victrex®

HIGH PERFORMANCE PEEK POLYMERS

VICTREX® PEEK polymer is a high-performance thermoplastic with a unique combination of properties for compressor components. Driven by stringent industry requirements for longer-life parts and reduced downtimes, VICTREX PEEK polymer helps decrease maintenance costs, lower material weight, reduce noise levels and decrease or eliminate lubricants.

KEY PROPERTIES OF VICTREX PEEK POLYMER

- **Dynamic Fatigue Resistance** — Outstanding resistance at standard compressor operating temperatures up to 120°C (248°F).
- **Chemical Resistance** — Insoluble in all common solvents and excellent resistance to common refrigerants, acids, bases, hydrocarbons, salts and steam. Substantially lower moisture absorption than nylons, polyimides and other polymers.
- **Wear Resistance Without Lubrication** — Offers excellent wear resistance coupled with a low coefficient of friction. High PV values allow VICTREX PEEK polymer to be used in demanding tribological applications. Outperforms metals in many aggressive environments.
- **High Temperature Resistance** — Withstands continuous operating temperature of 240°C (464°F). Also maintains short-term mechanical properties at temperatures approaching its melting point of 343°C (649°F).

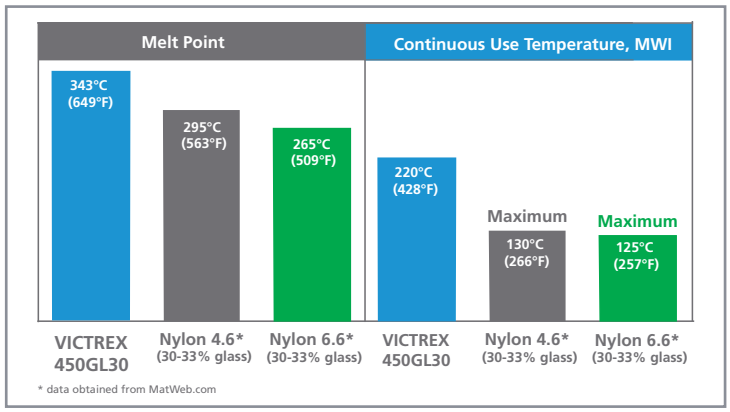
KEY BENEFITS OF VICTREX PEEK POLYMER

- **Injection molding** allows for parts consolidation as well as the ability to meet tight tolerances without the need for costly secondary operations.
- Can be **compounded with a wide range of fillers** to meet demanding applications.
- Ability to **run in oil-less environments** (i.e. food processing and medical industries).
- **Proven reliability** in the most demanding and critical compressor applications.

WHY VICTREX PEEK POLYMER VALVES REPLACE NYLON VALVES

Compressor efficiency is determined by the performance of the valves more than by any other component. The primary reasons why valves fail are fatigue caused by the repeated impact on the guard and fatigue caused by the varying differential pressure and corrosion.

Figure 1: Temperature Comparison of VICTREX 450GL30 vs 30% Glass Reinforced Nylon



VICTREX PEEK 450GL30 valve components outperform 30% glass reinforced nylon mainly due to:

Higher Temperature Performance

- Superior creep resistance allows retention of load-bearing properties at discharge temperatures.
- Greater dimensional stability and more reliable performance.
- Improved tensile, flexural and compressive strengths.
- Reduced likelihood of shutdowns due to temperature spikes caused by leaks in the seal.

Lower Water Absorption

- Ensures dimensional integrity and improves the stability of components.
- Maintains physical properties after hydrolysis.
- Excellent creep resistance.

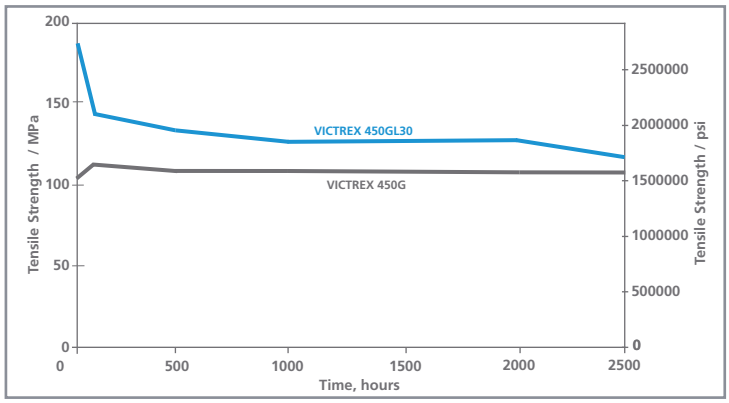
For Compressor Components

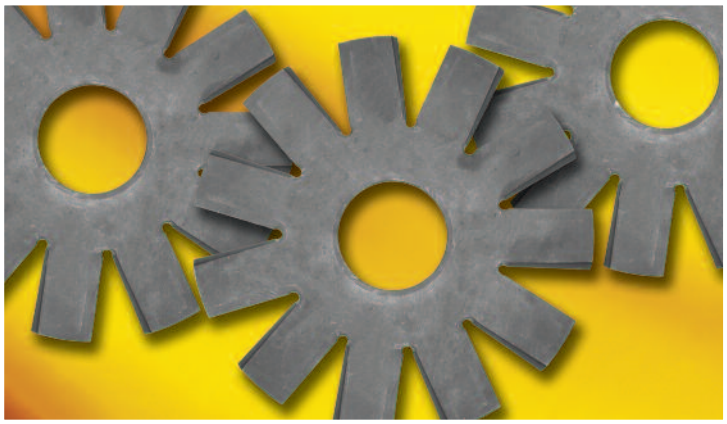
VICTREX® PEEK Polymers...

THE VICTREX PEEK POLYMER ADVANTAGE BY COMPRESSOR TYPE

Compressor Type	Application	VICTREX PEEK Polymer Advantage	Benefit
Reciprocating	Suction and Discharge Valves	Thermally Insulative vs. Metals Dynamic Fatigue Weight Reduction Parts Consolidation Embeddability	Efficiency Gain Longer Life / Reliability Efficiency Gain Reduced System Cost Maintain Sealing Capability
	Bearings and Piston Rings	Friction and Wear Weight Reduction	Longer Life Efficiency Gain
Screw	Star Gears	Dimensional Stability Friction and Wear	Efficiency Gain Longer Life
	Rotors	Dimensional Stability Friction and Wear	Efficiency Gain Longer Life
	Bearings	Friction and Wear	Longer Life
Scroll	Tip Seals	Injection Mold to Tolerance Superior Tribological Properties	Allows Larger Stack Up Tolerance Longer Life / Reliability
	Cams	Impact Strength Wear Resistance Injection Moldability	Longer Life / Reliability Longer Life / Reliability Design Optimization
	Shut Off Valve	Maintains High Discharge Pressure	Improved Efficiency
Rotary/Vane	Vanes	Low CLTE Thermally Insulative vs. Metals Friction and Wear	Efficiency Gain Efficiency Gain Longer Life / Reliability
Turbocompressors	Labyrinth Seals	No Heat Embrittlement Moisture Resistance Chemical Resistance	Longer Life / Reliability Efficiency Gain Longer Life / Reliability
Linear Compressors	Discharge Valve	Thermally Insulative vs. Metals Dynamic Fatigue Weight Reduction Parts Consolidation Embeddability	Efficiency Gain Longer Life / Reliability Efficiency Gain Reduced System Cost Maintain Sealing Capability

Figure 2: Retention of Tensile Strength After Conditioning in Steam at 200°C (392°F) and 1.4MPa (200psi)





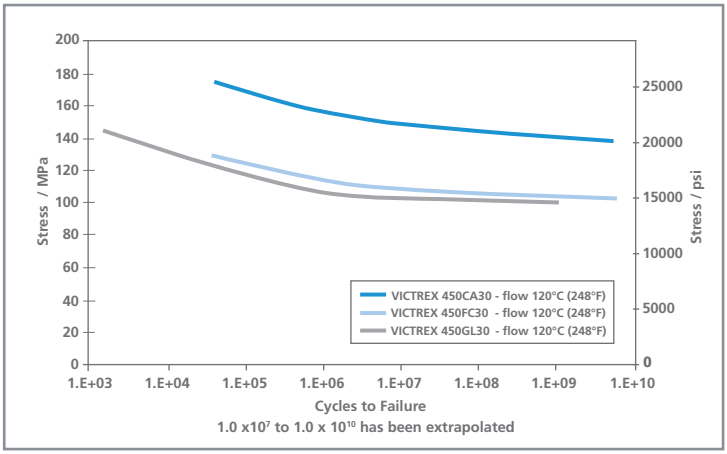
Star gear design improves thermal expansion and wear resistance over nylon and phenolics by 40%.

VICTREX PEEK POLYMER IMPROVES SCREW COMPRESSORS

The unique combination of VICTREX PEEK polymer properties at a continuous use temperature of 240°C (464°F) makes it an ideal material for star gears (gate rotors) in screw compressors.

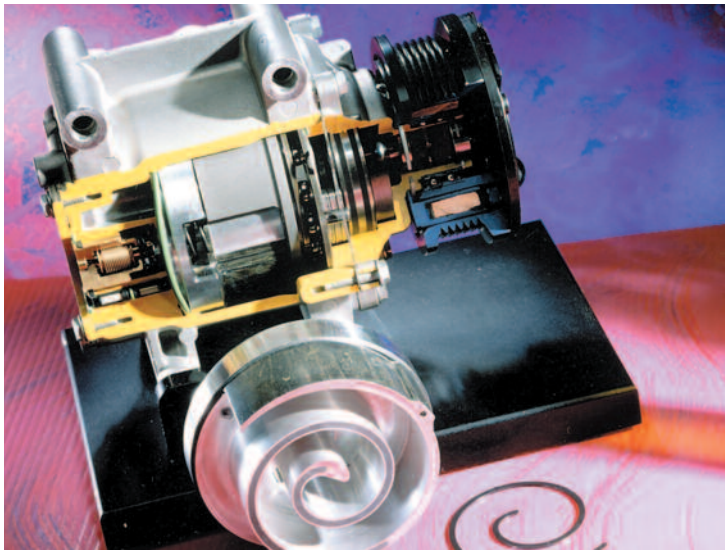
- Excellent wear resistance
- Dimensional stability
- Fatigue strength
- Chemical resistance
- Ability to machine to close tolerances improves flatness, reducing vibration and noise
- No dimensional change in oil environment
- Excellent mechanical strength
- Reduced maintenance
- Higher capacity and efficiency lowers power consumption

Figure 3: VICTREX PEEK Polymer Flexural Fatigue Endurance



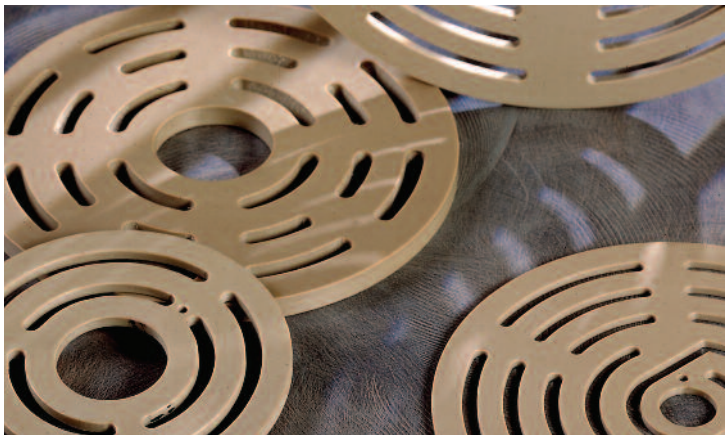
VICTREX PEEK POLYMER IMPROVES SCROLL COMPRESSORS

In a variable scroll compressor, the tip seal has to run over two holes so there has to be a certain amount of stiffness and wear resistance within the tip seal itself. Otherwise it would be rapidly worn away and eventually wear out. VICTREX PEEK polymer offers the wear resistance, stiffness and durability to make this a low risk type of seal. One of the key advantages of VICTREX PEEK polymer tip seals is the allowance of larger stack-up tolerances. The scroll halves do not have to be machined to as tight a tolerance if a tip seal is used. This is a cost saving.



The VICTREX PEEK polymer seals are located on the tips of the fixed and orbiting scrolls.

TYPICAL APPLICATIONS FOR COMPRESSORS



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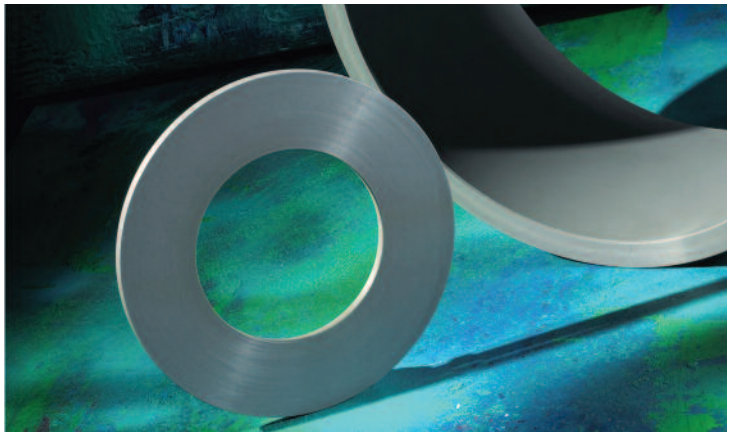
Valve Plates and Poppet Valves

VICTREX PEEK polymer provides excellent corrosion resistance, the ability to withstand higher impact velocities and increased resistance to dirt and liquids.

Suction and Discharge Valves

VICTREX PEEK polymer reduces noise generation during valve opening and closing because its lower mass — half the mass of aluminum and six times less mass than steel — produces less impact noise. In addition, its lower thermal conductivity will decrease heat transfer after shutdown, increasing volumetric efficiency at start-up.



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Thrust Washers

VICTREX PEEK polymer washers improve mechanical strength and wear withstanding higher axial forces and extreme tribological loads. Higher loads generate higher temperature conditions that are ideal for VICTREX PEEK polymer.

Piston Rings

VICTREX PEEK polymer provides improved temperature performance when compared to other polymers resulting in increased lifespan of the rings.

VICOTE®

VICTREX® PEEK COATING TECHNOLOGY

While thermoplastics will never replace certain metal components because of size and cost, VICOTE® Coatings are one way to impart similar material properties of VICTREX PEEK polymer. These coatings feature superior lubricity and abrasion resistance compared to many other thermoplastic coatings. They also provide superior adhesion and durability in harsh thermal, chemical, and tribological environments. Formulations are available for both electrostatic and dispersion coatings. Additives are available to further enhance abrasion resistance, lubricity and sealing capability.

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PROPERTIES OF VICTREX 450G, 450GL30 AND 450CA30

Property	Conditions	Test Method	Units	VICTREX 450G	VICTREX 450GL30	VICTREX 450CA30
General						
Density	Crystalline	ISO 1183	gcm^{-3}	1.30	1.51	1.41
	Amorphous	ISO 1183		1.26		
Water Absorption	24h,23° C	ISO 62-1	%	0.07	0.04	
(3.2 mm thick tensile bar)	Equilibrium, 23°C			0.4	0.3	0.3
Mechanical						
Tensile Strength	Break, 23°C	ISO 527	MPa	100	180	240
	Break, 130°C			50	98	130
	Break, 250°C			13	35	65
Tensile Elongation	Break, 23°C	ISO 527	%	40	2.7	1.7
Flexural Strength	23°C	ISO178	MPa	165	270	350
Flexural Modulus	23°C	ISO 178	GPa	4.1	11.3	23
Izod Impact Strength	0.25 mm notch, 23°C	ISO 180/A	kJm^{-2}	7.5	10	8
	Unnotched,23°C	ISO 180/U		no break	60	40
Thermal						
Melting Point		ISO 3146	°C	343	343	343
Glass Transition (Tg)		ISO 3146	°C	143	143	143
Specific Heat Capacity	23°C	DSC	$kJkg^{-1}$ °C	2.2	1.7	1.8
Coefficient of Thermal Expansion	Along flow below Tg	ISO 11359	ppm °C	45	18	5
	Average below Tg			55	45	40
	Along flow above Tg			120	18	6
	Average above Tg			140	110	100
Heat Deflection Temperature	1.8 MPa	ISO 75A-f	°C	152	328	336
Thermal Conductivity	23°C	ASTM C177	Wm^{-1} °C^{-1}	0.25	0.43	0.92
Continuous Use Temperature	Electrical	UL 746B	°C	260	240	
	Mechanical w/o impact			240	240	240
	Mechanical w/impact			180	220	200
Fire, Smoke & Toxicity						
Flammability Rating		UL94	n/a	V-0 @1.5 mm	V-0 @0.5 mm	V-0 @0.5 mm
Limiting Oxygen Index	0.4 mm thickness	ISO 4289	$\%O_2$	24		
	3.2 mm thickness			35		
Electrical Properties						
Dielectric Strength	thickness, 50µm	IEC 248	$kVmm^{-1}$	190	20	
Loss Tangent	23°C	IEC 112	n/a	0.003	0.005	
Dielectric Constant	50Hz, 0-150°C	IEC 250	n/a	3.2	3.2	
	50Hz, 200°C	IEC 250		4.5		
Volume Resistivity		IEC 93	$10^{16}\Omega cm$	4.9	1.0	

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