
PEEK (Polyether Ether Ketone) – High-Performance Engineering Thermoplastic Specification

1.0 Material Overview & Common Uses

PEEK (Polyether Ether Ketone) is a high-performance semi-crystalline engineering thermoplastic known for its exceptional mechanical strength, chemical resistance, and thermal stability. It maintains its properties at continuous service temperatures up to 260°C and offers excellent wear and creep resistance. PEEK is commonly used in demanding applications such as aerospace components, medical implants, semiconductor manufacturing equipment, oil and gas seals, and high-temperature electrical insulators.

Common grades include unfilled PEEK (e.g., Victrex 450G), 30% glass-filled PEEK (e.g., Victrex 450GL30), and carbon-fiber-reinforced PEEK for enhanced stiffness and thermal conductivity. It is available in sheet, rod, tube, and film forms.

2.0 Core Technical Properties & Sizing

- Density: 1.32 g/cm³ (unfilled); 1.51 g/cm³ (30% glass-filled)
- Tensile Strength: 90–100 MPa (unfilled) at 23°C; 70 MPa at 150°C
- Flexural Modulus: 3.6 GPa (unfilled); 7.0 GPa (30% glass-filled)
- Melting Point: 343°C (crystalline peak)
- Glass Transition Temperature (T_g): 143°C
- Continuous Service Temperature: 260°C (UL 746B)
- Coefficient of Linear Thermal Expansion: $47 \times 10^{-6} / ^\circ\text{C}$ (unfilled, below T_g)
- Dielectric Strength: 19 kV/mm (unfilled)
- Standard Sheet Thickness: 1.5 mm, 3 mm, 6 mm, 12 mm, 25 mm, 50 mm (tolerance ± 0.1 mm up to 6 mm, ± 0.2 mm above)
- Standard Rod Diameters: 6 mm to 150 mm (tolerance h8 per ISO 2768)
- Hardness: Shore D 85–90 (unfilled); Rockwell M 99 (30% glass-filled)
- Water Absorption: 0.1% (24 hours at 23°C, 50% RH)

3.0 Processing, Machinability & Application

PEEK is machinable using conventional metalworking equipment but requires sharp tooling and adequate cooling to prevent localized melting or work hardening. Due to its high melting point and low thermal conductivity, heat dissipation is critical. Annealing is recommended before final machining to relieve internal stresses and improve dimensional stability.

- Use carbide or polycrystalline diamond (PCD) tooling for best surface finish and tool life.
- Recommended cutting speed: 150–300 m/min for turning; 100–200 m/min for milling.
- Feed rate: 0.1–0.3 mm/rev for turning; 0.05–0.15 mm/tooth for milling.
- Depth of cut: 0.5–2.0 mm for roughing; 0.1–0.5 mm for finishing.
- Use flood coolant (water-soluble) or compressed air to control heat; avoid oil-based coolants that may cause swelling.

- Annealing: Heat to 200°C for 2 hours per 25 mm of thickness, then slow cool at 10°C/hour to room temperature.
- Welding: Ultrasonic welding, hot plate welding, and laser welding are possible; joint design must account for high melt viscosity.
- Adhesive bonding: Use epoxy or cyanoacrylate adhesives after surface roughening and cleaning with isopropyl alcohol.
- Injection molding: Melt temperature 360–400°C; mold temperature 160–200°C; drying required at 150°C for 3–4 hours before processing.

4.0 Common Defects & Quality Control

- Reject if visible surface cracks, voids, or bubbles exceed 0.5 mm in diameter on any face.
- Reject if thickness variation exceeds ± 0.1 mm for nominal thickness ≤ 6 mm, or ± 0.2 mm for > 6 mm.
- Reject if warpage (flatness deviation) exceeds 0.5 mm per 100 mm of length.
- Reject if discoloration (yellowing or dark streaks) indicates thermal degradation during processing.
- Reject if surface roughness R_a exceeds 1.6 μm for machined surfaces intended for sealing or bearing applications.
- Reject if material fails to meet tensile strength minimum of 85 MPa (unfilled) per ASTM D638.
- Reject if elongation at break is below 20% (unfilled) per ASTM D638.
- Reject if material shows signs of moisture absorption (e.g., splay marks in molded parts) indicating improper drying.

5.0 Storage, Handling & WHMIS Guidelines

- Store in a dry, clean environment at 15–25°C and below 50% relative humidity to prevent moisture absorption.
- Keep away from direct sunlight, UV sources, and ozone-generating equipment.
- Shelf life: Indefinite if stored properly; however, pre-drying is required before thermal processing if stored > 6 months.
- FIFO protocol: Use oldest stock first; label with receipt date and lot number.
- WHMIS Classification: Not classified as hazardous under WHMIS 2015 (GHS) in solid form. Dust or fines from machining may be combustible.
- Mandatory PPE: Safety glasses with side shields, cut-resistant gloves (e.g., Kevlar), and long sleeves during machining. Use NIOSH-approved N95 respirator if airborne dust is generated.
- Ventilation: Use local exhaust ventilation (LEV) to capture dust and fumes during machining; maintain air velocity > 0.5 m/s at source.
- Fire safety: PEEK is self-extinguishing (UL94 V-0). In case of fire, use dry chemical, CO₂, or water fog. Avoid direct water stream on molten material.
- Spill procedure: Sweep or vacuum solid dust; avoid creating airborne dust clouds. Dispose of waste per local regulations.

Regulatory Disclaimer: This document is a generic technical material specification provided for educational purposes. The end-user assumes all liability for reviewing, adapting, and validating all tolerances, properties, and safety protocols against specific OEM data sheets and local regulations before deployment.