



Genesis PEEK Injection Molding Processing Guide

Genesis PEEK — Natural (Unfilled)

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1. Material Overview

Genesis PEEK is a semi-crystalline, high-performance polyetheretherketone (PEEK) resin for use in implantable medical devices. Material attributes such as biocompatibility and a modulus like that of human bone, provide a compelling option for medical device makers and patients alike.

This guide covers starting-point injection molding conditions for the natural (unfilled), general-purpose grade of Genesis PEEK. It is intended to support process setup and troubleshooting; it does not address material qualification, certification, or end-use approval, which are governed separately under Genesis Medical Plastics' quality system.

The values in this guide are typical starting-point conditions for unfilled, general-purpose PEEK resin processing. Every molding cell, tool, and lot of material behaves somewhat differently — verify and fine-tune all parameters against your qualified process window before production use.

Key Material Characteristics

- Biocompatible
- Modulus similar to bone
- Excellent chemical resistance to organics, acids, and bases
- Compatible with steam, EtO, gamma, and e-beam sterilization processes
- High mechanical strength retained above 250 °C (480 °F)
- Best-in-class fatigue and wear resistance
- Low moisture absorption and high dimensional stability
- UL94 V-0 flammability rating at 1.6 mm

2. Key Properties — Genesis PEEK (Natural)

Property	Typical Value	Test Method
Specific gravity	1.30	ASTM D792
Melt flow rate (400 °C / 2.16 kg)	3.0 g/10 min	ASTM D1238
Tensile strength (yield)	95–96 MPa	ASTM D638 / ISO 527
Tensile modulus	3.5–3.8 GPa	ASTM D638 / ISO 527
Elongation at break	20–30%	ASTM D638
Flexural strength / modulus	121–146 MPa / 3.7 GPa	ASTM D790 / ISO 178
Notched Izod impact	91 J/m (9.2 kJ/m ²)	ASTM D256 / ISO 180
Glass transition temperature (T _g)	150 °C (302 °F)	ASTM D3418
Peak melting temperature (T _m)	340 °C (644 °F)	ASTM D3418
HDT @ 1.8 MPa, annealed	157 °C (315 °F)	ASTM D648
Water absorption, 24 hr	0.10%	ASTM D570
Mold shrinkage (flow / cross-flow)	1.1–1.3% / 1.3–1.5%	ASTM D955

Properties are typical values for unfilled, general-purpose PEEK resin and should not be construed as a specification. Confirm current values against the applicable Genesis PEEK material certification for your lot.

3. Material Handling & Drying

PEEK is hygroscopic and must be dried completely before melt processing. Incomplete drying produces surface streaks, splay, and severe bubbling/porosity in the molded part.

Parameter	Recommended Condition
Dryer type	Desiccant or heated dry air hopper dryer (preferred) or circulating air oven with trays
Drying temperature	150 °C (300 °F)
Drying time	4.0 hours minimum
Target moisture content	< 0.02% by weight prior to molding
Dew point	≤ -40 °C at the dryer hopper outlet

4. Injection Molding Equipment Requirements

4.1 Machine

- All-electric or hydraulic reciprocating-screw injection molding machines are suitable.
- Barrel, nozzle, and hopper throat must be rated for sustained processing temperatures up to 400 °C (750 °F).
- Use a nitrided or bimetallic barrel/screw and hardened, corrosion-resistant components; PEEK is not corrosive but high processing temperatures accelerate wear.
- Insulated barrel jackets and a shut-off (positive check-ring) nozzle are recommended to minimize drool and maintain melt temperature stability.

4.2 Screw Design

- General-purpose, three-zone screw; L/D ratio of 18:1 to 25:1.
- Compression ratio: 2.5:1 to 3.5:1.
- Flights divided evenly between feed, transition, and metering zones.
- Use a sliding (free-floating) check ring to minimize melt back-flow during injection.
- Apply minimum back pressure consistent with good melt homogeneity to limit shear heating.

4.3 Clamping

Because PEEK has relatively low viscosity at recommended processing temperatures, tonnage requirements are similar to other engineering thermoplastics — typically 3–5 tons/in² (41–69 MPa) of projected part and runner area is a reasonable starting point, refined during mold trials.

5. Mold Design Considerations

5.1 Tool Steel & Temperature Control

Hardened tool steel (H-13 or equivalent) is recommended given the elevated mold operating temperatures. Because mold temperatures run well above typical commodity-resin ranges, use oil-heated or high-temperature electric cartridge heating rather than standard water circulation; ensure adequate insulation between the mold and platens.

5.2 Gating & Venting

- Standard gate types (edge, submarine, hot-tip) are all compatible; hot runner systems are commonly used and should be sized for PEEK's higher melt temperature.
- Gate into the thickest section where practical to maintain packing pressure through solidification.
- Provide generous venting (0.02–0.04 mm depth) at flow-front termination points and weld lines — PEEK's fast crystallization and high melt temperature make trapped gas and burn marks more likely without adequate venting.

5.3 Draft & Ejection

Standard draft angles (0.5–1.0° minimum per side) apply. Because PEEK is molded at high mold temperatures and shrinks more than amorphous resins, verify ejector pin sizing and placement to avoid part deformation during ejection while the part is still warm.

6. Starting-Point Process Conditions — Genesis PEEK (Natural)

Parameter	Recommended Value
Rear (feed) zone temperature	355 °C (671 °F)
Middle (transition) zone temperature	365 °C (689 °F)
Front (metering) zone temperature	370 °C (698 °F)

Parameter	Recommended Value
Nozzle temperature	375 °C (707 °F)
Melt temperature (target)	370–385 °C (698–725 °F)
Mold (tool) temperature	175–205 °C (350–400 °F)
Injection speed	As fast as possible, consistent with acceptable part appearance
Screw compression ratio	2.5:1 to 3.5:1
Back pressure	Minimum required for melt homogeneity
Screw (recovery) speed	Moderate — minimize shear heating and residence time
Residence time in barrel	Minimize; avoid prolonged idle time at temperature

These are typical starting points for unfilled, general-purpose PEEK. Actual set points will vary with machine size, shot weight, part geometry, and tooling — optimize through DOE / mold trial and hold within a documented, qualified process window for Genesis PEEK.

7. Start-Up, Shutdown & Purging

7.1 Start-Up

- Bring barrel zones up to processing temperature before introducing Genesis PEEK; confirm with a soak/hold period so the melt is thermally uniform.
- Purge the prior resin from the barrel using a high-temperature purging compound or fractional-melt-flow HDPE at the incoming resin's normal processing temperature, then transition to Genesis PEEK processing temperatures.
- Confirm dried, in-spec material is feeding before beginning production shots.

7.2 Shutdown

- Empty the barrel completely and allow it to cool before extended idle periods.

7.3 Shutdown Notes

Never allow Genesis PEEK to sit idle in the barrel at processing temperature for extended periods — thermal degradation can occur, producing discoloration, off-gassing, and reduced mechanical properties in subsequent shots. If production is interrupted, remove resin, purge material and lower barrel temperatures rather than holding at temperature. It is recommended to fully tear down and clean screws and barrels between production runs.

8. Annealing (Optional Post Heat Treatment)

Annealing is not always a necessary step in PEEK production and is dependent on part geometry, processing dynamics, and numerous other factors. Annealing can, however, increase and stabilize crystallinity, improve dimensional stability, chemical resistance, and heat deflection temperature. It can also relieve molded-in stress.

Parameter	Typical Condition
Annealing temperature	200 °C (392 °F), or 10–20 °C below mold temperature
Annealing time	≥ 2 hours, dependent on section thickness, typically 24 hours per inch of cross section
Cooling	Slow, controlled cool-down in the oven to minimize new residual stress
Fixturing	Support thin or unsupported features to prevent warp during the heat cycle

9. Troubleshooting Guide

Defect	Likely Cause	Corrective Action
Silver streaks / splay	Residual moisture in resin	Verify dryer temperature, time, and dew point; re-dry per Section 3
Bubbling / voids	Moisture or excessive residence time / degradation	Confirm drying; reduce barrel residence time; check for degraded/off-color regrind

Defect	Likely Cause	Corrective Action
Short shots	Insufficient melt or injection pressure/speed, cold mold	Increase melt temperature within range, verify mold temperature, increase injection speed/pressure
Warpage	Uneven mold cooling / non-uniform crystallinity	Balance mold temperature (± 5 °C), review gate location and cooling layout
Sink marks	Insufficient packing / thick sections	Increase hold pressure/time, review wall-thickness design, gate near thick sections
Discoloration / degradation	Excess barrel residence time or overheating	Reduce cycle idle time, verify zone temperatures are not exceeding target, purge promptly on stoppages
Flash	Insufficient clamp tonnage or worn parting line	Verify clamp tonnage calculation, inspect mold parting surfaces
Weld line weakness	Poor venting or low melt/mold temperature at flow front	Increase venting at weld line location, raise melt/mold temperature within range, review gate placement

10. Safety & Handling

- Provide adequate local exhaust ventilation at the feed throat, nozzle, and mold area — processing temperatures approach the resin's decomposition threshold and can generate fumes.
- Use appropriate PPE (heat-resistant gloves, eye protection) when handling molten resin, purge strings, or hot tooling.
- Consult the current Genesis PEEK Safety Data Sheet (SDS) before initial use and keep it accessible at the molding press.
- Follow site EHS procedures for hot-melt burn hazards and high-temperature purge material disposal.

This guide reflects typical starting-point processing conditions for unfilled, general-purpose PEEK resin. Values are not a specification — confirm and qualify against Genesis Medical Plastics' internal process validation data before production use.