass fiber, normal)	
Glass transition temperature	°C	42 (dry); -35 (water saturated)	Men, Y; Rieger, J, Eur. Polym. J., 40, 2629-35, 2004.
Maximum service temperature	°C	80-120; 90-130 (15-50% glass fiber)	
Long term service temperature	°C	180-220; 180-200 (15-50% glass fiber)	
Heat deflection temperature at 0.45 MPa	°C	200-220	

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PARAMETER	UNIT	VALUE	REFERENCES
Heat deflection temperature at 1.8 MPa	°C	55-85; 215-230 (15-50% glass fiber)	
Dielectric constant at 100 Hz/1 MHz	-	-/3.6 (dry); -/6 (conditioned)	
Relative permittivity at 100 Hz	-	3 (dry); 8 (conditioned)	
Relative permittivity at 1 MHz	-	3 (dry); 4 (conditioned)	
Dissipation factor at 100 Hz	E-4	50 (dry); 1,500 (conditioned)	
Dissipation factor at 1 MHz	E-4	150-200 (dry); 700-3,000 (conditioned)	
Volume resistivity	ohm-m	1E11 to 1E12 (dry); 1E9 to 1E11 (conditioned)	
Surface resistivity	ohm	1E10 to 1E12 (conditioned)	
Electric strength K20/P50, d=0.60.8 mm	kV mm ⁻¹	26-32 (dry); 25-28 (conditioned); 30-34 (15-50% glass fiber, dry); 27-30 (15-50% glass fiber, conditioned)	
Comparative tracking index, CTI, test liquid A	-	600 (dry); 475-600 (conditioned)	
Permeability to oxygen, 25°C	cm ³ m ⁻² day ⁻¹ bar ⁻¹	14	
Permeability to water vapor, 25°C	g m ⁻² day ⁻¹	25	
MECHANICAL & RHEOLOGICAL PROPERTIES			
Tensile strength	MPa	45-75 (dry); 50 (conditioned); 110-220 (15-50% glass fiber, dry); 65-155 (15-50% glass fiber, conditioned)	
Tensile modulus	MPa	2,200-3,600 (dry); 600-1,600 (conditioned); 5,600-20,000 (15-50% glass fiber, dry); 2,900-13,500 (15-50% glass fiber, conditioned)	
Tensile stress at yield	MPa	70-90 (dry); 40-55 (conditioned)	
Elongation	%	5-25 (dry); >50 (conditioned); 2-4 (15-50% glass fiber, dry); 2.5-10 (15-50% glass fiber, conditioned)	
Tensile yield strain	%	4-5 (dry); 15-18 (conditioned)	
Flexural modulus	MPa	3,000 (dry)	
Charpy impact strength, unnotched, 23°C	kJ m ⁻²	NB to 75-80 (dry); NB to 100 (conditioned); 75-100 (15-50% glass fiber, dry); 90 (15-50% glass fiber, conditioned)	
Charpy impact strength, unnotched, -30°C	kJ m ⁻²	NB to 70-80 (dry); NB to 60 (conditioned); 60-80 (15-50% glass fiber, dry); 70-80 (15-50% glass fiber, conditioned)	
Charpy impact strength, notched, 23°C	kJ m ⁻²	4-9 (dry); 10-40 (conditioned); 12-15 (15-50% glass fiber, dry); 17-25 (15-50% glass fiber, conditioned)	
Charpy impact strength, notched, -30°C	kJ m ⁻²	3-6 (dry); 3-7 (conditioned); 5-12 (15-50% glass fiber, dry); 5-12 (15-50% glass fiber, conditioned)	
Izod impact strength, notched, 23°C	J m ⁻¹	4.5	
Ball indentation hardness at 358 N/30 S (ISO 2039-1)	MPa	135-145 (dry); 45-80 (conditioned); 160-180 (15-50% glass fiber, dry); 75-95 (15-50% glass fiber, conditioned)	
Shrinkage	%	0.7-1.2 (parallel); 0.8-1.4 (normal); 0.1 (15-50% glass fiber, parallel); 0.3-0.7 (15-50% glass fiber, normal)	
Viscosity number	ml g ⁻¹	195	
Melt volume flow rate (ISO 1133, procedure B), 275°C/5 kg	cm ³ /10 min	140	
Water absorption, equilibrium in water at 23°C	%	5-10.5; 13.7 (saturated film); 5-8 (15-50% glass fiber)	
Moisture absorption, equilibrium 23°C/50% RH	%	2-3.2; 1.1-3 (15-50% glass fiber)	

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PARAMETER	UNIT	VALUE	REFERENCES
CHEMICAL RESISTANCE			
Acid dilute/concentrated	-	poor	
Alcohols	-	good	
Alkalis	-	good	
Aliphatic hydrocarbons	-	good	
Aromatic hydrocarbons	-	good	
Greases & oils	-	good	
FLAMMABILITY			
Limiting oxygen index	% O ₂	35	
UL 94 rating	-	HB to V-0	
TOXICITY			
Carcinogenic effect	-	not listed by ACGIH, NIOSH, NTP	
Skin rabbit, LD ₅₀	mg kg ⁻¹	moderate irritant	
PROCESSING			
Typical processing methods	-	blown film, cast film, injection molding	
Preprocess drying: temperature/ time/residual moisture	°C/h/%	80/2-4/0.15	
Processing temperature	°C	240-285	
Processing pressure	MPa	3.5-10.5 (injection and packing pressure)	
Additives used in final products	-	flame retardant, nucleating agent	
Applications	-	automotive (air intake systems, electrical, electronics, interior, lighting, powertrain and chassis), electrical appliances and equipment, cables & tubes, connectors, energy distribution, lighting, industry and consumer goods (housewares, mechanical engineering, power transmission, sports & leisure, tools & accessories), medical packaging	
Outstanding properties	-	low friction, wear resistance	
BLENDS			
Suitable polymers	-	EVA, EVOH, PA6,10	
ANALYSIS			
x-ray diffraction peaks	degree	20.7, 22.9 (dry)	Men, Y; Rieger, J, Eur. Polym. J., 40, 2629-35, 2004.