

General information

Designation

Polyamideimide (Unfilled)

Tradenames

Duratron, Quadrant, Tecator, Torlon

Typical uses

Valves; bearings; electrical connectors; gears; parts for jet engines and internal combustion engines; printed circuit boards

Composition overview

Compositional summary

(-N-[CO₂]-C₆H₃-CO-NH-R)_n

Material family	Plastic (thermoplastic, amorphous)
Base material	PAI (Polyamide-imide)
Polymer code	PAI

Composition detail (polymers and natural materials)

Polymer	100	%
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Price

Price	* 20.6	-	21.9	USD/lb
Price per unit volume	* 1.8e3	-	1.98e3	USD/ft ³

Physical properties

Density	0.0506	-	0.0524	lb/in ³
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Mechanical properties

Young's modulus	0.693	-	0.728	10 ⁶ psi
Yield strength (elastic limit)	5.51	-	6.09	ksi
Tensile strength	26.4	-	29.3	ksi
Elongation	13.9	-	16.1	% strain
Compressive modulus	0.566	-	0.595	10 ⁶ psi
Compressive strength	* 30.5	-	33.4	ksi
Flexural modulus	0.708	-	0.743	10 ⁶ psi
Flexural strength (modulus of rupture)	33.1	-	36.5	ksi
Shear modulus	* 0.239	-	0.251	10 ⁶ psi
Shear strength	17.7	-	19.4	ksi
Poisson's ratio	0.44	-	0.46	
Shape factor	9.42			
Hardness - Vickers	11	-	13	HV

Hardness - Rockwell M	105	-	115	
Hardness - Rockwell R	* 120	-	130	
Fatigue strength at 10 ⁷ cycles	* 10.6	-	11.7	ksi
Mechanical loss coefficient (tan delta)	* 0.008	-	0.00832	

Impact & fracture properties

Fracture toughness	3.35	-	4.08	ksi.in ^{0.5}
Impact strength, notched 23 °C	0.00813	-	0.00899	BTU/in ²
Impact strength, unnotched 23 °C	0.0556	-	0.0673	BTU/in ²

Thermal properties

Glass temperature	507	-	547	°F
Heat deflection temperature 0.45MPa	* 532	-	644	°F
Heat deflection temperature 1.8MPa	482	-	583	°F
Maximum service temperature	392	-	428	°F
Minimum service temperature	* -319	-	-301	°F
Thermal conductivity	0.144	-	0.156	BTU.ft/hr.ft ² .°F
Specific heat capacity	0.237	-	0.247	BTU/lb.°F
Thermal expansion coefficient	16.6	-	17.4	µstrain/°F

Electrical properties

Electrical resistivity	7.87e21	-	7.87e23	µohm.in
Dielectric constant (relative permittivity)	3.8	-	4.3	
Dissipation factor (dielectric loss tangent)	0.026	-	0.031	
Dielectric strength (dielectric breakdown)	579	-	630	V/mil
Comparative tracking index	100	-	250	V

Magnetic properties

Magnetic type	Non-magnetic			
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Optical properties

Refractive index	1.65	-	1.66	
Transparency	Opaque			

Critical materials risk

Contains >5wt% critical elements?	No			
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Absorption & permeability

Water absorption @ 24 hrs	0.31	-	0.35	%
Water absorption @ sat	3.8	-	4.2	%
Humidity absorption @ sat	2.6	-	3	%

Processing properties

Polymer injection molding	Limited use
Polymer extrusion	Limited use
Polymer thermoforming	Unsuitable
Linear mold shrinkage	* 0.025 - 0.03 %
Melt temperature	581 - 698 °F
Mold temperature	* 392 - 419 °F
Molding pressure range	5.8 - 7.98 ksi

Durability

Water (fresh)	Excellent
Water (salt)	Excellent
Weak acids	Excellent
Strong acids	Limited use
Weak alkalis	Excellent
Strong alkalis	Limited use
Organic solvents	Excellent
Oxidation at 500C	Unacceptable
UV radiation (sunlight)	Excellent
Flammability	Self-extinguishing

Primary production energy, CO2 and water

Embodied energy, primary production	* 1.18e5 - 1.3e5 BTU/lb
CO2 footprint, primary production	* 15.2 - 16.8 lb/lb
Water usage	* 1.94e4 - 2.14e4 in^3/lb

Processing energy, CO2 footprint & water

Polymer extrusion energy	* 2.51e3 - 2.78e3 BTU/lb
Polymer extrusion CO2	* 0.439 - 0.485 lb/lb
Polymer extrusion water	* 134 - 201 in^3/lb
Polymer molding energy	* 8.36e3 - 9.23e3 BTU/lb
Polymer molding CO2	* 1.46 - 1.61 lb/lb
Polymer molding water	* 357 - 536 in^3/lb
Coarse machining energy (per unit wt removed)	* 834 - 922 BTU/lb
Coarse machining CO2 (per unit wt removed)	* 0.146 - 0.161 lb/lb
Fine machining energy (per unit wt removed)	* 6.5e3 - 7.19e3 BTU/lb
Fine machining CO2 (per unit wt removed)	* 1.13 - 1.25 lb/lb
Grinding energy (per unit wt removed)	* 1.28e4 - 1.42e4 BTU/lb
Grinding CO2 (per unit wt removed)	* 2.23 - 2.47 lb/lb

Recycling and end of life

Recycle	✓			
Embodied energy, recycling	* 3.99e4	-	4.43e4	BTU/lb
CO2 footprint, recycling	* 5.16	-	5.7	lb/lb
Recycle fraction in current supply	0.1			%
Downcycle	✓			
Combust for energy recovery	✓			
Heat of combustion (net)	* 1.08e4	-	1.13e4	BTU/lb
Combustion CO2	* 2.44	-	2.56	lb/lb
Landfill	✓			
Biodegrade	✗			

Notes

Other notes

Torlon PAI grades must be cured by heat treatment after molding to achieve full mechanical properties.

Links

ProcessUniverse

Producers

Reference

Shape