

## 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-[CO<sub>2</sub>]-C<sub>6</sub>H<sub>3</sub>-CO-NH-R)<sub>n</sub>

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	* 40	- 60	USD/kg
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## Physical properties

Density	1.4e3	- 1.45e3	kg/m <sup>3</sup>
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## Mechanical properties

Young's modulus	4.78	- 5.02	GPa
Yield strength (elastic limit)	38	- 42	MPa
Tensile strength	182	- 202	MPa
Elongation	13.9	- 16.1	% strain
Compressive modulus	3.9	- 4.1	GPa
Compressive strength	* 210	- 230	MPa
Flexural modulus	4.88	- 5.12	GPa
Flexural strength (modulus of rupture)	228	- 252	MPa
Shear modulus	* 1.65	- 1.73	GPa
Shear strength	122	- 134	MPa
Poisson's ratio	0.44	- 0.46	
Shape factor	9.42		
Hardness - Vickers	11.4	- 12.6	HV
Hardness - Rockwell M	105	- 115	

Hardness - Rockwell R	* 120	-	130	
Fatigue strength at 10 <sup>7</sup> cycles	* 73	-	81	MPa
Mechanical loss coefficient (tan delta)	* 0.008	-	0.00832	

### Impact & fracture properties

Fracture toughness	3.68	-	4.48	MPa.m <sup>0.5</sup>
Impact strength, notched 23 °C	13.3	-	14.7	kJ/m <sup>2</sup>
Impact strength, unnotched 23 °C	90.9	-	110	kJ/m <sup>2</sup>

### Thermal properties

Glass temperature	264	-	286	°C
Heat deflection temperature 0.45MPa	* 278	-	340	°C
Heat deflection temperature 1.8MPa	250	-	306	°C
Maximum service temperature	200	-	220	°C
Minimum service temperature	* -195	-	-185	°C
Thermal conductivity	0.25	-	0.27	W/m.°C
Specific heat capacity	994	-	1.03e3	J/kg.°C
Thermal expansion coefficient	29.8	-	31.4	µstrain/°C

### Electrical properties

Electrical resistivity	2e22	-	2e24	µohm.cm
Dielectric constant (relative permittivity)	3.8	-	4.3	
Dissipation factor (dielectric loss tangent)	0.026	-	0.031	
Dielectric strength (dielectric breakdown)	22.8	-	24.8	MV/m
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			

### 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	305	-	370	°C
Mold temperature	* 200	-	215	°C
Molding pressure range	40	-	55	MPa

## 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	* 274	-	302	MJ/kg
CO2 footprint, primary production	* 15.2	-	16.8	kg/kg
Water usage	* 700	-	774	l/kg

## Processing energy, CO2 footprint & water

Polymer extrusion energy	* 5.85	-	6.46	MJ/kg
Polymer extrusion CO2	* 0.439	-	0.485	kg/kg
Polymer extrusion water	* 4.84	-	7.26	l/kg
Polymer molding energy	* 19.4	-	21.5	MJ/kg
Polymer molding CO2	* 1.46	-	1.61	kg/kg
Polymer molding water	* 12.9	-	19.4	l/kg
Coarse machining energy (per unit wt removed)	* 1.94	-	2.14	MJ/kg
Coarse machining CO2 (per unit wt removed)	* 0.146	-	0.161	kg/kg
Fine machining energy (per unit wt removed)	* 15.1	-	16.7	MJ/kg
Fine machining CO2 (per unit wt removed)	* 1.13	-	1.25	kg/kg
Grinding energy (per unit wt removed)	* 29.8	-	32.9	MJ/kg
Grinding CO2 (per unit wt removed)	* 2.23	-	2.47	kg/kg

## Recycling and end of life

Recycle	✓			
Embodied energy, recycling	* 92.9	-	103	MJ/kg
CO2 footprint, recycling	* 5.16	-	5.7	kg/kg
Recycle fraction in current supply	0.1			%

Downcycle	✓			
Combust for energy recovery	✓			
Heat of combustion (net)	* 25	-	26.3	MJ/kg
Combustion CO2	* 2.44	-	2.56	kg/kg
Landfill	✓			
Biodegrade	✗			

## Notes

### Other notes

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

### Reference sources

Torlon 4203L

## Links

ProcessUniverse

Producers

Reference

Shape