



HIGH PERFORMANCE PEEK POLYMERS

The VICTREX® 90 family of high flow products is designed for injection molding thin-walled, intricate components and highly-filled compounds without sacrificing ease of processing.

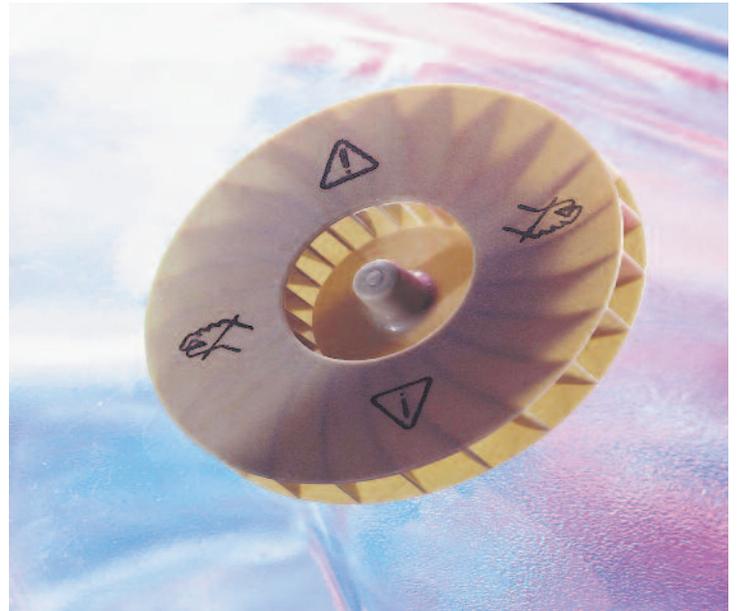
These new products facilitate the replacement of thermosets, ceramics and metals in electronic consumer, surface-mount technology and micro-fluid handling applications. High flow products are available unfilled, glass reinforced, or carbon reinforced. In addition to improved flow, these new products offer the following performance benefits:

IMPROVED FEATURES

- **Higher Filler Loading:**
Fiber loadings up to 60 wt% are possible without sacrificing ease of processing, surface finish or cycle time.
- **Higher Mechanical Properties:**
Exceptional fiber wet-out and distribution produces reinforced products with both enhanced and consistent short and long term mechanical properties. Higher filler loadings produce unparalleled improvements in modulus, toughness, and coefficient of thermal expansion (CTE).
- **Shorter Cycle Time:**
Less mechanical energy is required to move melt through injection molder. Grades crystallize faster and to a higher degree than standard grades thereby increasing mold release and broadening set points for recommended tool temperatures.
- **Excellent Surface Finish:**
Produces resin rich surface that fills in intricate topographies, prevents fibers from break-through and produces a smooth surface finish.

ADDITIONAL KEY PROPERTIES

- **High Temperature Performance:**
Very stable to thermal oxidation as both melt and solid. Semi-crystalline material retains mechanical properties well above glass transition temperature ($T_g = 143^\circ\text{C}$) to melt temperature ($T_m = 343^\circ\text{C}$). Grades available with heat deflection temperature (HDT) in excess of 340°C (644°F).
- **Exceptional Strength, Toughness, and Dimensional Stability:**
Highest room temperature stiffness of any thermoplastic. Excellent fatigue properties across a broad temperature



range. Low moisture absorption and CTE provides exceptional dimensional tolerances. Very low creep. Superior mechanical properties and toughness compared to liquid crystal polymers (LCP), polyphenylenesulfide (PPS), and ceramics.

- **Outstanding Chemical Resistance:**
Insoluble in all common solvents. Excellent resistance to acids, bases, hydrocarbons and salts. Superior chemical resistance compared to many exotic metals including stainless steel and titanium.
- **Exceptional Hydrolysis Resistance:**
VICTREX PEEK polymer is chemically inert to water and pressurized steam and has shown no change in tensile or flexural strength after conditioning at 200°C (392°F) in 1.4 MPa steam for over 2500 hours. Maximum moisture absorption less than 0.5 wt%.
- **Good Electrical Properties:**
Very stable electrical properties over a wide range of temperatures, frequencies and humidities.
- **Safe Combustion Products:**
Inherently UL94 V-0 material at 1.5 mm. VICTREX PEEK polymer contains no flame retardants and does not release halogen gases during combustion.

VICTREX® High Flow PEEK Products

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AVAILABLE GRADES

The VICTREX 90 family of high flow PEEK products is available in the following forms:

Table 1: VICTREX PEEK High-Flow Products

Nomenclature	Description
VICTREX® 90P	High flow unfilled powder
VICTREX® 90G	High flow unfilled pellets
VICTREX® 90GL30	30 wt% glass fiber reinforcement
VICTREX® 90GL60	60 wt% glass fiber reinforcement
VICTREX® 90CA30	30 wt% carbon fiber reinforcement
VICTREX® 90CA50	50 wt% carbon fiber reinforcement

Inquire about other high flow products directly with Victrex.

PROPERTY COMPARISONS

High flow products are produced by a carefully controlled manufacturing method to produce a lower molecular weight than other VICTREX PEEK polymers (i.e., VICTREX 150-based easy flow products and VICTREX 450-based standard flow products).

High flow products offer equivalent mechanical, thermal, chemical, and electrical properties as other VICTREX PEEK polymers; however, there are a few exceptions. VICTREX 150G has higher ductility than VICTREX 90G. Equivalently filled VICTREX 150-based products are also expected to have superior tribological properties to 90-based products. The following sections further differentiate high flow products from the existing VICTREX PEEK portfolio.

FLOW PROPERTIES

High flow products enable engineers to design components previously only possible with lower performing, lower viscosity polymers like LCP, PPS, and epoxy thermosets.

Compounds based on VICTREX 90 offer the highest flow across the range of VICTREX products. Even highly filled compounds based on VICTREX 90 have viscosities less than half that of standard VICTREX 450 compounds while maintaining good fiber wetting allowing extremely high filler loadings as seen in Figure 1. VICTREX 90-based products enable reliable molding of sections thinner than 0.2 mm.

MECHANICAL PROPERTIES

Unfilled high flow products offer equivalent mechanical properties to easy flow products. Equivalently reinforced high and easy flow products offer approximately equal tensile elongation. Short term properties of high flow products are exceptional. HDT for all reinforced high flow products are in excess of 320°C (608°F).

Figure 1: Melt Viscosity at Molding Shear Rates

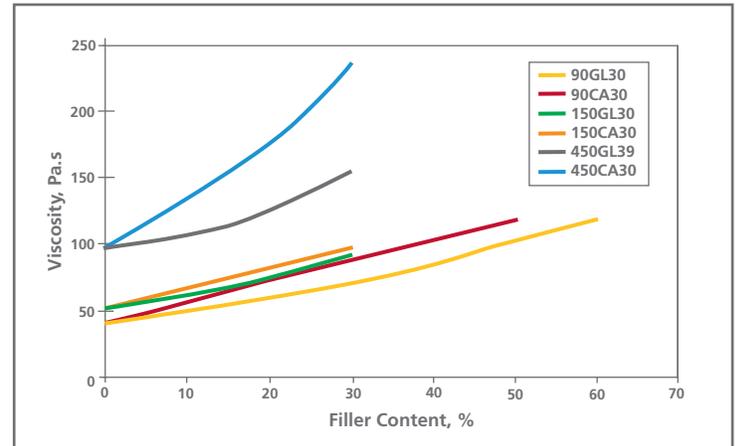


Figure 2: Flexural Modulus of VICTREX PEEK 90-based and 150-based Grades

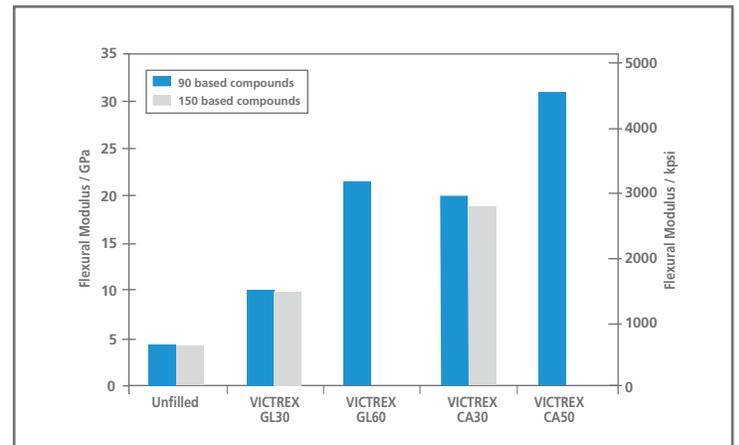


Figure 3: Fatigue Properties of VICTREX PEEK Reinforced Grades

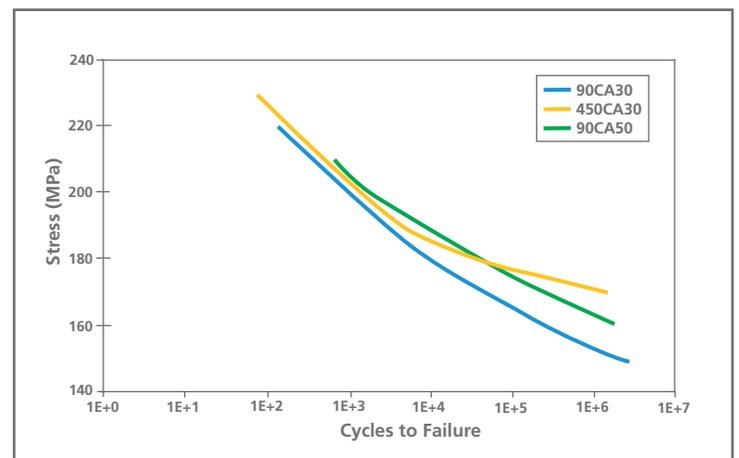


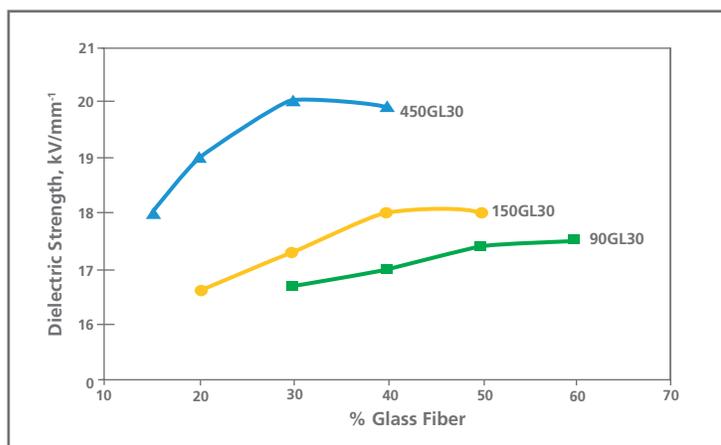
Figure 2 compares the flexural modulus of VICTREX 90-based and 150-based products. Modulus for unfilled grades at room temperature is very similar. High flow products provide a slight improvement in modulus at 30 wt% reinforcement. Highly reinforced grades (VICTREX 90GL60 and 90CA50) show substantial improvements in modulus over all other VICTREX PEEK products.

Figure 3 compares the cyclic fatigue performance of VICTREX high flow carbon fiber filled grades 90CA30 and 90CA50 with the standard flow product VICTREX 450CA30. The performance under cyclic loading of tensile bars at 5Hz is very similar for all products tested at 23°C (74°F).

ELECTRICAL PROPERTIES

VICTREX PEEK has very consistent electrical properties across a wide range of environments. One reason is due to very low moisture absorption. The dielectric strength of VICTREX PEEK varies not only with fiber loading, but also with molecular weight.

Figure 4: Dielectric Strength, Measured on 2.5 mm Thick Specimens



APPLICATIONS FOR HIGH FLOW PRODUCTS

Micro-Impeller

VICTREX 90G was selected over other engineering thermoplastics due to its superior ductility, dimensional stability and thermal aging, and aluminum was ruled out due to lower moment of inertia to reduce drive mechanism size and cost. Wall cross sections were less than 0.2 mm. The device spins at over 5,000 rpm continuously for over 2,000 hours without creep deformation.

Molded Electronic Components

VICTREX 90GL30 and 90GL60 have replaced nylon, PPS and glass-filled LCP in a variety of electronic components such as surface mount connectors and components, potentiometers, capacitors, resistors and micro switches in consumer electronics due to superior dimensional stability, lower outgassing and superior toughness. Low CTE and the ability to withstand lead-free solder reflow temperatures is key. Highly-filled high flow products offer processing advantages due to the extremely high HDT. Low water absorption prevents outgassing that interferes with the SMT manufacturing process. High flow compounded products are more ductile and have greater knit line strength than LCP compounds.

Injection Molded Ceramic Connectors

VICTREX 90GL60 has been used to replace injection molding ceramic automotive connectors under the hood and near exhaust sensors VICTREX 90GL60 provides significant cost savings due to reduced manufacturing cycle time. VICTREX PEEK is injection molded from pellet to part in one step, whereas injection molded ceramic requires costly compounding, molding, drying and sintering steps. VICTREX 90GL60 offers long term strength, fatigue and toughness to survive for a lifetime in an automobile.

INJECTION MOLDING PARAMETERS VICTREX PEEK 90 GRADES:

In order to achieve correct hopper feeding, the feed throat should be maintained between 70°C - 100°C (158°F - 217°F).

The recommended tool temperature range for VICTREX PEEK 90G is from 150°C - 180°C (302°F - 356°F), for reinforced grades from 170°C - 200°C (338°F - 392°F).

Further adjustments may be required to the mould tool and barrel temperatures depending on the size and shape of the mould cavity. For example, a long thin walled cavity may require slightly higher temperatures in order to fully fill because they tend to freeze faster than thick walled cavities.

Table 2: Properties of VICTREX PEEK 90G, 90GL30, 90GL60, 90CA30 and 90CA50

Grade	Rear Temp. °C (°F)	Middle Temp. °C (°F)	Front Temp. °C (°F)	Nozzle Temp. °C (°F)
VICTREX 90G	340(644)	350(662)	355(671)	360(680)
VICTREX 90GL30	350(662)	360(680)	365(689)	370(698)
VICTREX 90GL60	355(671)	370(698)	375(707)	380(716)
VICTREX 90CA30	355(671)	370(698)	375(707)	380(716)
VICTREX® 90CA50	360(680)	370(698)	380(716)	385(725)

Table 3: Properties of VICTREX PEEK90G, 90GL30, 90GL60, 90CA30 and 90CA50

Property	Conditions	Test Method	Units	VICTREX® 90G	VICTREX® 90GL30	VICTREX® 90GL60	VICTREX® 90CA30	VICTREX® 90CA50
Density	23°C	ISO 1183	g cm ⁻³	1.30	1.51	1.82	1.41	1.49
Color				beige	beige	beige	black	black
Melt Viscosity	400°C, 1000 s ⁻¹	Victrex	kPa.s	0.09	0.27	0.65	0.32	0.60
Tensile Modulus	23°C	ISO 527	GPa	3.9	12	24	27	39
Tensile Strength	23°C	ISO 527	MPa	110	190	220	260	240
Elongation at Break	23°C	ISO 527	%	15	2.3	1.4	1.4	0.9
Flexural Modulus	23°C	ISO 178	GPa	4.3	12	23	24	33
Flexural Strength	23°C	ISO 178	MPa	180	290	340	360	350
Notched Izod Impact Strength	23°C	ISO 180	kJ m ⁻²	4.5	8.5	9.5	6.5	5.5
Unnotched Izod Impact Strength	23°C	ISO 180	kJ m ⁻²	no break	40	45	35	30
Coefficient of Thermal Expansion	Below Tg, along flow	ISO 11359	x 10 ⁻⁶ °C ⁻¹	50	20	45	5	4
Mold Shrinkage (170°C Mold Temperature, 3 mm thickness)	across flow direction	Victrex	%	1.9-2.0	0.8-0.9	0.5-0.6	0.5-0.6	0.4-0.5
	in flow direction	Victrex	%	1.6-1.7	0.2-0.3	0.1-0.2	0.0-0.1	0.0-0.1
HDT 1.81 MPa		ISO 75A-f	°C	157	335	343	342	343

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