



HIGH PERFORMANCE PEEK POLYMERS

Electronic, Automotive and Aerospace Connectors Achieve Higher Performance and Cost Savings with VICTREX PAEK Polymers

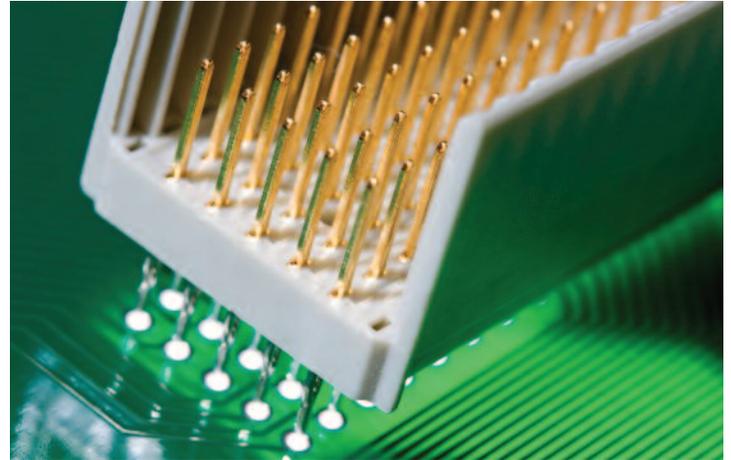
Demands for lightweight, durable, and miniature portable products continue to shape the way today's electronic components and connectors are being manufactured. As a result, higher performing materials are being selected that can facilitate the design of smaller and thinner connectors while enhancing quality and performance.

Victrex Polymer Solutions is the only company in the world exclusively focused on the development, manufacture and sale of high performance polyaryletherketones (PAEK) including VICTREX® PEEK polymer, VICTREX HT™ polymer and VICTREX ST™ polymer. These materials are increasingly being selected by connector OEMs to improve application performance, achieve more design freedom, and realize a reduction in system costs. Compared with traditional materials such as nylon, polyester, polyphenylene sulfide (PPS) and liquid crystal polymers (LCP), VICTREX PAEK polymers offer numerous advantages.

To support its innovative product offering, Victrex offers specialized and responsive technical support to help customers solve their manufacturing and design challenges. Our technical engineers are located around the world to assist with material evaluation, processing, application development, prototyping, and more. Victrex's Technical Innovation Centers offer processing capabilities to support customer trials and existing tooling to help bring product designs to life.

BENEFITS OF VICTREX PAEK POLYMERS

- ▲ Long lasting reliability in harsh environments
- ▲ Design and processing flexibility - can be molded into thin, intricate parts
- ▲ Perform well at various electrical and electromagnetic frequency ranges
- ▲ Cost effective - can facilitate the reduction of weight in a finished application



Connectors made with VICTREX PAEK polymers can increase performance and lower overall costs.

FEATURES OF VICTREX PAEK POLYMERS

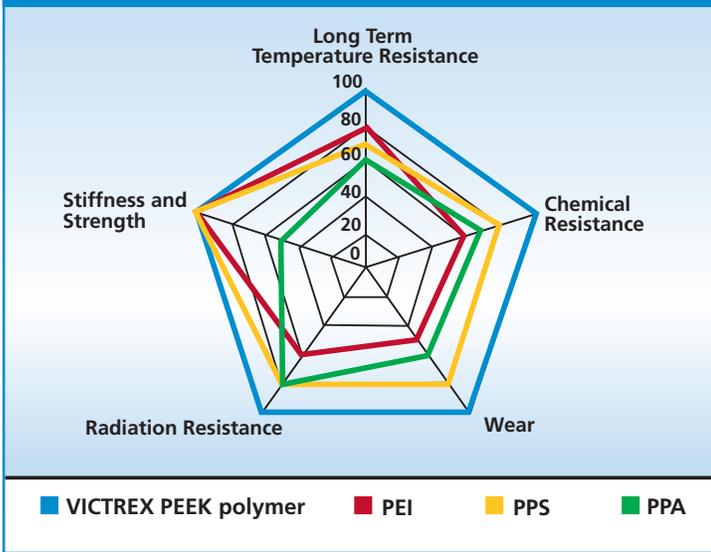
- ▲ **Mechanical Strength:** Offer better impact and weld-line strength when compared with LCPs. Excellent strength, stiffness, long-term creep and fatigue properties.
- ▲ **Chemical Resistance:** Unaffected by a wide range of acids, bases, hydrocarbons, and organic solvents which can be used in electronics and semiconductor device manufacturing processes.
- ▲ **Environmentally Friendly:** Fully recyclable, halogen free, RoHS and REACH compliant.
- ▲ **Low Dielectric Constant and Dissipation Factor:** Excellent high temperature and frequency performance (up to 10GHz and higher and temperatures up to 200°C (392°F) and higher).
- ▲ **Easy Processing:** Offer high melt flow which enables long flow lengths in tooling without multiple gating, coupled with low specific gravity which results in the ability to produce thin-walled parts from a lightweight, high performing polymer. Proven to mold with a minimum thickness of 0.1-0.2mm (0.004-0.008in) while keeping its mechanical strength and integrity. This is important when creating lighter weight and thinner connectors.

A High Performance Alternative to Traditional Materials

- ▲ **Low Smoke and Toxic Gas Emission:** Inherently flame retardant without the use of additives and has low toxicity of combustion gases.
- ▲ **High Temperature Resistance:** Maintain strength and dimensional stability with increased post-processing temperatures including those associated with lead-free soldering. No deformation following re-flow at 250-280°C (482-536°F) for 5-10 seconds for multiple cycles.

As seen in Figure 1, VICTREX PEEK polymer versus other polymers displays outstanding temperature and flammability performance while keeping their strength, chemical and wear properties.

Figure 1 – Comparison of VICTREX PEEK Polymer with Other High Temperature Polymers

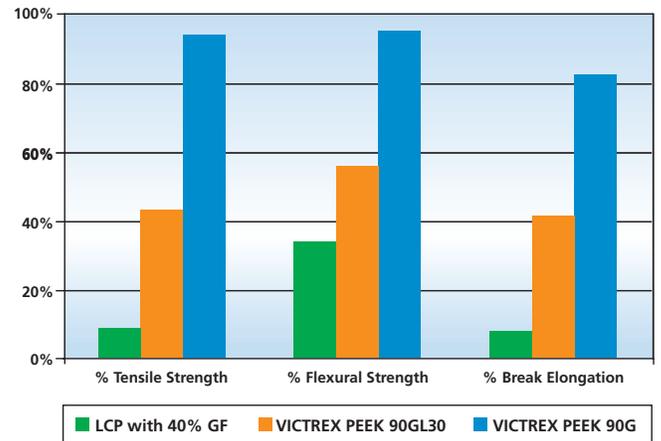


INDUSTRY APPLICATIONS

Mobile Devices

One of the biggest challenges for connectors used in mobile devices is miniaturization. Phones are being equipped with more functions while shrinking the size of the device and reducing the space available for each component. Connectors are also required to transmit more information than ever, resulting in continuously increasing pin density. These requirements are becoming more critical and, as a result, traditional materials such as LCP can face issues with impact and weld-line strength as well as brittleness which negatively impact manufacturing yield.

Figure 2 – Retention of Tensile Strength Over a Molded-in Weld Line



VICTREX PEEK polymer addresses these challenges by offering excellent mechanical strength and thermal resistance. This material is a great fit for lead-free solder interconnects, which are generally required for mobile device connectors including flexible printed circuit (FPC) connectors. VICTREX PEEK polymer overcomes the problems of brittleness and weak weld-lines commonly encountered in LCP connectors. Figure 2 shows how VICTREX PEEK polymer retains its weld-line strength. VICTREX PEEK high flow grades can fill sections as thin as 0.1-0.2mm (0.004-0.008in) thick to meet the challenges of miniaturization.

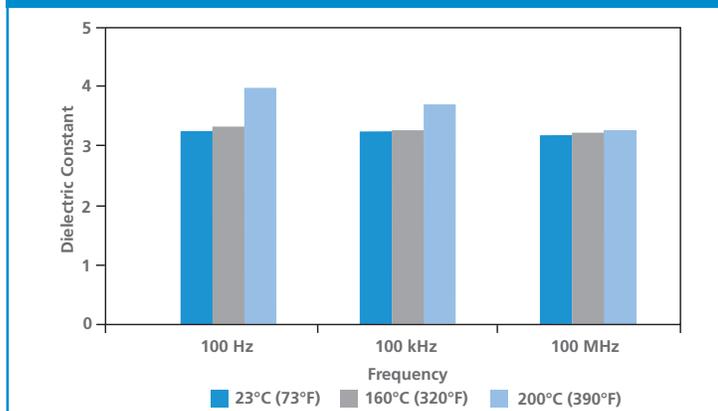
Other types of mobile phone connectors, such as co-axial cable connectors, require wear resistance and dielectric properties at high frequency. VICTREX PEEK polymer has good dielectric properties at both room temperature and elevated temperature. Figure 3 shows the dielectric constant for VICTREX PEEK 450G over a range of temperatures and frequencies.



Mobile Phone Co-Axial Connectors

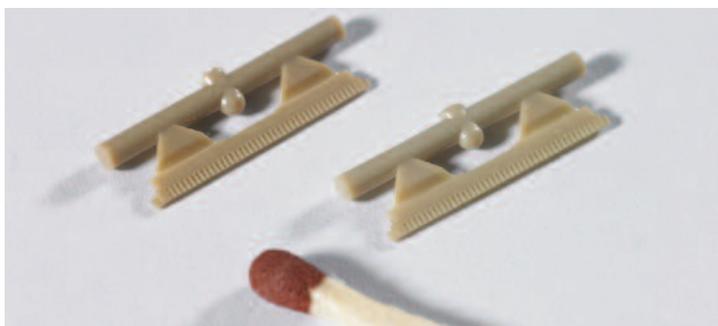
When TE Connectivity selected VICTREX PEEK 150GL30 for their mobile phone co-axial connectors, they needed a material that maintained dielectric properties at high processing temperatures and frequencies. By using VICTREX PEEK polymer they were able to maintain properties at temperatures up to 260°C (500°F) and frequencies up to 6 GHz.

Figure 3 – Dielectric Constant of VICTREX PEEK 450G



Automotive

Legislative requirements for high voltage connectors in electrical and hybrid vehicles are creating a need for higher performance materials. VICTREX PAEK polymers comply with both GADSL and RoHs standards. Designers and manufacturers of other vehicle systems such as exhaust-gas sensors are being driven by more stringent performance requirements such as broader chemical resistance and higher dimensional stability at extreme temperatures. VICTREX PEEK polymer and its high temperature variants, VICTREX ST and VICTREX HT polymers, are resistant to automotive fluids and exhaust-gas condensation and can help extend life and enhance reliability of finished products.



Flexible printed circuit connectors made with VICTREX PEEK polymer provide exceptional weld-line strength and dimensional stability at high temperatures.

Aerospace

Aerospace engineers require lightweight materials that provide design flexibility, reduce manufacturing costs, and durability in harsh environments. VICTREX PAEK polymers have successfully displaced metals, traditional composites and other plastics in a growing number of aerospace applications because they are exceptionally strong, inert, inherently flame retardant, lightweight and can be easily fabricated into tight tolerance parts. Electrical connector assemblies using VICTREX PAEK polymers can help improve performance and reduce systems cost in a variety of aircraft areas including fuel tanks, power and signal systems, engines as well as headsets and communication systems.

ENVIRONMENTAL PERFORMANCE

The connector market is increasingly focused on environmentally-friendly manufacturing. VICTREX PEEK 90G (unfilled, high flow grade) has excellent property retention as well as outstanding melt stability after multiple cycles of regrind.

Regrind performance measures vary per application, but tests have shown that unfilled VICTREX PEEK 90G can be recycled multiple times without any significant sacrifice in mechanical properties. Even though tensile strength has shown to decrease by 30% after 10 steps of regrind the material continues to provide good strength.

Victrex offers a variety of grades that provide excellent tensile or compressive strength at various temperatures (See Figure 4).

Figure 4 – VICTREX PEEK Polymer Strength at Elevated Temperatures

Property	Test Method	VICTREX PEEK 90GL30 [MPa (ksi)]	VICTREX PEEK 90GL60 [MPa (ksi)]	VICTREX PEEK 90CA30 [MPa (ksi)]
Tensile Strength				
@ 23°C (73°F)	ISO 527	190 (27.6)	220 (31.9)	260 (37.7)
@ 125°C (257°F)	ISO 527	130 (18.9)	140 (20.3)	180 (26.1)
@ 175°C (347°F)	ISO 527	80 (11.6)	80 (11.6)	110 (16.0)
@ 225°C (437°F)	ISO 527	60 (8.7)	65 (9.4)	85 (12.3)
@ 275°C (527°F)	ISO 527	45 (6.5)	45 (6.5)	65 (9.4)
Compressive Strength				
@ 23°C (73°F)	ISO 604	250 (36.3)	230 (33.4)	300 (43.5)
@ 120°C (248°F)	ISO 604	160 (23.2)	140 (20.3)	200 (29.0)
@ 200°C (392°F)	ISO 604	55 (8.0)	65 (9.4)	70 (10.2)

Figure 5 – VICTREX PEEK Polymer Comparison with Other Polymer Materials

	Mechanical Property Retention @ 200°C (392°F)	Solder Reflow Resistance	Moisture Absorption	Chemical Resistance	Abrasion/Wear Resistance	Dielectric Properties Over Frequency and Temperature	Weld-Line Strength	Use of Regrind
VICTREX PEEK Polymer	Excellent	Excellent	Very Low	Very Good	Excellent	Very Good	Very Good	Yes
LCP	Fair	Very Good	Low	Fair	Fair	Very Good	Poor	No
Nylons	Poor	Poor	High	Fair	Fair	Poor	Good	Limited
High Temperature Nylons	Fair	Fair	High	Fair	Fair	Good	Good	Limited
Thermoplastic Polyesters	Poor	Poor	Low	Fair	Fair	Poor	Good	Limited
Amorphous Materials (PSU, PEI)	Fair	Poor	Low	Poor	Fair	Poor	Good	Limited
PPS	Good	Very Good	Very Low	Very Good	Excellent	Very Good	Poor	Yes



ODU selected VICTREX PEEK polymer for the Medi-Snap® push-pull connector for its chemical and hydrolysis resistance, sterilization capabilities and excellent mechanical strength. Although originally designed and manufactured for use in the medical industry, its lightweight and high durability makes this connector ideal for a wide variety of industrial applications.

* Medi-Snap is a registered trademark of ODU

Figure 5 shows the many performance advantages of VICTREX PEEK polymer over traditional materials used for connectors. These advantages, coupled with the potential to reduce overall costs through design and process innovation, make it an innovative material of choice.

Summary

Through a combination of in-depth product and application development support, Victrex Polymer Solutions can help you achieve the greatest possible benefit from the use of its materials. This includes creating lighter weight designs, finding ways to enable improved performance, developing products that can operate in more demanding environments and achieving timely, cost-effective, reliable solutions for long-life applications. All of this, backed by more than 30 years of polyketone experience, makes Victrex the only company in the world that can offer this level of specialized support.

For more information please contact your local Victrex Polymer Solutions representative or visit www.victrex.com.

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