Liedtke Kunststofftechnik
Siemensstr. 32a /42551 Velbert/Germany (DE) • Tel. +49 2051 605 105

What is PEEK EN

PEEK

PEEK (polyether ether ketone) – semi-crystalline high-performance thermoplastic of the PAEK (poly aryl ether ketone) family

PEEK is one of the highest-performing thermoplastics available and a true premium material: it is used precisely where standard plastics such as POM or PA reach their limits – at high continuous temperatures, with aggressive media, or as a metal replacement for weight reduction.

Classification and basic character

PEEK is a semi-crystalline high-temperature thermoplastic with a glass transition temperature of around 143 °C and a melting point near 343 °C. This is the key to almost all of its properties: the material stays dimensionally stable and mechanically loadable at temperatures at which most other plastics have long gone soft. The continuous service temperature is about 250 °C, briefly even higher – putting PEEK in a class with only a few other high-performance materials such as PPS, PEI or PAI.

How PEEK is produced and processed

PEEK is formed by polycondensation of aromatic monomers into long chains of ether and ketone groups. The aromatic rings and the semi-crystalline structure are the reason for its high temperature, chemical and wear resistance. PEEK is processed as injection-moulding and extrusion granulate as well as semi-finished stock (plates, rods, tubes), from which we machine precision parts. Because of the high melting point (~343 °C) high processing temperatures are required; for dimensionally stable, low-stress parts the stock is annealed (controlled heat treatment).

Mechanical and physical properties

Unreinforced PEEK reaches a tensile strength of around 90–100 MPa at a modulus of about 3,600 MPa and a density of roughly 1.30 g/cm³. It is very stiff, strong and at the same time tough, with good fatigue and creep resistance. Especially notable are the excellent wear resistance and good sliding properties – which is why PEEK is preferred for bearings, bushings, seals and sliding elements.

Chemical and thermal resistance

PEEK is chemically exceptionally resistant – against practically all organic and inorganic chemicals, against hydrolysis (including hot water and steam) and against many solvents. It is essentially attacked only by concentrated sulphuric acid. Added to this are very good radiation resistance, inherent flame retardancy (UL 94 V-0 even without additives, low smoke generation) and good electrical insulation properties.

Typical grades

Different grades are available depending on the requirement:

- PEEK natural / unreinforced – balanced property profile, good toughness
- PEEK GF30 (30 % glass fibre) – higher stiffness and dimensional stability
- PEEK CF30 (30 % carbon fibre) – highest stiffness/strength, better heat dissipation, lower thermal expansion
- PEEK with PTFE / graphite / carbon – optimised friction and wear values (bearing and sliding grades)
- Biocompatible grades – for medical technology and implant applications

Liedtke Kunststofftechnik, 42551 Velbert, Siemensstr. 32a, +49 2051 605 105, Info@liedtke-kunststofftechnik.de, www.liedtke-kunststofftechnik.de

When PEEK is the right choice

PEEK pays off when several demanding requirements have to be met at the same time – for example:

- Continuous use at high temperatures (up to approx. 250 °C) where other plastics fail
- Contact with aggressive chemicals, hot water or steam
- Metal replacement for weight reduction at high strength (aerospace)
- Clean, low-abrasion applications (semiconductor, medical technology, sterilisability)
- Highly loaded sliding, bearing and sealing parts with long service life

When PEEK is NOT the right choice

Just as important are the limits – PEEK is not always the economically sensible solution:

- When a cheaper plastic is sufficient: at moderate temperatures and loads, POM, PA, PET or PVDF are often enough – PEEK would be unnecessarily expensive
- For purely cosmetic or lightly loaded parts without temperature/chemical requirements
- In contact with concentrated sulphuric acid and certain strongly oxidising media
- For permanent UV/outdoor weathering without protection – natural grade can yellow/embrittle; then use stabilised grades or other materials
- When the budget is tight and the high-performance properties are not actually needed

What does PEEK cost?

PEEK is one of the most expensive engineering plastics – the raw material is roughly 30 to 100 times the price of POM or PA. As a rough guide, semi-finished PEEK natural (rod/plate) ranges from about 150–400 €/kg depending on dimension and quantity; carbon-/glass-fibre-reinforced and especially biocompatible/implant grades are significantly higher. The part price is mainly determined by grade, stock form and dimension, material utilisation (waste), machining effort and batch size. We are happy to quote binding prices on request based on your drawing.

Machining at Liedtke

PEEK machines well – turning, milling and drilling work about as well as with brass or aluminium. We use sharp, polished tools and dissipate heat in a targeted way, since the low thermal conductivity would otherwise cause stresses. For tight tolerances, annealing (stress relieving) of the stock before and between machining steps is recommended. This lets us reliably achieve tight tolerances down to ±0.02 mm – from single parts to series production.

Advantages and disadvantages at a glance

An honest assessment – and how the disadvantages can be mitigated in practice:

Advantages

- Highest continuous service temperature (up to approx. 250 °C)
- Excellent chemical, hydrolysis and radiation resistance
- Very good wear, sliding and fatigue properties
- High strength/stiffness at low weight (metal replacement)
- Flame retardant (UL 94 V-0), sterilisable, biocompatible grades

Disadvantages

- Very high material price
- High processing temperatures; annealing needed for tight tolerances
- Unstabilised tendency to UV yellowing outdoors
- Economically over-specified for simple applications

Practical tip: the high cost can be put into perspective through material-saving programming, the right grade selection and making only the truly stressed parts from PEEK – for less critical parts we specifically recommend cheaper alternatives such as PVDF or PPS.

Typical Properties

- Highest continuous service temperature (up to approx. 250 °C)
- Excellent chemical and hydrolysis resistance
- Very good wear and sliding properties
- High mechanical strength and stiffness
- Flame retardant / self-extinguishing (UL 94 V-0)
- Low smoke density
- Good radiation resistance
- Sterilisable (biocompatible grades available)

Product Examples

- Plain bearings and bushings
- Seals, sealing rings and back-up rings
- Gears and drive elements
- Insulators and electrical components
- Valve seats and components
- Pump housings and impellers
- Wafer-handling and semiconductor parts
- Surgical instruments and implant components
- Compressor plates and valves
- Connectors and housings

Typical Industries

- Aerospace
- Medical technology
- Semiconductor and electronics industry
- Oil and gas / offshore
- Automotive industry
- Mechanical and plant engineering
- Chemical industry
- Food and pharmaceutical industry

	Test Method	Unit	Value
General Properties			
Density	DIN EN ISO 1183-1	g / cm³	1.31
Moisture absorption	DIN EN ISO 62	%	0.2
Flammability (thickness 3 mm / 6 mm)	UL 94		V0 / V0
Mechanical Properties			
Yield stress	DIN EN ISO 527	MPa	110
Elongation at break	DIN EN ISO 527	%	20
Tensile modulus	DIN EN ISO 527	MPa	4000
Shore hardness	DIN EN ISO 868	scale D	88
Thermal Properties			
Melting temperature	ISO 11357-3	°C	343
Glass transition temperature	ISO 11357-2	°C	143
Thermal conductivity	DIN 52612-1	W / (m * K)	0.25
Specific heat capacity	DIN 52612	kJ / (kg * K)	1.34
Coefficient of linear thermal expansion	DIN 53752	10^{-6} / K	50
Service temperature, long-term	Average	°C	-60 ... 250
Service temperature, short-term (max.)	Average	°C	310
Heat deflection temperature	DIN EN ISO 75, method A, HDT	°C	152

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	Test Method	Unit	Value
Electrical Properties			
Dielectric constant	IEC 60250		3.2
Dielectric dissipation factor (50 Hz)	IEC 60250		0.001
Volume resistivity	DIN EN 62631-3-1	Ω * cm	$>10^{12}$
Surface resistivity	DIN EN 62631-3-2	Ω	$>10^{12}$
Dielectric strength	IEC 60243	kV / mm	20

The values given are average values for typical, unreinforced PEEK natural, provided as information about our products and as an aid to material selection. Price figures are rough, non-binding guide values and may vary depending on market situation, grade, dimension and quantity. We do not legally warrant any specific properties or suitability for a particular purpose. As the properties also depend on the dimensions of the semi-finished stock, the grade and the degree of crystallinity, the actual property values may deviate. The electrical values were measured on natural, dry material.