

# High-Performance Engineering Plastics Comparative Whitepaper

## Performance Analysis of PTFE, PFA, PEEK, PPS, PVDF, and PI

### Executive Summary

This whitepaper provides a comprehensive comparison between six high-performance engineering plastics: PTFE (Polytetrafluoroethylene), PFA (Perfluoroalkoxy), PEEK (Polyether Ether Ketone), PPS (Polyphenylene Sulfide), PVDF (Polyvinylidene Fluoride), and PI (Polyimide). The analysis focuses on key performance indicators such as chemical resistance, temperature tolerance, mechanical properties, and cost-effectiveness across various industrial applications.

### Material Performance Comparison Matrix

Performance Criteria	PTFE	PFA	PEEK	PPS	PVDF	PI
Chemical Resistance	★★★★★ (5/5)	★★★★★ (5/5)	★★★★☆ (4/5)	★★★★★ (5/5)	★★★★☆ (4/5)	★★★★☆ (4/5)
Temperature Range (°C)	-200 to +260	-200 to +260	-60 to +160	-60 to +120	-40 to +150	-269 to +260
Tensile Strength (MPa)	20-40	20-28	90-100	80-120	35-55	100-200
Hardness (Shore D)	35-50D	40-55D	80-90D	85-95D	70-80D	80-90D
Coefficient of Friction	0.04-0.1	0.1-0.2	0.3-0.5	0.2-0.4	0.3-0.4	0.2-0.4
Wear Resistance	★★★☆☆ (3/5)	★★★☆☆ (3/5)	★★★★★ (5/5)	★★★★☆ (4/5)	★★★☆☆ (3/5)	★★★★☆ (4/5)
Electrical Insulation	★★★★★ (5/5)	★★★★★ (5/5)	★★★★☆ (4/5)	★★★★☆ (4/5)	★★★★★ (5/5)	★★★★★ (5/5)
Processability	★★★☆☆ (3/5)	★★★★★ (5/5)	★★★★★ (5/5)	★★★★★ (5/5)	★★★★★ (5/5)	★★★☆☆ (3/5)
Cost Index (Relative)	5.0	5.5	4.5	2.5	3.0	4.0

Rating Scale: ★★★★★ (Excellent) > ★★★★☆ (Very Good) > ★★★☆☆ (Good) > ★★☆☆☆ (Fair) > ★☆☆☆☆ (Poor)

### Detailed Material Analysis

#### PTFE (Polytetrafluoroethylene)

##### Strengths:

- Unmatched chemical inertness - resistant to virtually all chemicals
- Extremely low coefficient of friction (non-stick properties)
- Wide operating temperature range (-200°C to +260°C)

- Excellent dielectric properties
- Biocompatible and FDA compliant grades available

**Limitations:**

- Relatively low mechanical strength compared to other engineering plastics
- Cannot be melt processed - requires compression molding or paste extrusion
- Higher cost than conventional polymers
- Prone to cold flow under constant load

**PFA (Perfluoroalkoxy)**

**Strengths:**

- Combines chemical resistance of PTFE with melt processability
- Transparent in thin sections
- Wide operating temperature range (-200°C to +260°C)
- Excellent dielectric properties
- Can be injection molded or extruded into complex shapes

**Limitations:**

- Highest cost among fluoropolymers
- Lower mechanical strength than PEEK or PPS
- Limited availability in certain forms
- Requires specialized processing equipment

**Conclusion**

*Each high-performance engineering plastic offers unique advantages for specific applications. The selection should be based on the dominant performance requirements of the application, balancing factors such as chemical exposure, temperature, mechanical loads, electrical properties, and cost constraints.*

(内容由 AI 生成, 仅供参考)