



HIGH PERFORMANCE PEEK™ POLYMERS

INTRODUCING

VICTREX® MAX-Series™ Polymers

Combining the best of VICTREX® PEEK™ and EXTEM® UH TPI polymers

VICTREX® PEEK™

- Chemical Resistance
- Hydrolytic Stability
- Long-Term Heat/ RTI
- Wear Resistance

EXTEM® UH TPI

- Highest heat amorphous thermoplastic
- Dimensional stability
- High temperature strength
- HDT/creep



VICTREX® MAX-Series™ Polymers — Enhanced Performance Over Wide Temperature Range – 150-275°C (302-527°F)

- Good mechanical performance at elevated temperatures
- Good chemical resistance
- Low creep at elevated temperatures
- Good dimensional stability

VICTREX MAX-Series is the blend of two unfilled high temperature, melt processable thermoplastic materials: VICTREX PEEK polymer and genuine EXTEM® UH thermoplastic polyimide (TPI) resin from SABIC Innovative Plastics. Offering excellent temperature resistance with high performance, MAX-Series polymers are designed to meet the increasing demands for even higher temperatures versions of VICTREX PEEK polymer.

VICTREX MAX-Series Products

| Product | Description/Application |
|---------------|--|
| VICTREX M1000 | Performance like VICTREX PEEK polymer with improved load bearing properties and dimensional stability. |
| VICTREX M2000 | High strength, stiffness and dimensional stability of a polyimide with improved flow, environmental stress cracking resistance and wear characteristics. |

For Enhanced Performance and Controlled Coefficient of Thermal Expansion (CTE)

Introducing a New Level of High Performance, High Temperature Materials...VICTREX MAX-Series

KEY FEATURES

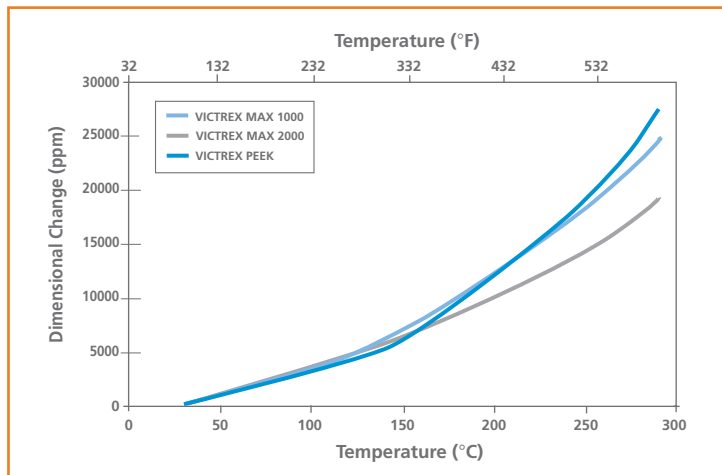
Until now, finding a melt-processable, ultra-high temperature material combined with chemical resistance, high purity, and controlled CTE was difficult. The new MAX-Series polymers have the ability to perform over temperatures in the range of 150-275°C (302-527°F). This capability can extend the life of an application, improve part reliability, and reduce overall system cost.

Compared with standard VICTREX PEEK polymer, VICTREX MAX-Series provides a significant performance jump in terms of mechanical properties at elevated temperatures. Whereas VICTREX T-Series™, another Victrex product blend, offers excellent mechanical properties and wear performance at elevated temperatures, the MAX-Series offers better controlled CTE over the whole temperature range.

- Ultra-High Temperature Performance
- Chemical Resistance
- High Purity
- Controlled CTE
- Melt Processable

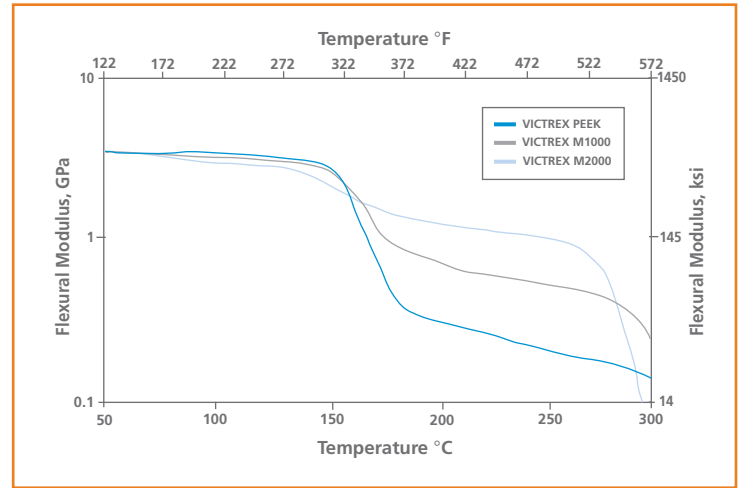
COEFFICIENT OF THERMAL EXPANSION

Dimensional Change with Temperature, Along the Flow



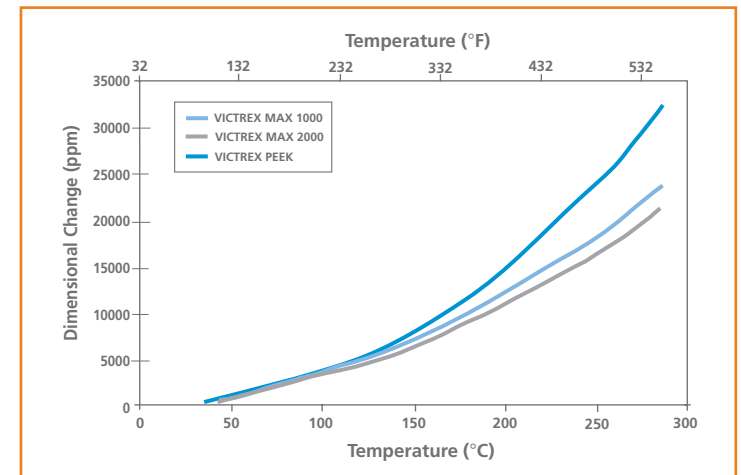
FLEXURAL MODULUS

Flexural Modulus by DMTA



VICTREX M1000 and M2000 show significantly improved retention of stiffness above the glass transition temperature of VICTREX PEEK polymer, through to over 250°C (480°F).

Dimensional Change with Temperature, Through the Flow

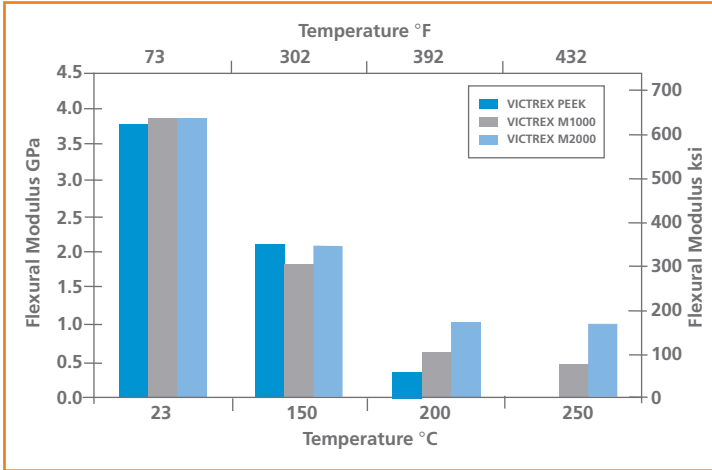


VICTREX PEEK shows a significant change in dimensions with temperature above its glass transition temperature which may make it unsuitable for certain applications. VICTREX M1000 offers performance similar to VICTREX PEEK polymer with improved dimensional stability. VICTREX M2000 performs more like an amorphous thermoplastic, with lower and more consistent dimensional changes through to elevated temperatures.

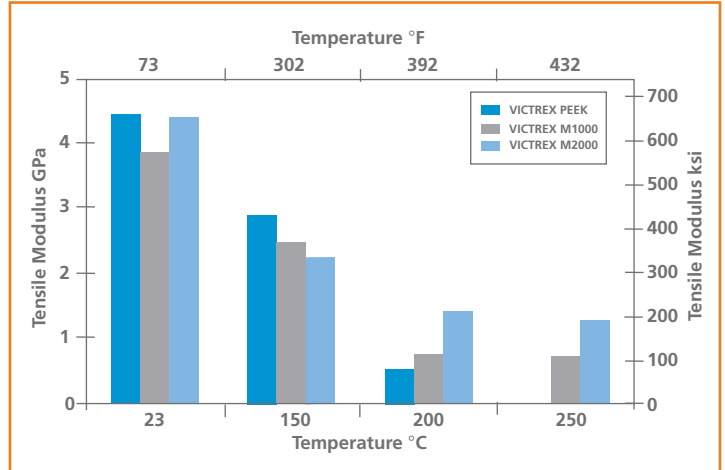
Enhanced Performance and Controlled CTE

IMPROVED MODULUS AND STRENGTH ABOVE 150°C (300°F)

Flexural Modulus

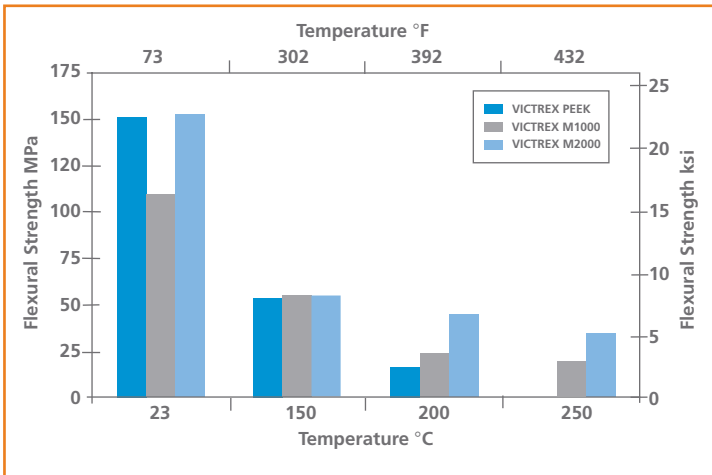


Tensile Modulus

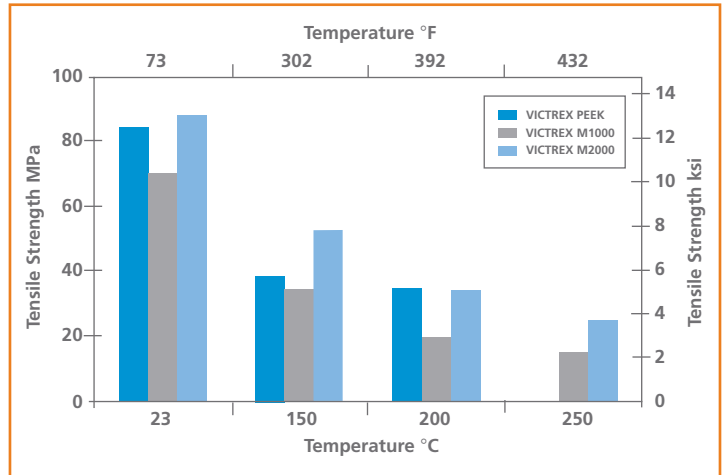


The Tensile and Flexural Modulus of VICTREX PEEK polymer decrease rapidly with temperatures above VICTREX PEEK polymer's glass transition temperature. VICTREX M1000 and M2000 have better retention of modulus at temperature, with VICTREX M2000 performing twice as well as VICTREX M1000 over 200-250°C (390-480°F).

Flexural Strength



Tensile Strength



The Tensile and Flexural Strength of VICTREX PEEK polymer decrease rapidly with temperature above VICTREX PEEK polymer's glass transition temperature. VICTREX M1000 and M2000 have better retention of strength at temperature, with VICTREX M2000 performing twice as well as VICTREX M1000 over 200-250°C (390-480°F).

High Temperature Mechanical Performance and Dimensional Stability

TYPICAL APPLICATIONS

VICTREX MAX-Series polymers are designed to perform in the most demanding applications, specifically those requiring a combination of high temperature mechanical performance and dimensional stability.



Oil and Gas

For oil and gas applications, long-term reliability and resistance to extreme temperatures, chemical, and wear conditions are critical. Victrex materials deliver superior long-term reliability over more traditional materials, and offer the ability to withstand extreme temperatures, chemical and wear conditions. These are important considerations, as new oil and gas developments require tougher and more durable materials. As operations go into deeper water, the requirements become more stringent for applications including:

- Downhole electrical connectors
- Subsea electrical connectors
- Seal rings



Semiconductor

In the semiconductor industry, fabrication facilities are constantly striving to develop products that combine high purity and high temperature resistance. The combination of a high purity and high temperature resistant product is important to FABs. By building upon the current benefits of VICTREX PEEK polymer, the new MAX-Series polymer provides an improved solution in certain application areas.

- Chip trays
- Wafer carriers
- Test sockets

Aerospace/Military

- Composites
- Connectors

Industrial

- Analytical equipment components

VICTREX MAX-Series Polymers: Properties and Injection Moulding Guidelines

PROPERTIES OF VICTREX MAX-SERIES POLYMERS

| PROPERTIES | TEST METHOD | TEST CONDITION | UNITS | VICTREX M1000 | VICTREX M2000 |
|--------------------------------|-------------|----------------|--|---------------|---------------|
| Tensile Modulus | ISO 527 | 23°C (73°F) | GPa (ksi) | 3.9 (570) | 3.6 (520) |
| Tensile Strength | ISO 527 | 23°C (73°F) | MPa (ksi) | 70 (10) | 90 (13) |
| Tensile Elongation | ISO 527 | 23°C (73°F) | % | 2.0 | 3.0 |
| Notched Izod Impact Strength | ISO 180/A | 23°C (73°F) | kJ/m ² (ft-lb/in ²) | 2.5 (1.2) | 3.5 (1.7) |
| Unnotched Izod Impact Strength | ISO 180/U | 23°C (73°F) | kJ/m ² (ft-lb/in ²) | 15 (7.1) | 50 (24) |
| Flexural Modulus | ISO 178 | 23°C (73°F) | GPa (ksi) | 4.2 (610) | 3.9 (570) |
| Flexural Strength | ISO 178 | 23°C (73°F) | MPa (ksi) | 120 (17) | 170 (25) |
| Melt Viscosity | Victrex | 400°C (750°F) | Pa.s (poise) | 350 (3500) | 1300 (13000) |
| | | 420°C (790°F) | | 250 (2500) | 870 (8700) |
| Density | ISO 1183 | 23°C (73°F) | g/cm ³ (lb/in ³) | 1.35 (0.0634) | 1.37 (0.0643) |

INJECTION MOULDING GUIDELINES

| | UNITS | VICTREX M1000 | VICTREX M2000 |
|-----------------------------|---------|---------------------------|---------------------------|
| Maximum Moisture Content | % | 0.02 | 0.02 |
| Drying Temperature | °C (°F) | 175 (350) | 175 (350) |
| Drying Time (Minimum) | hr | 6 | 6 |
| Drying Time (Cumulative) | hr | 24 | 24 |
| Melt Temperature | °C (°F) | 390-405 (735-760) | 400-415 (750-780) |
| Nozzle Temperature | °C (°F) | 385-400 (725-750) | 395-415 (745-780) |
| Front - Zone 3 Temperature | °C (°F) | 385-400 (725-750) | 395-415 (745-780) |
| Middle - Zone 2 Temperature | °C (°F) | 380-395 (715-745) | 390-405 (735-760) |
| Rear - Zone 1 Temperature | °C (°F) | 370-380 (700-715) | 380-390 (715-735) |
| Mould Temperature | °C (°F) | 175-200 (350-390) | 175-200 (350-390) |
| Back Pressure | bar | 3-5 (45-75) | 3-5 (45-75) |
| Screw Speed | rpm | 30-50 | 30-50 |
| Shot to Cylinder Size | % | 40-70 | 40-70 |
| Vent Depth | mm (in) | 0.025-0.075 (0.001-0.003) | 0.025-0.075 (0.001-0.003) |

CRITICAL SUCCESS FACTORS:

DRYING — Must dry to ≤0.02% moisture. Good dehumidifying dryer is critical [dew point must target -40°C (-40°F)]. If needed, dry longer than 6 hours and at a higher temperature [200°C (390°F)].

FEEDING — Minimise exposure of dried resin to humid air to avoid moisture absorption. Cover the feed hopper in case of an open hopper.

RESIDENCE TIME — Needs to be minimised, ideally, to 2 – 3 mins. if higher use a ramp profile, but maximum time ~ 5 mins.

INJECTION SPEED — Slow speed (e.g., 10 - 25 mm/sec) is better for part appearance.

GATES — Pin-gates (used for crystalline resins) cause shear degradation. Use generous gates when possible.

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Victrex plc is the leading global manufacturer of Polyaryletherketones, high-end polymers, which are sold under the brand names VICTREX® PEEK™, VICTREX® PEEK-HT™, VICOTE® and APTIV™. With production facilities in the UK backed by sales and distribution centres serving more than 30 countries worldwide, our global market development, sales, and technical support services work hand-in-hand with customers offering practical assistance in the areas of processing, design and application development. Contact us today to find out how we can help you.



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