High Performance Films

DuPont FEP

fluorocarbon film

Description

DuPont FEP film is a transparent, thermoplastic film that can be heat sealed, thermoformed, vacuum formed, heat bonded, welded, metalized, laminated—combined with dozens of other materials, and can also be used as an excellent hot-melt adhesive.

This wide variety of fabrication possibilities combines with the following important properties to offer a unique balance of capabilities not available in any other plastic film.

Chemical Compatibility

- Teflon® is the most inert of all plastics.
- Complies with USFDA legislations for safe use with food
- DuPont FEP film is chemically inert and solvent-resistant to virtually all chemicals, except molten alkali metals, gaseous fluorine, and certain complex halogenated compounds such as chlorine trifluoride at elevated temperatures and pressures.
- Low permeability to liquids, gases, moisture, and organic vapors

Electrical Reliability

- Superior reliability and retention of properties over large areas of film
- High dielectric strength, over 6500 V/mil for 1 mil film (260 kV/mm for 0.025 mm film)
- No electrical tracking, non-wettable, and non-charring
- Very low power factor and dielectric constant, only slight change over wide ranges of temperature and frequency

Wide Thermal Range

- Continuous service temperature –240 to 205°C (–400 to 400°F)
- Melting range 250 to 280°C (500 to 540°F)
- Heat sealable

Mechanical Toughness

- Superior antistick and low frictional properties
- High resistance to impact and tearing
- Useful physical properties at cryogenic temperatures

Long Time Weatherability*

- Inert to outdoor exposure; no measurable change after 20 years in Florida
- High transmittance of ultraviolet and all but far infrared

Reliability

- DuPont FEP film contains no plasticizers or other foreign materials
- Conventional equipment and techniques can be used for processing: basic composition and properties will not be influenced
- Rigid quality control by DuPont ensures uniform gauge, void-free film

The convenience of Teflon® in easy-to-use film facilitates the design and fabrication of this low-friction thermoplastic for all sorts of high-performance jobs. It is transparent and can be *heat sealed, thermoformed, welded,* and *heat bonded.*

*Type C film not recommended for outdoor use

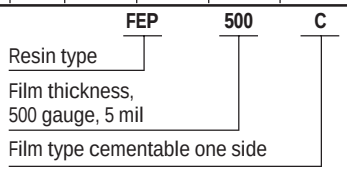
Superior antistick properties make it an ideal release film for many applications. A *cementable* type with an invisible surface treatment is available for bonding to none or both sides with adhesives.

This versatility is augmented by the superior properties of a true melt-processible fluorocarbon and by the wide choice of product dimensions available from DuPont.

Table 1
Types and Gauges of DuPont FEP Fluorocarbon Film

Gauge	**50**	**100**	**200**	**300**	**500**	**750**	**1000**	**1500**	**2000**	**3000**	**6000**	**9000**	**12500**	**19000**
Thickness, mil	0.5	1	2	3	5	7.5	10	15	20	30	60	90	125	190
Thickness, µm	12.5	25	50	75	125	190	250	375	500	750	1500	2300	3125	4750
Approximate area factor, ft^2/lb	180	90	45	30	18	12	9	6.0	4.5	3	1.5	1	0.72	0.47
Approximate area factor, m^2/kg	36	18	9	6	4	2.5	2	1.2	1	0.6	0.3	0.2	0.14	0.09
Availability														
Type A—FEP, general-purpose	X	X	X	X	X	X	X	—	X	—	—	—	—	—
Type C—FEP, one side cementable	X	X	X	X	X	—	—	—	—	—	—	—	—	—
Type C-20—FEP, both sides cementable	X	X	X	—	X	—	—	—	—	—	—	—	—	—
Type L—FEP, high stress crack resistance in extreme environments	—	—	—	—	X	—	X	X	X	X	X	X	X	X

Note: Each roll of DuPont film is clearly identified as to resin type, film thickness, and film type.



Property Values of DuPont FEP Fluorocarbon Film

Property	Test Method	Typical Value[a]	
		SI Units	English Units
Mechanical			
Tensile Strength at Break	ASTM D-882	21 N/mm^2	3000 psi
Elongation at Break	ASTM D-882	300%	
Yield Point	ASTM D-882	12 MPa	1700 psi
Elastic Modulus	ASTM D-882	480 MPa	70 000 psi
Impact Strength	DuPont pneumatic impact tester	7.7×10^3 J/m	144 ft-lb/in
Folding Endurance (MIT)	ASTM D-2176	10,000 cycles	
Tear Strength–Initial (Graves)	ASTM D-1004	2.65 N	270 g force
Tear Strength–Propagating (Elmendorf)	ASTM D-1922	1.23 N	125 g
Bursting Strength (Mullen)	ASTM D-774	76 kPa	11 psi
Thermal			
Melt Point	ASTM D-3418 (DTA)	260–280°C	500–536°F
Zero Strength Temperature	[b]	255°C	490°F
Coefficient of Thermal Conductivity	Cenco-Fitch	0.195 W/m·K	1.35 Btu·in/h·ft^2·°F
Specific Heat	—	1172 J/kg·K	0.28 Btu/lb·°F
Heat Deflection Temperature at 0.46 N/mm^2 (66 psi) at 1.82 N/mm^2 (264 psi)	ASTM D-648 Tensile Bars	 70°C 51°C	 158°F 124°F
Dimensional Stability	30 min at 150°C (302°F)	MD = 0.72% expansion TD = 2.2% shrinkage	
Flammability Classification[c]	ANSI/UL 94	VTM-0	
Oxygen Index	ASTM D-2863	95%	

(continued on next page)

[a]For 0.025 mm (1 mil) film at 25°C (77°F) unless otherwise specified.

[b]Temperature at which a film supports a load of 0.14 N/mm^2 (20 psi) for 5 sec.

[c]This classification rating is not intended to reflect hazards presented by this or any other material under actual fire conditions.

[d]Samples melted in arc did not track.

[e]To convert to cm^3/100 in^2·24 h·atm, multiply by 0.0645.

Property Values of DuPont FEP Fluorocarbon Film (continued)

Property	Test Method	Typical Value[a] SI Units	Typical Value[a] English Units
Electrical			
Dielectric Strength, short-time in air at 23°C (73°F), 6.35 mm (1/4 in) diameter electrode, 0.79 mm (1/32 in) radius 60 Hz, 500 V/s rate of rise:	ASTM D-149 Method A		
0.025 mm (1 mil) film		260 kV/mm	6500 V/mil
5 mm (20 mil) film		70 kV/mm	1800 V/mil
Dielectric Constant, 25°C (77°F), 100 Hz to 1 MHz	ASTM D-150	2.0	
–40 to 225°C (–40 to 437°F), 1000 Hz		2.02–1.93	
Dissipation Factor, 25°C (77°F), 100 Hz to 1 MHz	ASTM D-150	0.0002–0.0007	
–40 to 225°C (–40 to 437°F), 1000 Hz		0.0002	
–40 to 240°C (–40 to 464°F), 1 MHz		0.0005	
Volume Resistivity, –40 to 240°C (–40 to 464°F)	ASTM D-257	$>1 \times 10^{18}$ μm·cm	
Surface Resistivity, –40 to 240°C (–40 to 464°C)	ASTM D-257	$>1 \times 10^{16}$ Ω/sq	
Surface Arc Resistance	ASTM D-495	>165 sec[d]	
Insulation Resistance at 100°C (212°F)	Based upon 0.2 MF wound capacitor sections, using single layer, Teflon® 50A Film	350,000 Mohm·μF	
at 150°C (302°F)		250,000 Mohm·μF	
at 200°C (392°F)		65,000 Mohm·μF	

(continued on next page)

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Property Values of DuPont FEP Fluorocarbon Film (continued)

Property	Test Method	Typical Value[a] SI Units	English Units
Chemical			
Moisture Absorption	—	<0.01%	
Weatherability	Continuous exposure in Florida	No adverse effects after 20 yr	
Permeability, Gas:	ASTM D-1434	$cm^3/m^2 \cdot 24\ h \cdot atm$[e]	
Carbon Dioxide		25.9×10^3	
Hydrogen		34.1×10^3	
Nitrogen		5.0×10^3	
Oxygen		11.6×10^3	
Permeability, Vapors:	ASTM E-96	$g/m^2 \cdot d$	$g/100\ in^2 \cdot 24\ h$
Acetic Acid		6.3	0.41
Acetone		14.7	0.95
Benzene		9.9	0.64
Carbon Tetrachloride		4.8	0.31
Ethyl Alcohol		10.7	0.69
Hexane		8.7	0.56
Water		7.0	0.40
Teflon® is chemically inert and solvent-resistant to virtually all chemicals except molten alkali metals, gaseous fluorine, and certain complex halogenated compounds such as chlorine trifluoride at elevated temperatures and pressures.			
Miscellaneous			
Density	ASTM D-1505	2150 kg/m^3	134 lb/ft^3
Coefficient of Friction Kinetic (Film-to-Steel)	ASTM D-1894	0.1–0.3	
Refractive Index	ASTM D-542	1.341–1.347	
Solar Transmission	ASTM E-424	96%	

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