VICOTE®

VICTREX® PEEK™ COATING TECHNOLOGY

High Temperature Performance Coatings For Strength and Durability

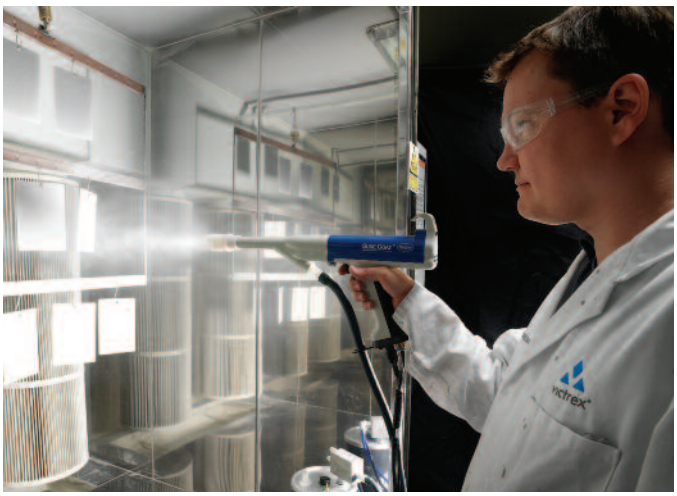
The Next Generation of Coatings...

VICOTE® Coatings, powder and liquid dispersions, based on VICTREX® PEEK™ polymer offer exceptional scratch and wear resistance, high temperature performance, strength and durability.

Eco-friendly VICOTE Coatings were developed to fill the performance gap found in many existing coating technologies today. Whether applied to industrial, automotive, food processing, semiconductor, electronics or pharmaceutical parts, VICOTE Coatings are a great choice for engineers looking to improve the wear performance and life of the coated part in their applications. VICOTE Coatings can be applied using electrostatic or conventional dispersion spray techniques.

The main ingredient of VICOTE Coatings is VICTREX® PEEK™ polymer, a linear, aromatic, semi-crystalline thermoplastic, widely regarded as one of the highest performing thermoplastic materials in the world. It offers a unique combination of properties to help processors and end-users reach new levels of cost savings, performance, and product differentiation.

VICOTE Coatings, as well as VICTREX PEEK polymer, are products manufactured by Victrex plc, a global manufacturer of innovative high performance materials. With production facilities based in the UK and backed by sales and distribution centers serving more than 30 countries worldwide, Victrex's 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 and training.



...For Durability and Long Life

Key Benefits

▲ **Exceptional Abrasion Resistance** – very hard, tough, and scratch resistant.

▲ **Excellent Mechanical Properties** – including wear, creep and cut through resistance. Extremely durable at high temperatures.

▲ **Excellent Wear Surface** – an excellent wear counterface to hard surfaces like steel and ceramics. Non-galling with low particulation and non-sloughing.

▲ **Good Lubricity** – offers a smooth and uniform surface.

▲ **High Load Bearing Surface** – one of the strongest thermoplastic coatings on the market. Very resistant to creep and flow caused by compression.

▲ **Excellent Radiation Resistance** – VICOTE 700 grades exhibit excellent radiation resistance. Can withstand high doses of Gamma radiation (> 10^9 Rads) without embrittlement.

▲ **High Temperature Performance** – one of the highest performing polymers available where continuous high temperature performance up to 260°C (500°F) is required. Withstands lead-free soldering temperatures. VICOTE 708, 709, F813 Blk and F814 grades are based on VICTREX PEEK-HT for even higher temperature performance up to 280°C (550°F) and enhanced mechanical properties.

▲ **Very Good Barrier Properties** – can be used as an effective barrier against many liquids and gasses. The barrier properties will depend on the service temperature, pressure and coating thickness as well as the concentration of the chemicals. A dry film thickness (DFT) of 100 microns of VICOTE Coatings should be used as a minimum.

▲ **Low Specific Gravity** – greater coverage than fluoropolymers.

▲ **Low Outgassing and Extractables** – where high purity and low contamination levels are key requirements.

▲ **RoHS Compliance** – the majority of grades comply with European RoHS (Restriction of Hazardous Substances) legislation that restricts the use of six hazardous materials found in a wide range of products including electrical and electronic products.

▲ **Eco-Friendly** – majority of dispersion grades are aqueous (water) based and are formulated to contain some of the industry's lowest levels of volatile organic compounds (VOCs).

▲ **Very Good Chemical Resistance** – insoluble in all common solvents. Excellent resistance to acids, bases, hydrocarbons, salts and steam.

▲ **One-Coat System** – no primer required with proper substrate pre-treatment.

▲ **Good Electrical Insulative Properties** – very stable electrical insulative properties over a wide range of temperatures, frequencies and humidities

▲ **Halogen Free, Low Smoke and Toxicity** – select grades are inherently UL V-O materials at 1.5 mm (.06 in). VICTREX PEEK polymer is classified as halogen-free according to the definition in IEC 61294-2-21.

▲ **Ease of Processing** – process temperatures between 380°C to 420°C (716°F to 788°F).

▲ **FDA Compliance** – the majority of VICOTE grades can be used in environments involving food contact.

▲ **Low Moisture Absorption and Excellent Hydrolysis Resistance** – properties are unaffected by exposure to water, humidity and steam.

VICTREX® PEEK™ VICOTE® GRADES CERTIFICATE OF COMPLIANCE WITH FDA REGULATION 21 CFR 175.300 RESINOUS AND POLYMERIC COATINGS.

Materials and articles manufactured from VICTREX® PEEK™ VICOTE® grades 701, 702, 703, 704, 705, 706, 707, 708 and 709 comply with the compositional requirements of regulation 21 CFR 175.300 for resinous and polymeric coatings of the Food and Drug Administration (FDA) of the United states of America. Regulation 21 CFR 175.300 further specifies that the finished coated part, which is in contact with food, is subject to extractive limitations. Compliance with any applicable extractive limits can only be demonstrated by testing carried out on the finished article.

Materials and articles manufactured from VICTREX® PEEK™ VICOTE® grades 804, 804 Blk, F804, F804 Blk, 805, F805, 806, F806, 807 Blk, F807 Blk, 808, F808, 809, F809, 810 Blk, F810 Blk, F813 Blk, F814, F815 and F816 Blk comply with the compositional requirements of regulation 21 CFR 175.300 for resinous and polymeric coatings of the Food and Drug Administration (FDA) of the United states of America. Regulation 21 CFR 175.300 further specifies that the finished coated part, which is in contact with food, is subject to extractive limitations. Compliance with any applicable extractive limits can only be demonstrated by testing carried out on the finished article.

Applications

Wear Plates

Advanced Mechanical Technology, Inc. (AMTI) chose VICOTE Coatings to coat an aluminum wear plate for its new dual belt instrumented treadmill because of the coating's superior friction and wear properties.

AMTI was experiencing problems with wearing underneath the belt surface. It experimented with different materials. After loading, testing and wearing out samples of other materials in minutes, the sample coated with VICOTE Coating was tested. After a few minutes it did not heat up so AMTI kept the test going for over an hour. After this length of time without any degradation, AMTI stopped the test and decided VICOTE Coating was the solution.

The dual design instrumented treadmill is a first for AMTI. It features two side-by-side rolling belts. One is two feet wide and the other is one foot wide. It uses digital amplifiers with Ethernet data acquisition for human performance research. 3-D forces and torques on each foot can be collected during walking or running.

Industrial & Automotive

- ▲ Chemical processing and transport components
- ▲ Vessels, pipes, valves, and ball seats
- ▲ Industrial mixers and agitators
- ▲ High performance washers
- ▲ Compressor components
- ▲ Rollers and bearings
- ▲ Molds
- ▲ Textile manufacturing

Food Processing

- ▲ Industrial bakeware
- ▲ Processing belts
- ▲ Cutting equipment

Semiconductor & Electronics

- ▲ Equipment components
- ▲ Ultra-pure water systems
- ▲ Circuit substrates
- ▲ Mobile phone sliders

Pharmaceutical

- ▲ Process tanks

Consumer

- ▲ Cookware
- ▲ Appliances
- ▲ Exercise Equipment

Food Processing Belts

Taconic International uses VICOTE Coatings in its new Tacmaster range of food processing belts used in aggressive food cooking environments where excellent wear, release and mechanical properties, and excellent temperature performance are required.

The coated belts provide increased wear and abrasion resistance, improved cut-through resistance, increased puncture and impact resistance as well as non-stick properties. When these properties are combined with improved dimensional stability, resistance to oils and grease, and continuous temperature resistance up to 260°C (500°F) the belt's life can be increased by up to 40%, reducing both downtime and maintenance costs for our customers.

Rice Cookers

Cuckoo Industrial chose VICOTE Coatings as a major ingredient for a new coating formulation for its latest range of high-pressure rice cookers.

The vulnerability to fast corrosion of the inner aluminum pot was the motivation behind developing a new coating material with high abrasion protection characteristics. Cuckoo also wanted to improve durability, as many food-standard coatings can be scratched by the frequent use of rice scoops and scrubbers. Cuckoo found that PTFE, PFA, and FEP are all fairly vulnerable to scratches and/or abrasion, and therefore simply don't last long in these very demanding applications.

VICOTE Coatings were chosen because of their remarkable mechanical performance at high temperatures, superb heat and abrasion resistance, and corrosion resistance.

Metal Plating Replaced by VICOTE Coatings in Needle Roller Bearings

Roller bearings are widely used in crankshaft and connecting rod mechanisms in engines especially in motorcycles, lawn mowers and outboard motors. Their purpose is to reduce the friction between two rotating surfaces. As a result, they are subject to extreme wear especially of the outer surface.

Current solutions are expensive and do not provide adequate wear relative to the demands of the application. However, the excellent wear resistance and durability of VICOTE Coating can withstand the extreme conditions of this application.

When tested at 9000 rpm for 100 hours, VICOTE Coatings outperformed current solutions such as traditional silver/copper plating, which wears away under the same test conditions causing damage to the cage and premature failure of the bearing. This performance was achieved with a VICOTE Coating thickness 50% lower than the traditional silver/copper plating.

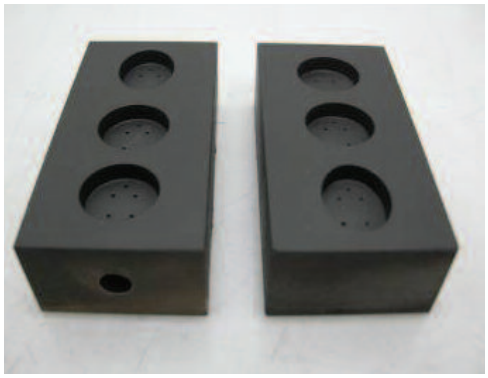
Industrial Textile Production

Rollers used in industrial textile production must withstand high temperatures as well as aggressive chemical and abrasive conditions. When coated with VICOTE Coatings, rollers last 4 times longer than the same rollers coated with PTFE.

VICOTE Coatings offer excellent high temperature performance — continuous use at temperatures up to 260°C (500°F) — and very good chemical resistance. They retain their mechanical properties at elevated temperatures and provide exceptional wear and abrasion resistance, as well as excellent durability.

Global Application Development Services

Victrex has two state-of-the-art application prototyping facilities to support OEMs and coaters with the development and commercialization of VICOTE Coatings in their application design. The Asia Innovation and Technology Centre (AITC) is located in the Xinzhuang Industry Park in Shanghai, China and the VICOTE Coatings Application Development Center (VADC) is located at Victrex headquarters in Thornton Cleveleys, Lanchashire, United Kingdom. Both centers provide customers with expertise and support in materials specification, training, prototyping, testing, and research.



Molds

VICOTE Coatings are an excellent choice for the coating of mold tools in the applications listed below. With a combination of good release properties and wear resistance, especially at elevated temperatures, VICOTE Coatings have been shown to outperform traditional Fluoropolymer coatings in mold applications. For example, in a coated shoe mold application, VICOTE Coatings lasted over 30 times longer than the same mold coated with PTFE.

Applications

- Tire molds
- Lozenge molds
- Shoe molds
- Cookie molds
- Composite parts
- Chocolate and candy molds
- Pharmaceutical molds (for pills)

Mold Substrates

- Steels
- Aluminum

VICOTE 700 Series

VICOTE 700 Series powder grades can be used for electrostatic coating and thermal spraying. The grade required will depend on the coating thickness required, the geometry of the part and the temperature requirements.

VICOTE 700 Series Powder Grades

Nomenclature	D50 Particle Size	Description
VICOTE 701	50 micron	Used electrostatically where heavy coating thickness are desired and where machining to tolerance may be required.
VICOTE 702	50 micron	Used electrostatically where increased flow and thinner coatings are desired. First choice for thin electrostatic coatings with good melt flow.
VICOTE 703	23 micron	Can be used electrostatically and/or in formulation of liquid dispersions.
VICOTE 704	10 micron	Used in formulation of liquid dispersions.
VICOTE 705	50 micron	Used electrostatically where higher flow is required. First choice for thinnest electrostatic coatings with highest melt flow.
VICOTE 706	23 micron	Can be used electrostatically where higher flow and thinnest coatings are required.
VICOTE 707	10 micron	Used where the high flow is required in formulation of liquid dispersions.
VICOTE 708	10 micron	Used where higher temperature performance is required in formulation of liquid dispersions
VICOTE 709	50 micron	Used electrostatically with higher temperature performance requirements.

Note: The 50 micron powders should be the first choice for electrostatic application.

VICOTE Coatings — Property Comparison with Fluoropolymer Coatings

Polymer	Abrasion Resistance	Outgassing and Extractables	No Cold Flow	Release (Coeff.of Friction) Grade Dependent
VICOTE Coatings	Excellent	Excellent	Excellent	Very Good
PTFE-Based	Poor	Fair	Poor	Excellent
ECTFE-Based	Poor	Good	Poor	Good
PFA-Based	Poor	Excellent	Poor	Excellent

Polymer	Mechanical Properties at Elevated Temperatures	Chemical Resistance	Heat Resistance	Smoke / Toxicity	Radiation Resistance
VICOTE Coatings	Excellent	Very Good	Excellent	Excellent	Excellent
PTFE-Based	Poor	Excellent	Excellent	Poor	Poor
ECTFE-Based	Poor	Excellent	Good	Poor	Poor
PFA-Based	Poor	Excellent	Excellent	Poor	Poor

VICOTE 800 Series

VICOTE 800 Series liquid dispersions are available where thinner coatings are required, where difficult geometries must be coated, and in instances where enhanced properties such as release are required.

VICOTE 800 Series Liquid Dispersions	
Nomenclature	**Description**
VICOTE 804 & F804 & 804 Blk* & F804 Blk*	A range of pure Victrex PEEK dispersions with typical properties being high continuous use temperature of 260°C (500°F), excellent wear, abrasion and cut through resistance at these high temperatures combined with very good chemical and excellent radiation resistance. Available in natural and black.
VICOTE 805 & F805, 806 & F806, and 807 Blk* & F807 Blk*	These grades have been specifically formulated to provide a tough, resilient, high wear resistant coating with varying levels of lubricants to give good release properties. Available in natural and black.
VICOTE 808 & F808, 809 & F809 and 810 Blk* & F810 Blk*	These grades have been specifically formulated to provide a resilient coating with varying levels of lubricant to give high wear and abrasion resistance combined with very good release properties. Available in natural and black.
VICOTE 811	The 811 grade has been specifically formulated to provide a tough, resilient coating with high wear and abrasion resistance combined with dry lubrication properties.
VICOTE 812*	The 812 grade has been specifically formulated to provide a tough coating with good wear and abrasion resistance.
VICOTE F813 Blk	This grade has been specifically formulated with VICTREX PEEK-HT and a lubricant additive to provide an even higher temperature tough, resilient, high wear resistant coating with good release properties. Available in black only.
VICOTE F814	A pure VICTREX PEEK-HT dispersion with typical properties being very high continuous use temperature of 280°C (550°F), excellent wear, abrasion and cut through resistance at these high temperatures combined with very good chemical and excellent radiation resistance. Available in natural.
VICOTE F815 & F816 Blk	These grades have been specifically formulated to provide a resilient coating with high wear and abrasion resistance combined with very good release properties throughout the profile of the coating. Available in natural and black.

* Electrostatic dissipative (ESD) grades. All other grades are Insulative coatings.

Electrostatic Dissipative (ESD) Grades

ESD grades available as part of the range of VICOTE Coatings can effectively help to control the rate of electrostatic charge build-up, which is of particular importance in hazardous-area industrial applications, as well as the manufacture of sensitive electrical and semiconductor equipment.

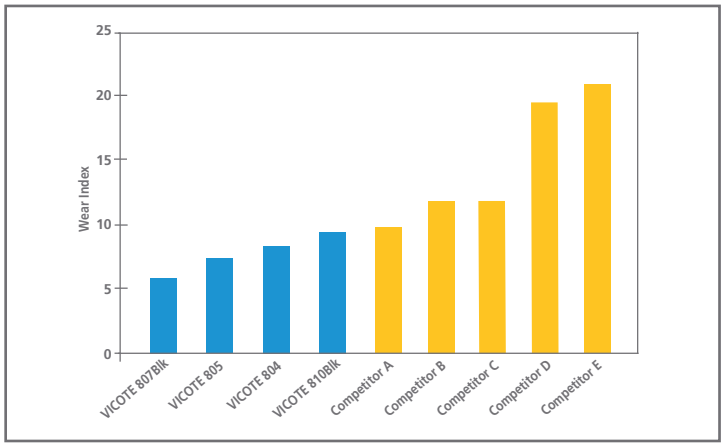
F-Grades

F-Grades of VICOTE Coatings are specially formulated by Victrex to solve the problem of flash rusting that can occur when water-based coatings are applied to ferrous metals such as mild steel. Can also coat non-ferrous substrates equally effectively.

Performance

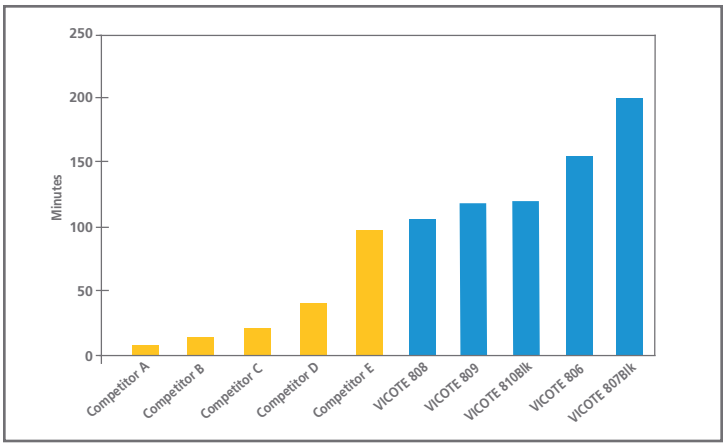
VICOTE Coatings Performance Characteristics	
Lubricity	Low coefficient of friction. VICOTE dispersions are available containing lubricants to further improve the coefficient of friction. Will not gall metals.
Abrasion Resistance	Four times the wear resistance of fluoropolymers. Virtually no particle sloughing.
Scratch Resistance	Excellent scratch resistance compared to other polymers.
Mechanical Properties	Mechanical strength exceeds that of all fluoropolymers.
Heat CUT Resistance	For use up to 260°C (500°F).
Electrical Insulation	Consistent over wide range of temperature, frequency, and humidity.
Chemical Resistance	Inert in most chemical environments. Not affected by steam. Low moisture absorption.
Purity	Extremely low extractables. Great in deionized water and food contact.
Adhesion	Excellent adhesion to the substrate negating the need for a primer during the coating process for reductions in systems costs.

Figure 1: Taber Abrasion Comparing VICOTE Coatings against high end industrial competitive coating systems at room temperature.



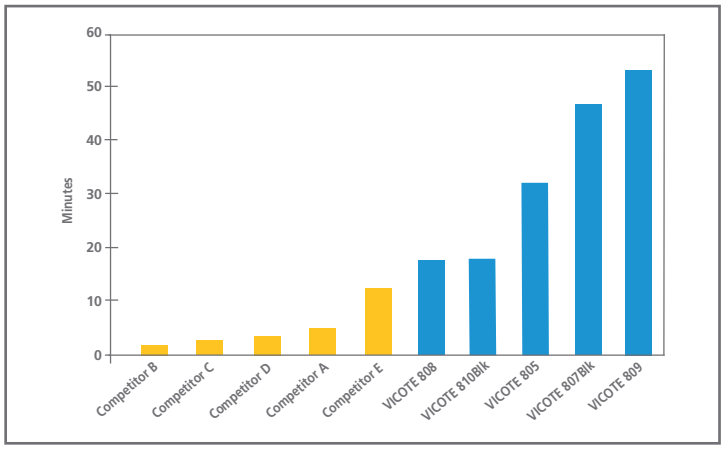
Taber Abrasion test carried out to ASTM D 4060

Figure 2: Comparison of VICOTE Coatings with high end industrial competitive coating systems. Time to wear through 25 microns with 250N load at room temperature.



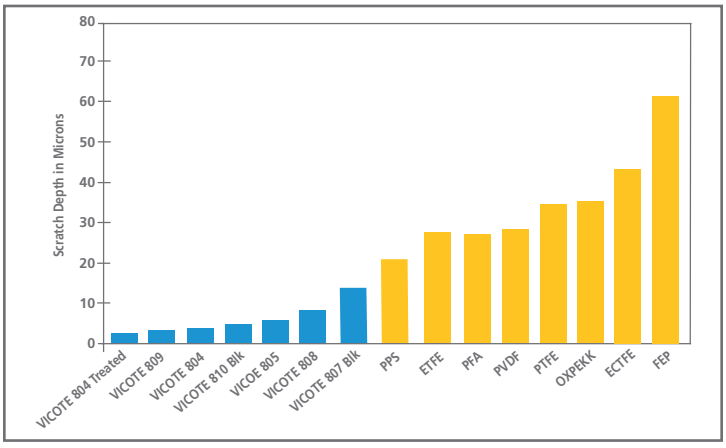
Tests were carried out by The National Tribology Centre, using a Cameron Plint wear test rig.

Figure 3: Comparison of VICOTE Coatings with high end industrial competitive coating systems. Time to wear through 25 microns with 250N load at 250°C (482°F).



Tests were carried out by The National Tribology Centre, using a Cameron Plint wear test rig.

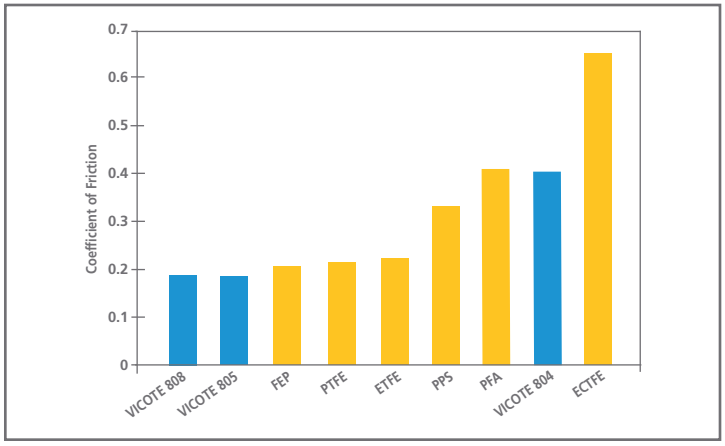
Figure 4: Tallysurf Scratch Resistance of VICOTE Coatings compared with various other coating materials with a load of 6kg at room temperature.



Scratch depth was determined using a Form Tallysurf Intra Measuring Instrument. A stylus is pulled over the scratch and a reading of the surface roughness can be measured. The Pv (peak valley) is also shown, this a measure in µm of the lowest valley present in the measured coating.

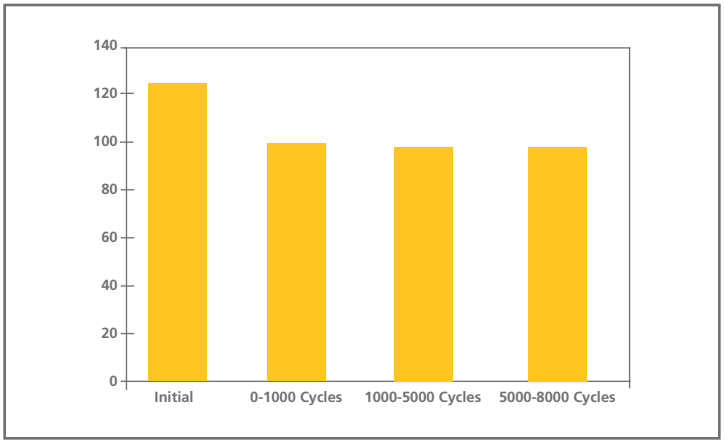
Properties

Figure 5: Coefficent of Friction of VICOTE Coatings compared with other polymers.



This test was carried out to ASTM G133-05 using a Plint TE test rig with 10 mm flat slider at 20 Hz and 11 mm stroke (22 mm total) at 50N load.

Figure 6: Contact Angle after 8000 Taber Cycles at 1kg load for the F815 and F816 Blk Grades.



SFE (surface free energy) was measured using water and diiodomethane at room temperature.

Typical Properties of VICOTE 700 Series Powder Coatings

Property	Conditions	Standard	Unit	VICOTE® 701	VICOTE® 702,703,704, 705, 706, 707	VICOTE® 708,709 (PEEK-HT™)
General						
Coating Finish Color (not powder color)				Grey/Tan	Grey/Tan	Grey/Tan
Solid Density	Crystalline	ISO 1183	g/cm³	1.3	1.3	1.3
Mechanical						
Abrasion Resistance	Taber CS 10		wear index	4.8	4.8	
Coefficient of Friction Dynamic	250N load	ASTM G133-05	—	0.37	0.37	
Water Absorption	23°C (73°F), 24 hours	ISO 262A	%	0.07	0.07	0.07
Thermal						
Melting Point		DSC	°C (°F)	343 (649)	343 (649)	372 (701)
Stoving Temperature	Object Temp.	—	°C (°F)	380 - 420 (716 - 788)	380 - 400 (716 - 752)	400 - 420 (752-788)
Specific Heat Capacity		DSC		2.16	2.16	
Max. Use Temperature -Continuous			°C (°F)	260 (500)	260 (500)	280 (550)
Fire, Smoke & Toxicity						
Limiting Oxygen Index	0.4 mm	ISO 4589	% oxygen	24	24	24
UL Flammability Test	Electrical	UL 94	—	V 0	V 0	V 0
Specific Optical Density (Ds)	3.2 mm Flaming	ASTM E662	—	19	19	
Electrical						
Dielectric Constant	50 Hz, 0-150°C	IEC 250	—	3.2	3.2	
Dielectric Strength	50µm film	IEC 248	kV/mm	190	190	
Loss Tangent	23°C (73°F), 1MHz	IEC 112		0.003	0.003	0.0035
Volume Resistivity		IEC 93	$10^{16}\Omega$ cm	4.9	4.9	4.9

For a more comprehensive list of VICOTE 700 Series data properties by grade, please contact a Victrex representative.

Properties

VICTREX PEEK Polymer Compared with Fluoropolymers

PROPERTY	VICTREX PEEK	VICTREX PEEK-HT	PTFE	PFA	ECTFE
Melting Point °C (°F)	343 (649)	372 (700)	327 (621)	310 (590)	245 (473)
Continuous Use Temperature °C (°F)	260 (500)	280 (536)	260 (500)	260 (500)	150 (302)
Tensile Strength MPa (ksi)	100 (14.5)	100 (14.5)	14-35 (2.03 - 5.07)	28-31 (4.06 -4.49)	49 (7.10)
Tensile Modulus Gpa (ksi)	3.5 (507)	3.5 (507)	0.55 (79.7)	0.78 (113)	1.65 (239)
Flexural Modulus Gpa (ksi)	4.0 (580)	4.0 (580)	0.45 (65)	0.67 (97)	1.7 (246)
Hardness (Shore D)	D85	D85	D50-D55	D60 - 64	D55 -75
Compressive Strength Mpa (ksi)	118 (17.1)	118 (17.1)		12 (1.74)	11 (1.59)
Specific Gravity	1.3	1.3	2.1 -2.2	2.1 -2.2	1.7

Note: Fluoropolymer data obtained from material supplier published data sheets

Typical Properties of VICOTE 800 Series Liquid Dispersions

Typical Property	Conditions	Standard	Unit	804	804Blk	805	806	807Blk	808	809	810Blk	811	812
Appearance				off white	black	off white	off white	black	off white	off white	black	grey	grey
% Solids Weight		Internal Test	%	37.40	36.70	37.39	37.5	36.90	37.40	37.40	36.70	41.3	37.5
Viscosity	25°C (77°F)	ISO 6	BSEN ISO 2431	32.00	25.00	26.00	19	17.00	29.00	23.00	22.00	54	22
S.G. ISO 2811	25°C (77°F)	ISO2811	g/cm³	1.09	1.09	1.10	1.12	1.12	1.10	1.12	1.12	1.13	1.17
Melting Point		DSC	°C (°F)	343(649)	343(649)	343(649)	343(649)	343(649)	343(649)	343(649)	343(649)	343(649)	343(649)
CUT			°C (°F)	260(500)	260(500)	260(500)	260(500)	260(500)	260(500)	260(500)	260(500)	260(500)	260(500)
Direct Impact	25°C (77°F)	ISO 6272	1m/1kg/ Indent 5mm	1	1	1	1	1	1	1	1	1	1
Konig Hardness		ISO 1522	Seconds	200	205	145	130	140	170	125	120	190	170
Bend		ISO 6860	mm	Pass at 3.2	Pass at 3.2								
ESD		EOS/ESD-S11	Ohms-cm		1x10E7			1x10E6			1x10E6		1x10E6

Typical Properties of VICOTE 800 Series F-Grade Liquid Dispersions

Typical Property	Conditions	Standard	Unit	F804	F804Blk	F805	F806	F807Blk	F808	F809	F810Blk	F813Blk	F814	F815	F816Blk
Appearance				off white	black	off white	off white	black	off white	off white	black	black	off white	off white	black
% Solids Weight		Internal Test	%	37.40	36.70	37.39	37.5	36.90	37.40	37.40	36.70	36.9	37.4	37.32	37.05
Viscosity	25°C (77°F)	ISO 6	BSEN ISO 2431	20.00	20.00	39.00	12	19.00	27.00	25.00	12.00	12	60	20	18
S.G. ISO 2811	25°C (77°F)	ISO2811	g/cm³	1.09	1.09	1.10	1.12	1.12	1.10	1.12	1.12	1.1	1.05	1.09	1.11
Melting Point		DSC	°C (°F)	343(649)	343(649)	343(649)	343(649)	343(649)	343(649)	343(649)	343(649)	372(702)	372(702)	343(649)	343(649)
CUT			°C (°F)	260(500)	260(500)	260(500)	260(500)	260(500)	260(500)	260(500)	260(500)	260(500)	280(550)	260(500)	260(500)
Direct Impact	25°C (77°F)	ISO 6272	1m/1kg/ Indent 5mm	1	1	1	1	1	1	1	1	1	1	1	1
Konig Hardness		ISO 1522	Seconds	200	205	145	130	140	170	125	120	105	143	122	116
Bend		ISO 6860	mm	Pass at 3.2	Pass at 3.2							Pass at 3.2	Pass at 3.2		
ESD		EOS/ESD-S11	Ohms-cm		1x10E7			1x10E6			1x10E6				

For a comprehensive list of VICOTE 800 Series data properties by grade, please contact a Victrex representative.

Coatings Procedures

VICOTE 700 Series Electrostatic Powder Coatings

Electrostatic equipment

VICOTE 700 Series powder coatings can be used in conventional electrostatic coating equipment either in manual or automatic powder booths using a negative Corona charge. The fluidizing unit should be capable of providing a steady stream of powder to the gun without slugging. The gun, powder delivery lines and fluidizing unit should be completely stripped and cleaned to remove all vestiges of other powders prior to charging the system with VICOTE Coatings, otherwise coating defects such as black specks, pin holes, and craters will be evident in the finished coating surface. The compressed air supply to the unit should be filtered and dried to remove any contaminants from the compressor. Powder recovered from the unit should be contamination free and may need to be mixed with virgin powder to adjust the particle size of the bulk powder as coarse particles will be deposited preferentially to the parts undergoing coating.

Preparation of the part/substrate

It is important that the part/substrate be prepared properly in order to gain the full advantage of a VICOTE Coating. Remove all sharp edges on the metal surfaces. A minimum of 1⁄4" radius on corners is recommended if the part design can accommodate. Deburr and smooth all welds to avoid stress concentration and pin holes in the coating.

Removal of old coatings

It is essential that all previous coatings, oil, grease and other deposits be removed before preparing the part for grit blasting and subsequent coating. Listed below are various methods of removing old coatings and contaminants.

- High temperature burn-off (pyrolysis) – This should be carried out at high enough temperature that does not damage the part, either by warpage or by significantly altering the mechanical properties of the metal. VICOTE Coatings require exposure to a temperature of 450- 490°C (842-914°F) for a few hours or until the coating is completely carbonized and can easily be removed by subsequent grit blasting.
- Thin VICOTE Coatings can be removed by conventional grit blasting.
- Thermoset polymer beads can be used for removal of both dispersion coatings and also thin powder coatings.
- Blast cleaning with dry ice is an effective method to remove coatings without affecting the geometry of mold tools.
- High pressure water jetting combined with sodium bicarbonate is also a method for removal of old coatings from mold tools.
- Laser ablation, although uncommon, is effective for removal of old coatings.
- Chemical cleaning of VICOTE Coatings from a metal substrate is not feasible.

Grit blasting the part/substrate

Use clean alumina grit, 60-80 mesh (250-177 microns), for grit blasting the metal surface. The surface profile will depend on the grit size, air pressure and type of metal. Normally, NACE* No. 1: White Metal Blast Cleaned Surface Finish is recommended. A surface profile of ~20% of the final coating thickness has been found to be adequate to provide good adhesion of VICOTE Coatings to the substrate.

NACE No. 1: White Metal Blast Cleaned Surface Finish is defined as a surface with a grey-white (uniform metallic) color, slightly roughened to form a suitable anchor pattern for coatings. This surface is free of all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint, and other foreign matter. Residual dust from blasting should be blown off with clean, dry air. It is also recommended that, if possible, a light cleaning with a suitable solvent be given as the final preparation step. All possible care should be taken to avoid deposition of lint on the part. Do not use paper towels.

At this stage, all precautions should be taken to avoid handling the part with bare hands. Use clean latex gloves or, preferably, tongs.

Drying

It is recommended that VICOTE Coating powders be dried in an air circulating oven at 150°C (302°F) for 3 hours or 120°C (248°F) overnight before use.

Coating with powder

To apply VICOTE Coatings evenly, flow out the coating at 380-420°C (716–788°F) part surface temperature. The time required to flow out the powder into a uniformly glossy fluid coat will depend upon the thermal mass, size and shape of the part as well as the oven temperature. However, the oven temperature should never be below 360°C (680°F). Flow out is indicated by a wet glossy surface with no “orange peel” appearance.

It is not advisable to use too high an oven temperature as some sections of the part may heat up faster than others and lead to problems of pull back, dripping or degradation. Hot and cold spots in the ovens can also lead to such problems especially if too high oven temperatures are used.
The parts should be rotated in both

* National Association of Corrosion Engineers

Coatings Procedures
VICOTE 700 Series Electrostatic Powder Coatings

horizontal and vertical direction (if possible) to obtain uniform thickness and uniform exposure to heat. This will prevent one section from curing before the other. If step-wise rotation is made, then change in direction should be made after removing the part from the oven. If a direction change is made with the powder on, the potential for the powder to shake off and form lumps exists.

Subsequent coats also should be applied to hot part following the above instructions. After flowing out the final coat, allow the part to cool uniformly, especially for parts of large thermal mass.

The temperature recommendation will vary with part mass and geometry. The most important consideration is to use the lowest practical temperature and shortest oven cycle time to obtain a smooth, continuous, even coating.

Extended oven cycles and extreme temperature cycles (e.g. cooling to room temperatures between coats) wastes energy and can lead to poor quality coatings. When the desired thickness is obtained, allow the part to cool in a clean area.

Thickness correction

After the part has cooled, the thickness should be checked. If the part does not have the desired thickness, then clean the part with a clean rag and solvent, and heat it in an oven at 380-420°C (716-788°F). Remove the part after reaching the desired temperature and continue adding additional coats as described above.

Part recovery

If the coating is poor and not satisfactory, the part can be recovered in the following manner:

Place lined part in an oven (with adequate outside exhaust venting) at 450-490°C (842-914°F). Place a shallow pan under the part coated with VICOTE Coating.

Heat the part and allow the major portion of the VICOTE Coating to melt and drip off the part and into the pan. Remove the pan containing the melted VICOTE Coating from the oven. Allow the part to remain in the oven for approximately four hours or until the VICOTE Coating is reduced to char. Remove charred VICOTE Coating by wire brushing. A further light grit blasting may be required at this point. Re-coat by following the procedure previously outlined.

Cross-contamination

It is recommended that dedicated spraying equipment be used for applying VICOTE Coatings or, at least, equipment that has been thoroughly cleaned to remove all traces of other polymers. At VICOTE Coating processing temperatures other lower melting point polymers that could be present if the application equipment is not thoroughly cleaned, will lead to coating defects such as black specks and pin holes.

Thermal Spraying of VICOTE® Coatings

For some time it has been recognized that the ability to apply VICOTE Coatings using a thermal spraying process could provide advantages for some applications. As a one step process done on site it expands the use of VICOTE Coatings and allows design freedoms by eliminating the restriction of size imposed by traditional heating ovens, reduces the curing temperature to allow for coating on potentially thermally sensitive substrates with no loss of mechanical properties, enables quick and easy application of thick coatings, and increases the efficiency of processing imposed by traditional methods that require the substrate to be transported between facilities.

During thermal spraying a stream of VICOTE Coating powder passes through a high temperature flame that melts the polymer particles which are then deposited onto a substrate in layers. The result, a crystalline in nature finish, similar to that of an electro-statically applied and cured powder coating, provides all the excellent properties of a powder coating applied by traditional methods.

Coatings Procedures
VICOTE 800 Series Liquid Dispersions

Dispersion coating equipment

VICOTE 800 Series liquid dispersions can be applied using conventional gravity, suction HVLP or pressure spray coating equipment. Tip sizes of between 0.7 – 1.8 mm can be used depending on the volume of dispersion to be sprayed. Spraying pressures of between 35 and 50 psi are typically used for VICOTE Coating liquid dispersions. The air supply should be clean and free of contaminants from the air compressor.

Coating material preparation

Some VICOTE Coating liquid dispersion formulations may have a tendency toward soft settling but are readily re-dispersed by hand mixing or by the use of relatively unsophisticated equipment such as a low speed roller or stirrer.

VICOTE Coating liquid dispersions containing fluoropolymers may be prone to gelation, if subjected to high speed or high shear mixing.

Mixing for 10-20 minutes is adequate in most cases; regardless, mixing should continue until any settling has been eliminated. It is imperative that the coating material is homogeneous prior to use.

Viscosity adjustment

The coating is generally suitable for spray application as supplied; however, some viscosity adjustment may be necessary depending upon the type of application equipment employed. Conditions of high ambient temperatures and low relative humidity may cause the dispersion to spray "dry" and necessitate viscosity reduction.

If viscosity adjustment is deemed necessary, use only distilled or de-ionized water. Add the diluent to the coating material in increments of one percent (1%) until the desired spray characteristics are obtained, i.e., when the coating is easily atomized and produces a smooth, wet film. Take care not to add too much water to the coating material.

Preparation of the part/substrate

Final coating quality demands careful surface preparation. Your choice of procedures should be based upon the design requirements of the part/substrate. If you are unsure which process is best suited to your needs, please contact a Victrex representative. They will be pleased to offer specific recommendations.

1. Remove oils and greases
Each part/substrate must be free of all contaminants (oil, grease, metal shavings, etc.). Contaminated parts/substrates will cause poor adhesion of the coating material to the substrate and defects in the dry film.

a) Vapor de-grease to remove conventional lubricants from the parts/substrates. Use a suitable solvent.

b) Wash/rinse to remove water soluble lubricants from the parts/substrates. Use the appropriate detergent formula.

c) A third acceptable method of removing oils and greases from parts/substrates is a high temperature "burn out." This is preferred by many processors. Expose the parts/substrates to a fifteen (15) minute pre-bake at 400-425°C (750-800°F) to insure that petroleum base contaminants are fully carbonized and rendered harmless. Assess the possibility of warpage, annealing the parts/substrates, etc., prior to utilizing this method of "degreasing."

2. Grit blast
Industrial hardware is typically grit blasted with 60 or 80 mesh (250 or 177 microns) aluminum oxide grit media. Grit blasting is necessary for the coating's adhesion, wear resistance, and overall durability. A surface profile of ~20% of the final dry film thickness has been found to be adequate to provide good adhesion of VICOTE Coatings to the substrate.

3. Rinse each work-piece to remove gritty residue
Solvent rinsing is preferred. Water will cause flash rust to form on carbon steel. Compressed air cleaning is also acceptable, although some grit will remain and flash rust may form on carbon steel if the compressed air is contaminated with water vapor.

It is important that the part/substrate be prepared properly in order to gain the full advantage of a VICOTE Coating. Remove all sharp edges on the metal surfaces. A minimum of 1⁄4" radius on corners is recommended if the part design can accommodate. Deburr and smooth all welds to avoid stress concentration and pin-holes in the coating.

Coatings Procedures
VICOTE 800 Series Liquid Dispersions

Application equipment and techniques

VICOTE Coating liquid dispersion formulations may be applied with standard air spray equipment. Any spray apparatus associated with the application of fluoropolymer or enamel coatings, including HVLP units, will provide a uniform film using VICOTE Coating products without difficulty. The use of standard personal protection equipment is recommended. It may be advantageous to filter the dispersion through a coarse filter before use.

"Wet" parts/substrates may be accumulated for a batch oven; however, they may be affected by dust, moisture, or other airborne contaminants. Process coated parts/substrates as quickly as feasible.

Film thickness/multiple coats

VICOTE Coating liquid dispersions may be applied at 1-2 mils (25-50 microns) per coat; multiple coats may be applied in proper cure sequences.

Stoving cycles

Stoving time is directly related to the melt temperature of VICOTE Coating and the mass of the part/substrate being coated. All temperature statements refer to the part/substrate temperature.

VICOTE Coating liquid dispersions should be dried in air after coating for approximately 5 minutes then placed in an oven for 5 minutes at 120°C (248°F) to dry the coating thoroughly. Coated article should then be placed in an oven set at 380-420°C (716-788°F) until the coating has a smooth and glossy appearance.

Technical troubleshooting guides and FAQs

Technical troubleshooting guides and FAQs relating to coatings are available from Victrex on request.

Safety and environmental
Safety and environmental issues for the raw materials used in VICOTE Coating formulations may be found in our Material Safety Data Sheets. Please contact Victrex for more information.

Conclusion

VICOTE Coatings provide excellent wear resistance, strength and durability for demanding applications that require exposure to extreme conditions such as high temperature, chemicals and abrasion. By using VICOTE Coatings in the coated parts of their applications, customers can extend application life, improve product performance and functionality, reduce systems cost and facilitate design freedom to achieve product differentiation.

VICOTE® Coatings — High Temperature Performance Coatings for Strength and Durability

www.vicote.com

Victrex plc is the leading global manufacturer of Polyaryletherketones, high-end polymers, which are sold under the brand names VICTREX® PEEK™, VICTREX® PEEK-HT™, VICTREX® T-Series™, 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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