Celanese
The chemistry inside innovation™

FORTRON® PPS

POLYPHENYLENE SULFIDE (PPS)

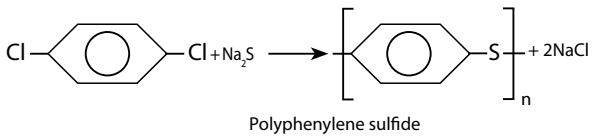
Short-Term Properties Guide

Fortron® PPS polyphenylene sulphide (PPS) is a high- performance thermoplastic with an excellent balance of properties. It is stiff, strong, hard and tough, and has outstanding heat, chemical and oxidative resistance. It retains these properties at temperatures well above 200°C and its continuous-use temperature extends to 240°C.

It absorbs little moisture and is both dimensionally stable and inherently flame retardant. It also has excellent electrical properties, is highly impermeable to most liquids and gases, has minimal creep even at elevated temperatures, and flows well in molding to fill long, thin and complex parts.

Fortron® PPS is a linear, partially aromatic plastic containing a phenylene ring and a sulfur atom, which are linked alternating in para-position **(Fig. 1)**. It is made from the relatively complex reaction of paradichlorobenzene and sodium sulfide in a special solvent. It is semicrystalline, with the linear structure providing relatively more toughness compared with branched PPS.

Fig. 1



Chemical structure of Fortron® PPS

Fortron® PPS is being employed in demanding applications in the automotive industry (air intake systems, pumps, valves, gaskets, components for exhaust gas recirculation systems), in the aircraft industry (composites for high-load parts in aircraft wings), and in electrical engineering/ electronics,(e.g., connectors and connector strips, coil forms, relay parts, switches, encapsulation of capacitors and transistors). Fortron® PPS is also used to produce complex functional parts for mechanical and precision engineering.

As a linear PPS, Fortron® PPS provides all the prerequisites for producing high-tenacity monofilaments, e.g., for high-efficiency filters. These are also used as drying belts in the papermaking, food and chemical industries and in environmental engineering. In addition, there are Fortron® PPS grades with the necessary approvals (FDA/BFR*) for contact with foods.

Fortron® PPS is supplied as a powder and as ready-to-use pellets. The addition of glass fibers and glass fiber-mineral blends results in a marked increase in stiffness and strength, as well as in the heat-deflection temperature. The range comprises extrusion and injection-molding grades which differ as to the type and amount of additive used, and in their melt viscosity.

The powder grades offer a wide range of applications for powder technology methods, e.g., as heat-resistant binders and as additions to PTFE compounds. The unreinforced pellet grades are mainly used for fiber production and for special applications in extrusion.

In addition, special grades for medical technology are available. Fortron® PPS MT® grades are optimized for applications in medical technology and are certified to conform to specific property and quality standards, and to comply with applicable regulatory requirements. All medical technology grades have passed a variety of biocompatibility testing by independent bodies. Fortron® PPS MT® grades have the regulatory certifications (Food and Drug Administration, European Union, BFR). In addition, Drug and Device Master Files have been listed with the U.S. FDA. For further information, please contact Celanese.

* FDA: Food and Drug Administration
BFR: Bundesinstitut f. Risikobewertung

Fortron® PPS grades

Unreinforced grades	Supply form	Description
0203B6, 0203P6	Flakes and pellets	Very low melt viscosity
0205B4, 0205P4	Flakes and pellets	Low melt viscosity
0205B4/20 µm	Fine powder	Low melt viscosity for use in powder-based technologies
0214B1, 0214P1, 0214C1	Flakes, pellets and crystallized pellets	Medium melt viscosity
0309B4	Flakes	Low melt viscosity
0320B0,0320P0, 0320C0	Flakes, pellets and crystallized pellets	High melt viscosity

Reinforced grades	Fillers Glass/Mineral	Process	Description
1115E7	15%	Injection molding	Very easy flow, low flash
1120L4	20%	Injection molding	Medium flow
1130L4	30%	Injection molding	Medium flow
1140L4	40%	Injection molding	Medium flow
1140L6	40%	Injection molding	Easier flow
ICE 504L	40 %	Injection molding	Medium flow
ICE 506L	40 %	Injection molding	Easier flow
4184L4	53%	Injection molding	Medium flow
4184L6	53%	Injection molding	Easier flow
4332L6	65%	Injection molding	Very easy flow
ICE 716L	65%	Injection molding	Very easy flow
4665B6	65%	Injection molding	Medium flow
6160B4	60%	Injection molding	Very easy flow
6165A4	65%	Injection molding	Medium flow
6165A6	65%	Injection molding	Easier flow
ICE 716A	65%	Injection molding	Medium flow
6850L6	50%	Injection molding	Low warp
1115L0	15%	Blow molding and extrusion	High melt viscosity
1131L4 ITT	30%	Injection molding	Lower flash
1140L0	40%	Extrusion	High melt viscosity
1141L4	40%	Injection molding	Lower flash
1342L4	40% low wear modified	Injection molding	Medium melt viscosity
6341L4	40% low wear modified	Injection molding	Medium melt viscosity
6345L4	30% low wear modified	Injection molding	Medium melt viscosity
6450A6	65% low wear modified	Injection molding	Medium melt viscosity
6162A7	60%	Injection molding	Very easy flow
CES51	20%	Injection molding	Low chlorine content
1200L1	Unfilled	Extrusion and injection molding	Higher toughness
FX32T4	Unfilled	Injection molding	Flexible PPS
FX4382T1	Unfilled	Extrusion	Impact modified
FX55T1	Unfilled	Blowmolding, coating	Flexible PPS
FX72T6	Unfilled	Injection molding	Flexible PPS
FX75T1	Unfilled	Blowmolding	Flexible PPS
SKX-390	Electrically modified	Injection molding	Thermally/ Electrically conducting

Physical properties of Fortron® PPS grades

		Unreinforced Grades					
	Test Method	0203B6, 0203P6	0205B4, 0205P4	0205B4/ 20µm	0214B1, 0214P1, 0214C1	0309B4	0320B0, 0320P0, 0320C0
Physical							
Density, g/cm³	ISO 1183	1.35	1.35	1.35	1.35	1.35	1.35
Mold shrinkage – parallel, 2 mm, p = 600 bar, %	ISO 294-4		1.2		1.2		1.2
Mold shrinkage – transverse, 2 mm, p = 600 bar, %	ISO 294-4		1.5		1.5		1.5
Water absorption (23°C-sat), %	ISO 62	0.02	0.02	0.02	0.02	0.02	0.02
Mechanical Properties							
Tensile strength (5 mm/min), MPa	ISO 527-2/1A	33	66	66	90	90	90
Tensile strain at break (5 mm/min), %	ISO 527-2/1A	1	2	2	3	8	8
Tensile modulus (1 mm/min), MPa	ISO 527-2/1A	4200	4000	4000	3800		3500
Flexural modulus (23°C), MPa	ISO 178	3900	3900	3900	3750	4200	4200
Flexural strength at break, MPa	ISO 178	135	130	130	125	145	145
Charpy impact strength at 23°C, KJ/m²	ISO 179/1eU						
Charpy impact strength at -30°C, KJ/m²	ISO 179/1eU						
Charpy notched impact strength at 23°C, KJ/m²	ISO 179/1eA						
Charpy notched impact strength at -30°C, KJ/m²	ISO 179/1eA						
Unnotched impact strength (Izod) at 23°C, KJ/m²	ISO 180/1U	8	30	30	45		82
Notched impact strength (Izod) at 23°C, KJ/m²	ISO 180/1A				3.5		2.6
Notched impact strength (Izod) at -30°C, KJ/m²	ISO 180/1A						2.5
Rockwell hardness, M-Scale	ISO 2039-2	100	95	95	95	90	90
Thermal Properties							
Melting temperature DSC (10°C/min), °C	ISO 11357-1,-2,-3	280	280	280	280	280	280
Glass transition temperature DSC (10°C/min), °C	ISO 11357-1,-2,-3	90	90	90	90	90	90
DTUL at 1.8 MPa, °C	ISO 75-1, -2	120	115	115	110	115	115
DTUL at 8.0 MPa, °C	ISO 75-1, -2	95	95	90	95	95	95
Coeff. of linear thermal expansion (parallel/transverse), x10⁻⁴/°C (T = -50 bis 90°C)	ISO 11359-2						
Coeff. of linear thermal expansion (parallel/transverse), x10⁻⁴/°C (T = 90 bis 250°C)	ISO 11359-2						
Limiting oxygen index (LOI), %	ISO 4589						
Flammability/thickness tested (h), mm	UL94						V-0/3
Electrical Properties							
Relative permittivity – 10KHz	IEC 60250			3.2	3.2	2.8	2.7
Dissipation factor – 10KHz, 10⁻⁴	IEC 60250						
Dissipation factor – 1MHz, 10⁻⁴	IEC 60250						11
Volume resistivity, Ω · m	IEC 60093	$1 \cdot 10^9$	$1 \cdot 10^9$	$1 \cdot 10^{11}$	$1 \cdot 10^9$	$1 \cdot 10^9$	$1 \cdot 10^9$
Surface resistivity, Ω	IEC 60093			$>10^{15}$			
Electric strength, KV/mm	IEC 60243-1	17	17		18	18	18
Comparative tracking index CTI	IEC 60112	100	100		125	125	125

These values are for these specific compositions only. Additives of any kind may alter some or all of these properties. The data listed here fall within the normal range of product properties but they should not be used to establish specification limits nor solely relied on as the basis of design.

Reinforced Grades									
1115E7	1120L4	1130L4	1140L4, 1140L6, ICE 504L, ICE 506L	4184L4, 4184L6	4332L6, ICE 716L	4665B6	6160B4	6165A4 6165A6 ICE 714A ICE 716A	6850L6
	1.48	1.58	1.65	1.8	1.95	2.03	1.9	1.95	1.8
	0.3	0.3	0.3	0.3		0.2	0.2	0.2	
	0.7	0.7	0.6	0.6		0.6	0.6	0.5	
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
80	120	170	195	165	160	110	145	130	125
1.2	1.5	1.9	1.9	1.4	1.1	1.2	1	1.2	1
7040		12000	14700	16600	21600	17300	17300	19000	18500
	8000	11000	14500	16200	22000	16000	16700	18800	16800
123	170	260	285	250	255	200	220	210	190
		34	53	29	20		27	20	16
			53					20	
		9	10	7	10		7	7	4
			10					7	
	35	30	34					20	
5.0	7		10	7			6	6	4
			10					6	
	100		100	100		100	100	100	96
280	280	280	280	280	280	280	280	280	280
90	90	90	90	90	90	90	90	90	90
	255		270	270	270	270	270	270	270
			215	215	220	215	220	215	215
			0.12/0.40	0.13/0.36	0.16/0.38			0.14/0.25	
			0.07/0.90	0.12/0.80			0.19/0.80	0.13/0.60	
			47					53	
	V-0/1.6	V-0/0.38	V-0/0.38	V-0/0.75	V-0/0.38	V-0/0.82	V-0/0.81	V-0/0.75	V-0/0.38
			4	4.7			4.9	5.4	
			2	8			5	10	10
			62	20			10	20	10
		$>10^{13}$	$>10^{13}$	$>10^{13}$	$>10^{15}$		$>10^{13}$	$>10^{15}$	$>10^{13}$
		$>10^{15}$	$>10^{15}$	$>10^{15}$	$>10^{15}$		$>10^{15}$	$>10^{15}$	$>10^{15}$
			28				26	25	
			125		125	250	175	175	

Physical properties of Fortron® grades continued....

	Test Method	Specialty Grades						
		1115L0	1131L4 ITT	1140L0	1141L4	1342L4	6341L4	6345L4
Physical								
Density, g/cm³	ISO 1183	1.44	1.56	1.65	1.65	1.69		1.66
Mold shrinkage – parallel, 2 mm, p = 600 bar, %	ISO 294-4							
Mold shrinkage – transverse, 2 mm, p = 600 bar, %	ISO 294-4							
Water absorption (23°C-sat), %	ISO 62	0.02	0.02		0.02	0.02		0.02
Mechanical Properties								
Tensile strength (5 mm/min), MPa	ISO 527-2/1A	121	165	185	195	165	206	125
Tensile strain at break (5 mm/min), %	ISO 527-2/1A	2.65	1.9	1.9	1.9	1.6	1.85	1.3
Tensile modulus (1 mm/min), MPa	ISO 527-2/1A	7700	12200		15500	14400	15300	11000
Flexural modulus (23°C), MPa	ISO 178	7500	12000	14000	14800	13700	13200	11200
Flexural strength at break, MPa	ISO 178	207	255	280	290	245	290	180
Charpy impact strength at 23°C, KJ/m²	ISO 179/1eU	32	42			44	59	
Charpy impact strength at -30°C, KJ/m²	ISO 179/1eU				53			
Charpy notched impact strength at 23°C, KJ/m²	ISO 179/1eA	5.9	8		12	8.5	13	
Charpy notched impact strength at -30°C, KJ/m²	ISO 179/1eA			10				
Unnotched impact strength (Izod) at 23°C, KJ/m²	ISO 180/1U							
Notched impact strength (Izod) at 23°C, KJ/m²	ISO 180/1A		8			8.5		9
Notched impact strength (Izod) at -30°C, KJ/m²	ISO 180/1A							
Rockwell hardness, M-Scale	ISO 2039-2							
Thermal Properties								
Melting temperature DSC (10°C/min), °C	ISO 11357-1,-2,-3							
Glass transition temperature DSC (10°C/min), °C	ISO 11357-1,-2,-3							
DTUL at 1.8 MPa, °C	ISO 75-1, -2	220	265		270	270	230	260
DTUL at 8.0 MPa, °C	ISO 75-1, -2	115	205	202	215	215		190
Coeff. of linear thermal expansion (parallel/transverse), x10⁻⁴/°C (T = -50 bis 90°C)	ISO 11359-2							
Coeff. of linear thermal expansion (parallel/transverse), x10⁻⁴/°C (T = 90 bis 250°C)	ISO 11359-2							
Limiting oxygen index (LOI), %	ISO 4589							
Flammability/thickness tested (h), mm	UL94		V-0/0.38	V-0/0.38	V-0/0.38	V-0/0.75		
Electrical Properties								
Relative permittivity – 10KHz	IEC 60250		3					
Dissipation factor – 10KHz, 10⁻⁴	IEC 60250							
Dissipation factor – 1MHz, 10⁻⁴	IEC 60250							
Volume resistivity, Ω · m	IEC 60093		>10¹³		>10¹⁵			
Surface resistivity, Ω	IEC 60093	>10¹⁵	>10¹⁵		>10¹⁵			
Electric strength, KV/mm	IEC 60243-1							
Comparative tracking index CTI	IEC 60112							

	6450A6	6162A7	CES51	1200L1	FX32T4	FX72T6	FX55T1	FX75T1	SKX-390
	1.58	1.92	1.48	1.35	1.25	1.18	1.25	1.20	1.6
			0.2	1.3	1.2	1.3	1.5	1.9	
			0.4	1.6	1.2	1.3	1.6	2.1	
	0.4	0.02		0.02					
	98	115	110	72	50	40	50	42	55
	1.5	1.3	2.5	21	20	20	40	80	0.5
	11050	15400	7200	4150	2300	1680	2300	1650	13000
	11500	14500	7000	4000	2300	1700	2300	1600	14500
	144	185	175	141					120
	18	16	50		-	-	-	-	11
	7	4.5	17	>200	12	10	60	70	1.5
							35	46	
	6	18							
		6.0			12	10			
		100							
			280	280	280	280	280	280	280
			90	90	90	90	90	90	90
	250	270	240	115	100	100	100	95	222
	193	215		95					186
		V-0/0.8							
				3.2					
					2	3	30	6	
				$1 \cdot 10^{12}$	$2 \cdot 10^{15}$	$2 \cdot 10^{15}$	$9 \cdot 10^{14}$	$2 \cdot 10^{15}$	$4 \cdot 10^{4}$
				$>10^{15}$					$5 \cdot 10^{2}$
		225							

Quality management

Meeting the quality requirements of our customers is a critical activity for Celanese. We constantly pursue and update the certifications needed for this purpose. Our quality management system has been certified to ISO 9000 standards since the early 1990s. In 2003, we built on this foundation by implementing the Global Celanese Integrated Management System (TIMS) for quality, environmental and risk management.

Important certifications include the following standards:

- ISO 9001
- ISO/TS 16949
- ISO 14001
- ISO/IEC 17025

Quality Management System Certifications under ISO 9001 and ISO/TS 16949 have now been achieved for all relevant production sites of Celanese worldwide.

All relevant production sites of Celanese achieved registration under ISO 14001, the Environmental Management System Standard.

The appropriate Celanese laboratories are accredited to meet general requirements according to ISO/IEC 17025:2005 for testing and calibration laboratories.

Our celanese.com website provides further information under “Company” > “Quality and Certifications.” The information includes the current details of business lines and facilities covered and PDF files of all certificates of registration.

Celanese

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