

Description

Image



Caption

1. Cervical cage made from PEEK with a modulus very close to that of bone and excellent toughness and fatigue resistance. © Eisertech, LLC 2. Complex PEEK injection part for Oil & Gas and automotive industry. © MING-LI Precision Steel Molds CO.

The material

Polyetheretherketone (PEEK) is a high-performance thermoplastic, meaning that - among thermoplastics - it has exceptionally high stiffness, strength and resistance to heat. This comes at a price: PEEK is 50 times more expensive than PP, and 10 to 20 times more than nylon. This limits its use to applications in which technical performance is paramount.

Compositional summary

$(O-(C_6H_4)-O-(C_6H_4)-C(O)-(C_6H_4))_n$

General properties

Density	81.2	-	82.4	lb/ft ³
Price	* 42	-	45	USD/lb
Date first used	1975			

Mechanical properties

Young's modulus	* 0.544	-	0.573	10 ⁶ psi
Shear modulus	* 0.197	-	0.207	10 ⁶ psi
Bulk modulus	0.783	-	0.827	10 ⁶ psi
Poisson's ratio	* 0.378	-	0.393	
Yield strength (elastic limit)	9.43	-	13.8	ksi
Tensile strength	10.2	-	14.9	ksi
Compressive strength	10.4	-	15.2	ksi
Elongation	30	-	150	% strain
Hardness - Vickers	26.1	-	28.5	HV
Fatigue strength at 10 ⁷ cycles	* 4.08	-	5.98	ksi

Fracture toughness	* 2.49	-	3.91	ksi.in ^{0.5}
Mechanical loss coefficient (tan delta)	* 0.0101	-	0.0106	

Thermal properties

Melting point	611	-	655	°F
Glass temperature	289	-	390	°F
Maximum service temperature	462	-	500	°F
Minimum service temperature	* -190	-	-99.7	°F
Thermal conductor or insulator?	Good insulator			
Thermal conductivity	* 0.139	-	0.15	BTU.ft/h.ft ² .F
Specific heat capacity	* 0.345	-	0.358	BTU/lb.°F
Thermal expansion coefficient	40	-	108	µstrain/°F

Electrical properties

Electrical conductor or insulator?	Good insulator			
Electrical resistivity	3.3e21	-	3e22	µohm.cm
Dielectric constant (relative permittivity)	3.1	-	3.3	
Dissipation factor (dielectric loss tangent)	* 0.0015	-	0.0017	
Dielectric strength (dielectric breakdown)	* 423	-	508	V/mil

Optical properties

Transparency	Opaque			
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Processability

Castability	1	-	2	
Moldability	4	-	5	
Machinability	3	-	4	
Weldability	5			

Eco properties

Embodied energy, primary production	* 3.07e4	-	3.38e4	kcal/lb
CO2 footprint, primary production	* 22	-	24.3	lb/lb
Recycle	✓			

Recycle mark



Supporting information

Design guidelines

PEEK can be used up to temperatures of 300 C for a short time and 250 C for a long time. It offers high hardness and therefore abrasion resistance; it has excellent fatigue properties and good creep resistance. It has a low coefficient of friction, a low flammability, and low smoke emission during combustion. Chemical resistance is very good (and retained to the same high temperatures) and there is very low water absorption. Unreinforced PEEK offers the highest elongation and toughness of all PEEK grades. Glass-reinforcement significantly reduces the expansion rate and increases the flexural modulus. PEEK can be used as a matrix in continuous carbon fiber composites. Carbon-reinforced PEEK has high compressive strength and stiffness and low expansion coefficient, and its thermal conductivity can be 3 times better than pure PEEK. Processing PEEK is not difficult, despite its high heat resistance, provided the temperature is held at 375 C. It can be injection molded, extruded (into rod, profile, film or wire insulation) and compression molded. It is available as extruded film and sheet in thicknesses from approximately 0.001" to 0.040".

Technical notes

PEEK is a semi-crystalline thermoplastic. It has a high glass transition temperature ($T_g = 150$ C) and can be used well above this temperature, but its stiffness falls and its expansion coefficient rises above T_g .

Typical uses

Electrical connectors, hot water meters, F1 engine components, valve and bearing components, wire and cable coatings, film and filament for specialized applications, pump wear rings, electrical housing, bushings,

Tradenames

Ketron PEEK, Thermocomp, Victrex

Links

Reference

ProcessUniverse

Producers