

PROPERTY DATA

46 Nylon

Stanyl® Glass Fiber Reinforced Heat Stabilized

Chart below covers grades that are heat stabilized, glass fiber reinforced Nylon 46 resins, providing low creep and high stiffness and strength characteristics.

Typical Properties*	Unit	ASTM Test	TW200F3	TW200F6	TW200F8	TW241F10
Glass Fiber Content	% wt		15	30	40	50
Specific Gravity	g/cc	D792	1.30	1.41	1.51	1.62
Melting Point	°F	D3417	563	563	563	563
Linear Mold Shrinkage 1/8" average section	in/in	D955	0.005-0.009	0.004-0.006	0.004-0.005	0.002-0.004
Water Absorption Equilibrium	%	-	3.1	2.6	2.2	1.8
Impact Resistance, Izod - Notched (1/8") dry conditioned	ft-lb/in	D256	1.6	2.0	2.1	2.2
	ft-lb/in	D256	2.4	3.5	3.6	3.7
Tensile Strength dry conditioned	psi	D638	21,800	30,000	32,000	34,000
	psi	D638	14,500	17,000	20,300	23,200
Tensile Elongation dry conditioned	%	D638	3	4	3	3
	%	D638	-	8	6	4
Tensile Modulus dry conditioned	psi x 10 ⁵	D638	8.41	13.00	18.30	23.20
	psi x 10 ⁵	D638	4.06	6.50	10.60	14.50
Flexural Strength dry conditioned	psi	D790	31,900	43,000	43,500	50,750
	psi	D790	18,900	27,000	29,000	29,000
Flexural Modulus dry conditioned	psi x 10 ⁵	D790	7.98	12.0	17.0	20.3
	psi x 10 ⁵	D790	3.92	6.60	10.0	13.0
HDT @ 264 psi	°F	D648	480	545	545	545
Peak Temperature (1 min)	°F		>445	>480	>480	>480
Coninuous Use Temperature (5000 hours)	°F		330	330	330	330

*All mechanical tests conducted at 73°F unless otherwise noted.

Data from DSM Engineering Plastics.
For additional information call 800-333-4237.

PROPERTY DATA

46 Nylon

Stanyl®
Flame Retardant
Heat Stabilized

Chart below covers grades that are heat stabilized, flame retardant Nylon 46 resins, designed for electrical applications, UL 94 V-0 @ 0.8 mm.

Typical Properties*	Unit	ASTM Test	TTE351	TE250F3	TW250F6	TW250F9
Glass Fiber Content	% wt		0	15	30	45
Specific Gravity	g/cc	D792	1.35	1.47	1.68	1.82
Melting Point	°F	D3417	563	563	562	562
Linear Mold Shrinkage 1/8" average section	in/in	D955	0.018-0.020	0.006-0.009	0.004-0.006	0.002-0.004
Water Absorption Equilibrium	%	-	2.4	2.1	1.6	1.2
Impact Resistance, Izod - Notched (1/8")	dry	D256	1.1	0.5	1.3	1.9
	conditioned	D256	2.5	-	1.9	2.2
Tensile Strength	dry	D638	8,300	16,500	25,400	29,000
	conditioned	D638	5,500	10,000	18,100	21,800
Tensile Elongation	dry	D638	15	8	2.5	2.1
	conditioned	D638	30	20	3.5	3.0
Tensile Modulus	dry	D638	3.90	10.00	18.10	25.00
	conditioned	D638	2.50	5.50	11.60	17.00
Flexural Strength	dry	D790	34,000	27,000	37,700	42,500
	conditioned	D790	6,000	17,500	27,600	36,300
Flexural Modulus	dry	D790	3.80	11.25	16.00	22.00
	conditioned	D790	1.30	5.50	12.00	16.00
HDT @ 264 psi	°F	D648	320	480	545	545
Coefficient of Linear Thermal Expansion	D696	in/in/°F x 10	10		2	2
UL Flame Class 1/32"	UL94	-	V-0	-	V-0	V-0
Volume Resistivity	dry	IEC 250	10 ¹⁶	-	10 ¹⁵	10 ¹⁵
	conditioned	IEC 250	10	10	10	10
Surface Resistivity	dry	IEC 259	>10 ¹⁶		10 ¹⁶	10 ¹⁶
	conditioned	IEC 250	10 ¹⁴		10 ¹⁴	10 ¹⁴
Peak Temperature (1 min)	°F		>445	>480	>480	>480
Continuous Use Temperature (5000 hours)	°F		265	-	300	-

*All mechanical tests conducted at 73° unless otherwise noted.

Data from DSM Engineering Plastics.
For additional information call 800-333-4237.

PEEK™

PROPERTIES OF VICTREX® PEEK™ 150G & 450G



150G - Easy flow grade for injection molding of thin sections and complex parts

450G - General purpose grade for injection molding and extrusion.

Property	Test Method	Units	150G	450G
GENERAL PROPERTIES				
Relative Density: (Crystalline)	ASTM D 792	----	1.30	1.30
(Amorphous)	ASTM D 792	---	1.26	1.26
Typical Level of Crystallinity	----	%	30-35	30-35
Mold Shrinkage	----	%	1.000-1.80	1.00-1.80
Water Absorption: 24 hrs. @ 73°F	ASTM D 570	%	0.50	0.50
Equilibrium @ 73°F	ISO R26A	%	0.50	0.50
MECHANICAL PROPERTIES				
Tensile Strength: @ 73°F (break)	ASTM D 638 (5mm/min)	psi	13,500	13,500
@ 482°F (break)	ASTM D 638 (5mm/min)	psi	1,740	1,740
Elongation at Break @ 73°F	ASTM D 638 (5mm-min)	%	20	80
Elongation at Yield @ 73°F	ASTM D 638 (5mm-min)	%	4.90	4.90
Flexural Modulus: @ 73°F	ASTM D 790	psi	594,000	594,000
@ 248°F	ASTM D 790	psi	580,100	580,100
@ 482°F	ASTM D 790	psi	43,500	43,500
Flexural Strength: @ 73°F	ASTM D 790	psi	24,650	24,650
@ 248°F	ASTM D 790	psi	14,500	14,500
@ 482°F	ASTM D 790	psi	1,800	1,800
Izod Impact Strength @ 73°F	----	----	----	----
Notched 0.01 in radius, 0.14 in depth	----	----	1.12	1.57
Unnotched	ASTM D 256	ft.-lb./in.	----	No Break
THERMAL PROPERTIES				
Melt Point	DSC	°F	649	644
Glass Transition Temp., Tg (onset value)	DSC	°F	289	289
Melt Flow Index: 370°C/2.16 kg	ASTM D 1238	g/10 min.	27	----
400°C/5 kg			----	17
Coefficient of Thermal Expansion: <Tg	ASTM D 696	10 ⁻⁵ °F ⁻¹	2.60	2.60
<Tg	ASTM D 696	10 ⁻⁵ °F ⁻¹	6	6
Heat Deflection Temperature, 264 psi	ASTM D 648	°F	311	320
UL Continuous Use Temperature	UL746B	°F		
Mechanical			464	464
Electrical			500	500
ELECTRICAL PROPERTIES				
Dielectric Strength (50u film)	ASTM D 149	KV/cm	190	190
Dielectric Constant: 50Hz-10kHz, 0-300°F	ASTM D 150	----	3.20-3.30	3.20-3.30
50Hz, 392°F			4.50	4.50

Values quoted for properties of products are results of tests on representative samples and do not constitute a specification. Information contained in this publication (and otherwise supplied to users) is based on our general experience and is given in good faith, but we are unable to accept responsibility in respect to factors which are outside our knowledge or control. Freedom under patents. Copyright and registered designed cannot be assumed.

VICTREX® is a Registered Trademark of Victrex plc. PEEK™ is a Trademark of Victrex plc.
Data from Victrex USA Inc.

For additional information call Victrex at 1-800-VICTREX.

PEEK™**PROPERTIES OF VICTREX® PEEK™ 150GL30 & 450GL30**

150GL30 - Easy flow 30% glass fiber reinforced grade for injection molding

450GL30 - General purpose 30% glass fiber reinforced grade for injection molding and extrusion

Property	Test Method	Units	150GL30	450GL30
GENERAL PROPERTIES				
Relative Density: (Crystalline)	ASTM D 792	----	1.50	1.50
Typical Level of Crystallinity	----	%	30-35	30-35
Mold Shrinkage	----	%	0.5	0.5
Water Absorption: 24 hrs. @ 73°F	ASTM D 570	%	0.11	0.11
MECHANICAL PROPERTIES				
Tensile Strength: @ 73°F (break)	ASTM D 638 (5mm/min)	psi	25,800	22,600
@ 482°F (break)	ASTM D 638 (5mm/min)	psi	4,930	4,930
Elongation at Break @ 73°F	ASTM D 638 (5mm-min)	%	1.7	2.0
Flexural Modulus: @ 73°F	ASTM D 790	psi	1,450,000	1,450,000
@ 248°F	ASTM D 790	psi	1,334,000	1,334,000
@ 482°F	ASTM D 790	psi	43,500	43,500
Flexural Strength: @ 73°F	ASTM D 790	psi	33,785	33,785
@ 248°F	ASTM D 790	psi	25,375	25,375
@ 482°F	ASTM D 790	psi	10,150	10,150
Izod Impact Strength @ 73°F	ASTM D 256	ft.-lb./in.	----	----
Notched	----	----	1.6	1.8
Unnotched	----	----	15.0	13.6
THERMAL PROPERTIES				
Melt Point	DSC	°F	649	644
Glass Transition Temp., T _g (onset value)	DSC	°F	289	289
Melt Flow Index: 400°C/5 kg	ASTM D 1238	g/10 min.	16	3
Coefficient of Thermal Expansion:	ASTM D 696	10 ⁻⁵ °F ⁻¹	1.2	1.2
Heat Deflection Temperature, 264 psi	ASTM D 648	°F	600	600
UL Continuous Use Temperature	UL746B	°F		
Mechanical			464	464
Electrical			464	464
ELECTRICAL PROPERTIES				
Dielectric Strength (50u film)	ASTM D 149	KV/cm	175	175
Dielectric Constant: 50Hz-10kHz, 0-300°F	ASTM D 150	----	3.70	3.70

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Data from Victrex USA Inc.

For additional information call Victrex at 1-800-VICTREX.

PVDF Solef® 6008

Homopolymer

General information about SOLEF® PVDF:

SOLEF® PVDF is a fluorinated semi-crystalline thermoplastic which is obtained by polymerizing vinylidene fluoride. Important properties include excellent chemical resistance to most aggressive substances and solvents, excellent mechanical strength and toughness, high abrasion resistance, high temperature capabilities, excellent aging resistance, high purity, resistance to UV and nuclear radiation, excellent intrinsic fire resistance, resistance to weathering, low permeability to most gases and liquids, and easily melt-processed by standard methods of molding and extrusion.

Tensile properties are achieved with varying methods of sample fabrication. Information provided by Solvay Solexis, Inc.

Solvay
Advanced Polymers



www.solvaysolexis.com

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	Standards	Unit	Metric	English
Physical Properties				
Density	ISO 1183	-	1.78 g/cm ³	0.0643 lb/in ³
Water Absorption (24 h at 23°C)	ISO 62 (method 1)	%	< 0.04	< 0.04
Melt Flow Index	ASTM D1238			
	230°C, 5 kg	g/10 min	24	24
	230°C, 2.16 kg	g/10 min	8	8
Mechanical Properties				
Tensile				
Tensile stress at yield	MPa/psi	53 - 57	7685 - 8265	
Tensile stress at break	ASTM D638	MPa/psi	35 - 50	5075 - 7250
Elongation at yield	23°C, 50 mm/mn	%	5 - 10	5 - 10
Elongation at break	%	20 - 50	20 - 50	
Modulus	23°, 1 mm/min	MPa/psi	2500	362500
Flexion				
Maximum load	ASTM D790	MPa/psi	78	11310
Modulus	23°C, 2 mm/min	MPa/psi	2200	319000
Izod Impact, notched V 10 mm, at 23°C, 4 mm thick	ASTM D256	-	0.65 J/cm	1.22 ft-lb/in
Hardness, Shore D 2 mm thick	ASTM D2240	-	77	77
TABER Abrasion resistance	CS 10/1 kg	mg/1000 rev	5-10	5-10
Friction coefficient: static	ASTM D1894	-	0.2 - 0.4	0.2 - 0.4
dynamic			0.2 - 0.3	0.2 - 0.3
Thermal Properties				
Crystallinity by DSC				
Melting point	ASTM D3418	°C/°F	174	345
Heat of Fusion (80°C to end of melting)		-	62 J/g	26.7 BTU/lb
VICAT point (4 mm thick) load 1 kg	ISO 306	°C/°F	170	338
Deflection temperature (4 mm thick)				
at 0.46 MPa	ASTM D648	°C/°F	147	294
at 1.82 MPa	after annealing	°C/°F	112	234
Electrical Properties				
Surface resistivity	ASTM D 257/ DIN 53483			
Voltage < 1V, after 2 min - 500 V at 23 °C		ohm/square	≤ 1.10 ¹⁴	≤ 1.10 ¹⁴
Volume resistivity	ASTM D 257/ DIN 53483			
Intensity = 10 mA, after 2 min at 23 °C		ohm/cm	≤ 1.10 ¹⁴	≤ 1.10 ¹⁴
Thermal conductance at 23°C	ASTM C177	-	0.2 W/m.K	1.39 BTU-in/hr-ft ² -°F
Fire resistance				
UL-94 Flammability test		UL-94	Class	V-O V-O
Limiting Oxygen Index (sheet 3 mm thick)	ASTM D 2863	%	44	44

HALAR® ECTFE FLUOROPOLYMER

Halar ECTFE is a partially fluorinated semi-crystalline polymer offering a unique combination of mechanical properties, thermal and chemical resistance with an outstanding ease of processability.

Halar ECTFE, a copolymer of ethylene and chlorotrifluoroethylene, can bring advantages to the end user when compared to other fluoropolymers. It is a very versatile polymer, available in all forms to meet processing needs.

Halar offers excellent resistance to abrasion, harsh chemicals, and permeation.

Halar ECTFE is a high purity fluoropolymer with a very smooth surface, which accounts for its extensive use in the semiconductor industry. Halar meets the demands for fire-safe, non-fire propagating plastics.

TYPICAL PHYSICAL PROPERTIES - Halar 300 ECTFE Medium Viscosity - Extrusion

Typical Property	Test Method	US Unit	SI Unit
MECHANICAL PROPERTIES			
Tensile			
Tensile Yield Strength	ASTM D638 23°C/73°F 2in/min 50mm/min	4300 psi	30 MPa
Tensile Break Strength		7800 psi	54 MPa
Elongation at Yield		5 %	5 %
Elongation at Break		250%	250%
Tensile Modulus		240,000 psi	1655 MPa
ELECTRICAL PROPERTIES			
Dielectric Strength @ 23°C, 73°F @ 3.2 mm Thickness	ASTM D149	350 V/mil	14 kV/mm
Dielectric Constant, 23°C @10 ⁸ Hz	-	257	257
Volume Resistivity @23°C, 50% RH	ASTM D257	1.4 x 10 ¹⁶ ohm-in	5.5 x 10 ¹⁶ ohm.cm
THERMAL PROPERTIES			
Melting Point	DSC	°F 468	°C 242
Heat of Fusion		18 BTU/lb	42 J/g
DTUL, 66 psi (0.46 MPa)	ASTM D648	195 °F	90 °C
DTUL, 264 psi (1.82 MPa)	ASTM D648	150 °F	65 °C
Glass Transition Temperature	DMA	185 °F	85 °C
Brittleness Temperature	ASTM D746A	<-105 °F	<-76 °C

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Phenolic & Glass Epoxy Materials

These materials are exceptionally versatile because of their unusual combination of properties. All grades are light in weight (about half the weight of aluminum), dense, structurally strong, resistant to moisture and good electrical insulators. None will soften appreciably under the reapplication of heat.

GRADE XXX - PAPER PHENOLIC ROD

A paper base phenolic laminate with good mechanical properties, high dielectric strength, and good resistance to moisture. Grade XXX is recommended for most mechanical applications, for use at radio frequencies, and in high humidity applications.

GRADE CE - CANVAS PHENOLIC ROD

A cotton fabric base phenolic laminate. Grade CE is strong, tough, and has high impact strength. It machines readily and is excellent for a wide variety of mechanical applications such as gears, pulleys, sheaves, insulators, bushings, washers, and rollers.

GRADE LE - LINEN PHENOLIC ROD

A fine weave cotton fabric base phenolic laminate. Grade LE is low in moisture pick up and dissipation factor, and is excellent in all electrical properties. It can be machined easily and cleanly to very close tolerances, and is recommended for use where there is a need for good mechanical properties combined with excellent electrical characteristics.

GRADE G-10/FR4 - GLASS EPOXY ROD

A continuous woven glass fabric laminated with an epoxy resin. This grade is extremely high in mechanical strength, has low moisture absorption and dissipation factors, and has superior electrical characteristics which are exhibited over a wide range of temperatures and humidities. Grade G-10/FR4 is flame retardant and at 300° F retains 25% of its flexural strength while maintaining all of its electrical properties. This grade is recommended for applications where superior strength and excellent electrical properties are required over a wide range of temperatures.

SPECIFICATIONS	PAPER PHENOLIC XXX	CANVAS PHENOLIC CE	LINEN PHENOLIC LE	GLASS EPOXY G-10/FR4
Specific Gravity	1.38	1.37	1.34	1.85
Tensile Strength (psi)	13,000	10,000	13,000	38,000
Comp. Strength (psi)	35,000	36,000	36,000	66,000
Flexural Strength (psi)	22,000	17,000	18,000	60,000
Hardness, M Scale	101	100	100	115
Bond Strength (lbs)	1200	1900	1900	2300
Shear Strength (lbs)	12,800	14,000	13,500	21,500
Dissipation Factor 10 ⁶				
Cycles, Cond. A	.035	N/A	.065	.032
Dielectric Constant 10 ⁶				
Cycles, Cond. A	5.1	5.5	5.7	4.8
Electric Strength V/Mil				
Cond. A	700	550	625	800
Flammability Rating	94HB	94HB	94H8	94V-O
Max Oper. Temp °C	140	125	125	140
Coeff. Thermal Exp. in/in/°C x 10 ⁻⁵	1.5	2.0	1.8	1.0
Water Absorbion % - 24 Hrs.	.57	2.0	1.9	.10
Military/Fed Spec	Mil-I 24768/10 Type PBE	Mil-I 24768/14 Type FBG	Mil-I 24768/13 Type FBE	Mil-I 24768/27 Type GEE-F

All values given are average based on test samples. The performance characteristics attributed to the products described herein are based on assumptions of general and reasonable use. As results can not be predicted or guaranteed for any specific set of renditions, each user should make his own determination of these products suitability for their particular application.

ATLAS FIBRE COMPANY

For additional information call 1-800-323-1408 (In Illinios: 1-847-674-1234).

REXOLITE®

Rexolite® is a thermoset, rigid and translucent plastic produced by cross linking polystyrene with divinylbenzene. This material has outstanding dielectric properties, radiation resistance, rigidity and dimensional stability, is able to withstand high voltage and has excellent acoustic impedance close to water. Alkalies, alcohols, aliphatic hydrocarbons and mineral acids have no effect. Subzero properties are excellent maintaining a dielectric constant of 2.55 dissipation factor. At -270° C the dissipation factor is .00019. Rexolite is light weight at 15% less than Acrylic and less than half of TFE.

Typical Properties	REXOLITE 1422	REXOLITE 2200
ELECTRICAL PROPERTIES		
Dielectric constant at 1MHz - 500GHz	2.53	2.62
Typical dissipation factor at: 1MHz	.00012	.0004
Typical dissipation factor at: 10MHz	.00025	.0005
Typical dissipation factor at: 10GHz	.00066	.0014
Volume resistivity (Ohm-cm)	>10~16	5 x 10~13
Surface resistivity (Ohm)	>10~14	5 x 10~12
Dielectric strength - step by step (volts/Mil)	500	500
PHYSICAL PROPERTIES		
Specific gravity	1.05	1.11
Tensile Strength (psi)	9000	9500
Flexural Strength (psi)	11500	10500
Impact strength - Room temp. to -75°C (ft/lb./in. of notch)	0.3	0.75
Coefficient thermal expansion (1°C)	7.0 x 10~5	5.7 x 10~5
Thermal conductivity - Col/Sec/cm° C/cm	3.5 x 10~4	5.0 x 10~4
Recommended operating temp. range	-60° to +100°C	-75° to +100°C
Acoustic impedance - Velocity of sound	93 x 10~3/sec	----
CHEMICAL PROPERTIES		
Water Absorption	.05 Max	.10 Max
Alkalies (Sodium/Potassium Hydroxide)	No effect	No effect
Alkalies (Sodium/Potassium Hydroxide)	No effect	No effect
Alcohols (Methanol/Isopropanol)	No effect	No effect
Aliphatic Hydrocarbons (Pentane, Cyclohexane, n-Heptane, n-Hexane)	No effect	No effect
Aromatic Hydrocarbons (Benzene, Toluene, Xylene, Styrene)	Swells	Swells
Mineral Acids (Hydrochloric, Sulfuric, Nitric)	No effect	No effect
Chlorinated Hydrocarbons (Carbon Tetrachloride, Chloroform)	Swells	Swells
OPTICAL PROPERTIES		
Visible light 1" thick	87%	----
Refractive index 589	1.59	----
Refractive index 486	1.604	----
Refractive index 656	1.585	----

REXOLITE 1422: Thermoset cross-linked styrene copolymer. Combination of good physical and excellent electrical properties including low loss and stable dielectric constant makes this material suitable for use in microwave lenses as well as for precision components. *Note: Rexolite 1422 meets requirements of L-P-516A (Type E2) formerly MIL-P-77 (Type E-2).

REXOLITE 2200: Thermoset cross-linked styrene copolymer with glass mat reinforcement to provide greater temperature stability and strength. Highly suited for missile and other applications where extreme cold, thermal shock and mechanical stress are encountered. Used principally for printed circuit boards.

For additional information call 1-215-708-7731.



UDEL[®] POLYSULFONE

Udel polysulfones are tough, rigid, high-strength thermoplastics that are suitable for continuous use up to 300°F (149°C). The resins are resistant to oxidation and hydrolysis and withstand prolonged exposure to high temperatures and repeated sterilization. Udel polysulfones are highly resistant to mineral acids, alkali and salt solutions. Their resistance to detergents and hydrocarbon oils is good. These resins are also highly resistant to degradation by gamma or electron beam radiation. Electrical properties of Udel polysulfones are stable over a wide temperature range and after immersion in water exposure to high humidity.

	ASTM Test Method ⁽²⁾	TYPICAL VALUES ⁽¹⁾			
		U.S. Customary Units		SI Units	
		Value	Units	Value	Units
MECHANICAL PROPERTIES					
Tensile strength	D 638	10.2	kpsi	70.3	MPa
Tensile elongation at break	D 638	50-100	%	50-100	%
Tensile modulus	D 638	360	kpsi	2.48	GPa
Tensile impact	D 1822	200	ft-lb/in ²	420	kJ/m ²
Flexural strength	D 790	15.4	kpsi	106.2	MPa
Flexural modulus	D 790	390	kpsi	2.69	GPa
Izod impact strength Notched	D 256	1.3	ft-lb/in	69	J/m
THERMAL PROPERTIES					
Heat deflection temperature at 264 psi (1.82 MPa)	D 648	345	°F	174	°C
Coefficient of thermal expansion	D 696	31	ppm/°F	56	ppm/°C
ELECTRICAL PROPERTIES					
Dielectric strength	D 149	425	V/mil	17	kV/mm
Dielectric constant					
at 60 Hz	D 150	3.15		3.15	
at 1 kHz	D 150	3.14		3.14	
at 1 MHz	D 150	3.10		3.10	
Dissipation factor					
at 60 Hz	D 150	0.0011		0.0011	
at 1 kHz	D 150	0.0013		0.0013	
at 1 MHz	D 150	0.0050		0.0050	
Volume resistivity	D 257	5x10 ¹⁶	ohm-cm	5x10 ¹⁶	ohm-cm
GENERAL PROPERTIES					
Specific gravity	D 792	1.24		1.24	
Moisture absorption 24 hours	D 570	0.30	%	0.30	%
Melt flow rate at 650°F (343°C)	D 1238	7.0	g/10 min	7.0	g/10 min

⁽¹⁾ Actual properties of individual batches will vary within specification limits.

⁽²⁾ Test methods are ASTM unless otherwise noted.



For additional product information or assistance, please contact
BP Amoco at 1-800-621-4557(U.S. only) or 1-770-772-8200.

Vespel® Polyimide

Typical Properties	°F	Temp Method	ASTM Units	Grade SP-1 M*	DF*
MECHANICAL PROPERTIES					
Tensile Strength, Ultimate	73 500	D-1708 or E8†	psi	12,500 6,000	10,500 5,300
Elongation, Ultimate	73 500	D-1708 or E8†	%	7.5 6.0	7.5 7.0
Flexural Strength, Ultimate	73 500	D-790 500	psi	16,000 9,000	12,000 6,500
Flexural Modulus	73 500	D-790 500	10 ³ psi	450 250	360 210
Compressive Stress @ 10%	73	D-695	psi	19,300	16,300*
Compressive Modulus	73	D-695	10 ³	350	350*
Shear Strength	73	D-732	10 ³	13.0	----
Impact Strength, Izod, notched-	73	D-256	ft lb/in	0.8	----
Impact Strength, Izod, unnotched	73	D-256	ft lb/in	14	----
Wear & Friction Wear Rate††		----	----	----	
Friction Coefficient** PV-25,000				.29	.29
THERMAL PROPERTIES					
Coefficient of Linear Expansion	73-572 -80-73	E-228	10 ⁻⁶ in/in/°F	30 25	28 ----
Thermal Conductivity		104	BTU in hr ft ² °F	2.4	2.0*
Specific Heat			BTU/lb °F	0.27	----
Deformation under 2000 psi load	122	D-621	%	0.14	0.20
Deflection Temp. @ 264 psi		D-648	°F	~680	----
ELECTRICAL PROPERTIES					
Dielectric Constant @10 ² Hz	73	D-150		3.62	----
Dielectric Strength, Short time 80 mils thick	73	D-149	Volts/mil	560	----
Volume Resistivity	73	D-257	ohm-m	10 ¹⁴ -10 ¹⁵	----
OTHER PROPERTIES					
Water Absorption 24 hrs @ 73°F		D-570	%	.24	----
Equilibrium-50% RH				1.0-1.3	1.0-1.3
Specific Gravity		D-792		1.43	1.34
Hardness		D-785	Rockwell "E"	45-60	----

VESPEL parts have an outstanding continuous-use temperature range (up to 500°F (288°C) continuously, with short-term use to 900°F (482°)). It has excellent dimensional stability and, unlike most plastics, are non-flammable. Parts perform without melting or softening, have high resistance to creep, resist radiation more effectively than most other plastics and possess outstanding compressive strength. VESPEL parts exhibit ultra-low outgassing-even in high vacuums, will not soften or melt, and are chemically compatible with most fuels, solvents, lubricants, and hydraulic fluids.



For additional information call:
 Du Pont Engineering Polymers
 Newark, DE 19714-6100
 1-800-972-7252

†Machined tensile specimens made per D-1708 and direct-formed specimens made per figure 19 of E-8 (standard bar for powered metallurgy products); specimens tested by D-638

*Direct-formed (DF) properties marked with asterisk were measured parallel to the forming direction. All other direct-formed properties were measured perpendicular to the forming direction. Machined (M) properties are non-directional.

††Unlubricated in air (PV-25,000)

**Steady state, unlubricated in air.

PVC & CPVC

PVC (Polyvinyl Chloride)

PVC offers excellent corrosion and weather resistance, has a high strength-to-weight ratio and is a good electrical and thermal insulator. PVC may be used to temperatures of 140°F (60°C) and is self-extinguishing per UL flammability tests. PVC white and other colors are available.

Clear PVC

Clear PVC provides the reliable chemical resistance of standard PVC. In addition to exhibiting desirable physical properties and optimum transparency, this material complies with the provisions of Title 21 of the FDA Code of Federal Regulations as being safe for use in food-contact applications.

CPVC (Chlorinated Polyvinyl Chloride)

CPVC shares most of the features and properties of PVC. CPVC provides advantages in elevated temperature environments due to its high heat-distortion temperature. This enables the fabrication of end items or parts for use in applications with service temperatures up to 200°F. CPVC exhibits excellent fire resistance and chemical resistance.



Physical Properties	Value	Test Method
PVC		
Max. Service Temp.	140°F	----
Cell Classification	12454	ASTM D1784
Specific Gravity	1.38 ± 2 g/cu.cm @ 73°F	ASTM D792
Tensile Strength @ yield	7,300 psi @ 73°F	ASTM D638
Modulus of Elasticity	410,000 psi @ 73°F	ASTM D638
Flexural Modulus	420,000 psi @ 73°F	ASTM D790
Izod Impact	0.8 ft-lbs/inch notch @ 73°F	ASTM D256
Coefficient of Linear Expansion	2.9 x 10 ⁻⁵ in/in/°F	ASTM D696
Flammability	V-0	UL-94
Hardness, Shore D	80 ± 3	ASTM D2240
Clear PVC		
Max. Service Temp.	140°F	----
Cell Classification	12454	ASTM D1784
Specific Gravity	1.38 ± 2 g/cu.cm @ 73°F	ASTM D792
Tensile Strength @ yield	7,094 psi @ 73°F	ASTM D638
Modulus of Elasticity	435,000 psi @ 73°F	ASTM D638
Flexural Modulus	458,000 psi @ 73°F	ASTM D790
Izod Impact	0.76 ft-lbs/inch notch @ 73°F	ASTM D256
Coefficient of Linear Expansion	3.77 x 10 ⁻⁵ in/in/°F	ASTM D696
Flammability	V-0	UL-94
Hardness, Shore D	76 ± 3	ASTM D2240
CPVC		
Max. Service Temp.	200°F	----
Cell Classification	23437	ASTM D1784
Specific Gravity	1.55 ± 2 g/cu.cm @ 73°F	ASTM D792
Tensile Strength @ yield	8,100 psi @ 73°F	ASTM D638
Modulus of Elasticity	370,000 psi @ 73°F	ASTM D638
Flexural Modulus	350,000 psi @ 73°F	ASTM D790
Izod Impact	1.5 ft-lbs/inch notch @ 73°F	ASTM D256
Coefficient of Linear Expansion	3.4 x 10 ⁻⁵ in/in/°F	ASTM D696
Flammability	V-0, 5VB, 5VA	UL-94
Hardness, Rockwell	119	ASTM D2240

For additional information call 1-610-252-7355.

Fluoropolymer Spec Chart

Property Comparison of Various Fluoropolymers

Property	ASTM test	PTFE	PFA	FEP	ETFE	CTFE
PHYSICAL PROPERTIES						
Specific gravity	D792 D570/24 hrs 1/2"t	2.13-2.22	2.12-2.17	2.12-2.17	1.70-1.76	2.10-2.18
Water absorption (%)		<0.00	<0.03	<0.01	<0.1	<0.00
Mold shrinkage (cm/cm)		0.02 ~0.05	0.04	0.03-0.06	0.03-0.04	0.015-0.020
Contact angle (degree)	Angle to level	110	115	115	96	84
MECHANICAL PROPERTIES						
Tensile strength (kgf/cm ²)	D638/23°C	140-350	280-315	190-220	410-470	320-420
Elongation (%)	D638/23°C	200-400	280-300	250-330	420-440	80-250
Compression strength (kgf/cm ²)	D695/1% deformation, 25°C	50-60	50-60	50-60	109	90-120
Tensile modulus (kgf/cm ²)	D638/23°C	4,000	—	3,500	5,000-8,000	10,500-21,000
Hexural Modulus (kgf/cm ²)	D790/23°C	5,000-6,000	6,600-7,000	5,500-6,500	9,000-14,000	13,000-18,000
Impact strength (ft-lb/in)	D256/23°C Izod	3.0	—	No breakdown	No breakdown	2.5-2.7
Hardness (Shore)	Durometer	D50-D65	D60	D55	D75	D90
Deformation under load (%)	D621/100°C 70 kfg/cm ² , 24 hrs D621/25°C 140 kfg/cm ² , 24 hrs	5.0 7.0	2.4 2.7	5.0 3.0	5.4 2.3	2.6 0.2
Static friction coefficient	Coated steel surface	0.20	0.50	0.50	0.60	0.80

Typical properties values.

PTFE · PFA · FEP · ETFE · CTFE

Property Comparison of Various Fluoropolymers

Property	ASTM test	PTFE	PFA	FEP	ETFE	CTFE
THERMAL PROPERTIES						
Thermal conductivity (cal/sec/cm)	C177	6×10^{-4}	—	6×10^{-4}	5.7×10^{-4}	$4.7\text{--}5.3 \times 10^{-4}$
Coefficient of linear thermal expansion (1/°C)	D696/23~60°C	10×10^{-5}	12×10^{-5}	$8.3\text{--}10.5 \times 10^{-5}$	$5\text{--}9 \times 10^{-5}$	$4.5 \sim 7.0 \times 10^{-5}$
Melting point (°C)		327	302~310	270	260	210~212
Melt viscosity (coise)		$10^{-11}\text{--}10^{-13}$ (340~380°C)	$10^{-4}\text{--}10^{-5}$ (380°C)	$4 \times 10^{-4}\text{--}10^{-5}$ (380°C)	$10^{-4}\text{--}10^{-5}$ (300~330°C)	10^{-7} (23°C)
Maximum temp. for continuous use (°C/°F)		260/500	260/500	200/392	150/302	120/248
ELECTRICAL PROPERTIES						
Dielectric constant	D150/10 ³ Hz	2.1	2.1	2.1	2.6	2.3~2.7
	D150/10 ⁸ Hz	2.1	2.1	2.1	2.6	2.3~2.5
Dielectric dissipation factor	D150/10 ³ Hz	$<1 \times 10^{-5}$	1×10^{-5}	6×10^{-5}	8×10^{-4}	(2.3~2.7)
	D150/10 ⁸ Hz	2×10^{-5}	3×10^{-5}	5×10^{-5}	5×10^{-3}	$X10^{-2}$ 1×10^{-2}
Dielectric breakdown strength (V/ml)	D149/Short time, 1/8 in	480	500	500~600	400	500
Volume resistivity (ohm-cm)	D257	$>10^{-18}$	$>10^{-18}$	$>10^{-18}$	$>10^{-18}$	$>10^{-18}$
Chemical resistance Weatherability Combustibility (%)	D2863/Oxygen concentration index	Excellent > 95	Excellent > 95	Excellent > 95	Excellent > 95	Excellent > 95

Typical properties values.

For additional information contact:
INTERPLAST, INC.
 Burlington, NJ 08016
 1-800-220-1159
 www.interplastinc.com

GLASS REINFORCED

Vinyl Ester

Typical Properties	Metric	English	Standards
MECHANICAL PROPERTIES			
Hardness, Barcol	45	45	ASTM D2583
Tensile Strength, Ultimate	207 MPa	30000 psi	Lengthwise; ASTM D638
Tensile Strength, Ultimate	48.3 MPa	7000 psi	Crosswise; ASTM D638
Tensile Modulus	17.2 GPa	2500 ksi	Lengthwise; ASTM D638
Tensile Modulus	5.52 GPa	800 ksi	Crosswise; ASTM D638
Flexural Modulus	12.4 GPa	1800 ksi	Lengthwise; ASTM D790
Flexural Modulus	5.52 GPa	800 ksi	Crosswise; ASTM D790
Flexural Strength	68.9 MPa	10000 psi	Crosswise; ASTM D790
Flexural Strength	207 MPa	30000 psi	Lengthwise; ASTM D790
Compressive Strength	103 MPa	15000 psi	Crosswise; ASTM D635
Compressive Strength	207 MPa	30000 psi	Lengthwise; ASTM D635
Compressive Modulus	6.89 GPa	1000 ksi	Crosswise; ASTM D635
Compressive Modulus	17.2 GPa	2500 ksi	Lengthwise; ASTM D635
Shear Modulus	3.1 GPa	450 ksi	
Shear Strength	68.9 MPa	10000 psi	Punch Shear; ASTM D732
Shear Strength	31 MPa	4500 psi	Short Beam Shear; ASTM D2344
Izod Impact, Notched	13.3 J/cm	25 ft-lb/in	Lengthwise; ASTM D256
Izod Impact, Notched	2.14 J/cm	4 ft-lb/in	Crosswise; ASTM D256
ELECTRICAL PROPERTIES			
Dielectric Constant	5	5	60 Hz; Perpendicular to Laminate Face; ASTM D150
Dielectric Strength	7.87 kV/mm	200 V/mil	Perpendicular to Laminate Face; ASTM D149
Dielectric Strength	1.38 kV/mm	35 kV/in	Lengthwise; ASTM D149
Arc Resistance	120 sec	120 sec	Lengthwise; ASTM D495
THERMAL PROPERTIES			
CTE, linear 20°C		4.44 µin/in-°F	Lengthwise; ASTM D696
Flame Spread Index	Max 25	Max 25	Tunnel Test; ASTM E84
ADDITIONAL PROPERTIES			
Flammability	Nonburning		ASTM D635
Density	1.72 - 1.94 g/cc	0.062 - 0.07 lb/in³	ASTM D792
Water Absorption	Max 0.45 %	Max 0.45 %	24 hrs; ASTM

Some of the values displayed above may have been converted from their original units and/or rounded in order to display the information in a consistent format.

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