

DUPONT™ TEDLAR® POLYVINYL FLUORIDE (PVF) FILMS

GENERAL PROPERTIES

SUMMARY OF PROPERTIES

GENERAL

Unique properties of DuPont™ Tedlar® polyvinyl fluoride (PVF) biaxially oriented film include excellent resistance to weathering, outstanding mechanical properties, and inertness towards a wide variety of chemicals, solvents, and staining agents. General properties are summarized in Table 1.

Tedlar® is available in clear or pigmented forms in Type 2, 3 and 5 and clear Type 4. These range from a high tensile strength, high flex variety (Type 2) to a high elongation, high tear modification (Type 4). A special Type 1 film is also available, which has controlled shrinkage.

Tedlar® contains no plasticizers; hence, it has good aging properties and remains tough and flexible over a broad temperature range.

Type 5 Tedlar® film has been developed for applications where deep draw and texturing are required. The proven characteristics of cleanability, durability, color stability, and color reproducibility are retained with this film type. The film can also be printed on and laminated to a variety of substrates.

Type 5 Tedlar® applications exist where formed parts require surface protection, such as aircraft cabin interior surfaces containing complex curves. The high degree of formability of this film is obtained by extending both the elongation and ultimate tensile strength over a very broad range. Ultimate elongation is almost twice that of standard Type 3 film.

Tedlar® is supplied with different surface characteristics. “A” (one side adherable) and “B” (two side adherable) surfaces are used with adhesives for bonding to a wide variety of substrates. These surfaces have excellent compatibility with many classes of adhesives, including acrylics, polyesters, epoxies, rubbers and pressure-sensitive mastics.

The “S” surface has excellent anti-stick properties for use as a mold release agent for epoxies, phenolics, rubbers, and other plastic resins. It is especially suited as a release sheet for printed circuit board and composite part fabrication.

Outdoor weathering tests on Tedlar® pigmented films have been conducted for more than 20 years. The weather resistance, inertness and strength characteristics suggest broad use as a finish for metals, hardboards, felts, or plastics in architectural, decorative, or industrial uses.

Properties of interest to the electrical industry include excellent hydrolytic stability and high dielectric strength and dielectric constant.

Tedlar® PVF film is generally available in thicknesses from 1.0 to 2.0 mil.



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TABLE 1
GENERAL PROPERTIES OF DUPONT™ TEDLAR® PVF FILMS

	Property	Typical Value	Test Method	Test Condition
PHYSICAL	Bursting Strength	29–65 psi	Mullen, ASTM D-774	22°C (72°F)
	Coefficient of Friction (Film/Metal)	0.18–0.21	ASTM D-1894	22°C (72°F)
	Density	1.37–1.72 g/cc	ASTM D-1505	22°C (72°F)
	Impact Strength	10–20 in lb/mil	Spencer ASTM D-3420	22°C (72°F)
	Moisture Absorption	<0.5% for most types	Water immersion	22°C (72°F)
	Water Vapor Transmission	9–57 g/m ² d	ASTM E-96	39.5°C, 80% RH
	Refractive Index	1.46 n _D	ASTM D-542 Abbe Refractometer	30°C (86°F)
	Tear Strength			
	Propagated	15–60 g/mil	Elmendorf-ASTM D-1922	22°C (72°F)
	Initial (Graves)	260–500 g/mil	ASTM D-1004	22°C (72°F)
	Tensile Modulus	300–380 x 10 ³ psi	ASTM D-882	22°C (72°F)
	Ultimate Tensile Strength	8–16 x 10 ³ psi	ASTM D-882	22°C (72°F)
	Ultimate Elongation	90–250%	ASTM D-882	22°C (72°F)
Ultimate Yield	6000–4900 psi	ASTM D-882	22°C (72°F)	
CHEMICAL	Chemical Resistance	No visible effect	1 yr immersion in Acids Bases Solvents 2 hr immersion in Acids Bases Solvents Soil Burial—5 yr	25°C (77°F) 25°C (77°F) 25°C (77°F) Boiling Boiling Boiling —
	Gas Permeability	Strength and appearance not affected		
	Carbon Dioxide	11.1 cc/(100in ²)(24 hr)(atm)(mil)	ASTM D-1434	24°C (75°F)
	Helium	150 cc/(100in ²)(24 hr)(atm)(mil)	ASTM D-1434	24°C (75°F)
	Hydrogen	58.1 cc/(100in ²)(24 hr)(atm)(mil)	ASTM D-1434	24°C (75°F)
	Nitrogen	0.25 cc/(100in ²)(24 hr)(atm)(mil)	ASTM D-1434	24°C (75°F)
	Oxygen	3.2 cc/(100in ²)(24 hr)(atm)(mil)	ASTM D-3985	24°C (75°F)
	Vapor Permeability (at part. press. or vapor at given temp.)			
	Acetic Acid	45 g/(100m ²)(hr)(mil)	ASTM E-96, modified	24°C (75°F)
	Acetone	10,000 g/(100m ²)(hr)(mil)	ASTM E-96, modified	24°C (75°F)
	Benzene	90 g/(100m ²)(hr)(mil)	ASTM E-96, modified	24°C (75°F)
	Carbon Tetrachloride	50 g/(100m ²)(hr)(mil)	ASTM E-96, modified	24°C (75°F)
	Ethyl Acetate	1000 g/(100m ²)(hr)(mil)	ASTM E-96, modified	24°C (75°F)
	Ethyl Alcohol	35 g/(100m ²)(hr)(mil)	ASTM E-96, modified	24°C (75°F)
	Hexane	55 g/(100m ²)(hr)(mil)	ASTM E-96, modified	24°C (75°F)
Weatherability	Excellent	Florida exposure	Facing South at 45° to horizontal	
THERMAL	Aging	3000 hr	Circulating Air Oven	150°C (302°F)
	Heat Sealability	Some varieties—see Heat Sealability Technical Bulletin		
	Linear Coefficient of Expansion	2.8 x 10 ⁻⁵ in/in/°F		
	Shrinkage (Type 2) MD and TD	4% at 130°C (266°F)	Air Oven, 30 min	
	(Type 3) TD only	4% at 170°C (338°F)	Air Oven, 30 min	
(Type 4) TD only	2.5% at 170°C (338°F)	Air Oven, 30 min		
Temperature Range				
Continuous Use	-72 to 107°C (-98 to 225°F)			
Short Cycles or Release (1-2 hr)	up to 175°C (350°F)			
Zero Strength	260 to 300°C (500 to 570°F)	Hot Bar		
ELECTRICAL	Corona Endurance (hr)	TTR20SG4 TWH20BS3 2.5 6.2	ASTM Suggested T method	60 cPs, 1000 V/mil
	Dielectric Constant	8.5 11.0	ASTM D-150	1 Kc at 22°C (72°F)
	Dielectric Strength (kV/mil)	3.4 3.5	ASTM D-150	60 cPs, kV/mil
	Dissipation Factor (%)	1.6 1.4	ASTM D-150	1000 cPs, 22°C (72°F)
		2.7 1.7	ASTM D-150	1000 cPs, 70°C (158°F)
		4.2 3.4	ASTM D-150	10 Kc, 22°C (72°F)
		2.1 1.6	ASTM D-150	10 Kc, 70°C (158°F)
	Volume Resistivity (ohm.cm)	4 x 10 ¹³ 7 x 10 ¹⁴ 2 x 10 ¹⁰ 1.5 x 10 ¹¹	ASTM D-257 ASTM D-257	22°C (72°F) 100°C (212°F)

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PHYSICAL AND THERMAL PROPERTIES

DuPont™ Tedlar® PVF film is strong, flexible and fatigue-resistant. Its resistance to failure by flexing is outstanding. Tedlar® performs well in temperatures ranging from approximately -72 to 107°C (-98 to 225°F), with intermittent short-term peaking up to 204°C (400°F). Some physical and thermal properties of representative Tedlar® PVF films are summarized in **Table 2** for the fabrication of specialty release laminates.

TABLE 2
TYPICAL PROPERTIES OF DUPONT™ TEDLAR® PVF FILMS

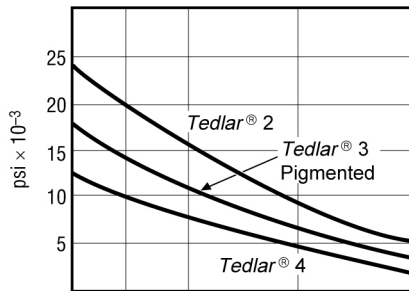
Description	Units	1.0 mil UV Screening Transparent Type 3	1.0 mil Transparent Type 3	1.5 mil Low Gloss White Type 3	2.0 mil Satin White Type 3	Test Method
Designation	Units	TUT10BG3	TTR10BG3	TWH15BL3	TWH20BS3	Test Method
Physical Properties						
Area Factor	ft ² /lb m ² /kg	140 28.7	140 28.7	87 17.8	60 12.3	—
Ultimate Tensile Strength, Min. (MD)	kpsi MPa	13 90	13 90	8 55	9 62	ASTM D-882
Tensile Modulus (MD)	kpsi MPa	310 2,138	301 2,075	305 2,103	385 2,655	ASTM D-882
Ultimate Elongation, Min. (MD)	%	95	95	90	110	ASTM D-882
Bursting Strength	psi/mil MPa/m	56.9 15.446	48.1 13,057	28.9 7,845	>34.7 >9,420	Mullen ASTM-D-774
Tear Strength— Propagating (MD)	g/mil kN/m	17.1 6.6	19.2 7.4	23.1 8.9	46.2 17.8	Elmendorf ASTM-D-1922
Tear Strength— Propagating (TD)	g/mil kN/m	19.0 7.3	17.4 6.7	18.6 7.2	26.6 10.3	Elmendorf ASTM-D-1922
Tear Strength— Initial (MD)	g/mil kN/m	373 144	423 163	333 129	506 195	Graves ASTM-D-1004
Tear Strength— Initial (TD)	g/mil kN/m	435 168	478 185	264 102	377 146	Graves ASTM-D-1004
Impact Strength	in lb/mil kJ/m	20.3 90.3	17.5 77.9	9.6 42.7	16.1 71.6	Spencer ASTM D-3420
Specific Gravity	—	1.37	1.39	1.46	1.71	ASTM D-1505
Coefficient of Friction Film/Metal	—	0.21	0.21	0.18	0.18	ASTM D-1894
Coefficient of Abrasion	—	—	—	385	—	ASTM D-658
Moisture Absorption	%	<0.5	<0.5	<0.5	<0.5	ASTM D-570
Moisture Vapor Transmission	g/m ² d	30.1	30.2	24.5	16.9	ASTM E-96
Thermal Properties						
Aging in Air	Hours to embrittlement	3,000	3,000	3,000	3,000	Oven at 300°F
Heat Sealability	—	—	Some varieties—see Heat Sealability Technical Bulletin			
Linear Coefficient of Expansion (MD)	m/mK	7.8 x 10 ⁻⁵	8.8 x 10 ⁻⁵	6.7 x 10 ⁻⁵	9.7 x 10 ⁻⁵	D-696 (at 50–70°C)
Linear Coefficient of Expansion (TD)	m/mK	8.1 x 10 ⁻⁵	7.1 x 10 ⁻⁵	8.0 x 10 ⁻⁵	8.3 x 10 ⁻⁵	D-696 (at 50–70°C)
Shrinkage, Max. (TD)	% at °C	6 at 150	5 at 170	5 at 170	5 at 170	ASTM D-1204
Specific Heat	cal/g °C kJ/kg K	0.42 1.76	0.24 1.01	0.26 1.09	0.25 1.05	DuPont 990 Thermal Analyzer

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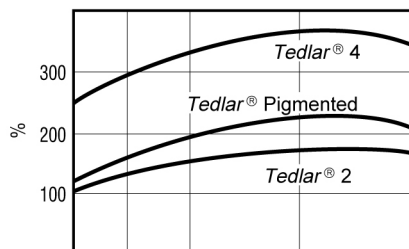
GENERAL PROPERTIES

PHYSICAL PROPERTIES VS. TEMPERATURE

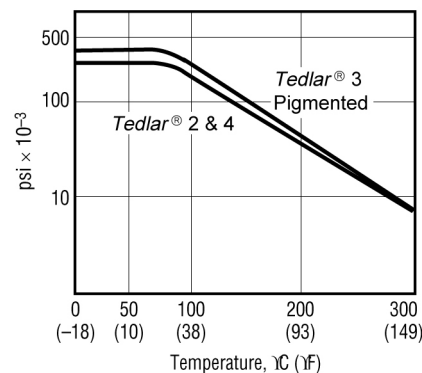
Tensile Strength



Elongation



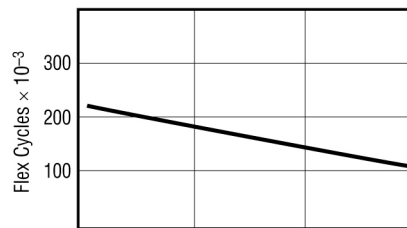
Tensile Modulus



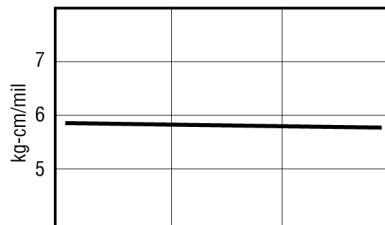
HYDROLYTIC STABILITY

DuPont™ Tedlar® PVF film has excellent resistance to hydrolysis. Strength, yield stress, and elongation are not measurably affected after 60 hr exposure in 85 psig steam 163°C (325°F).

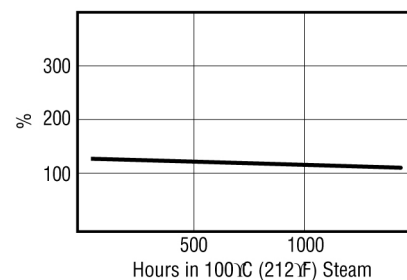
Flex Life



Impact Strength*

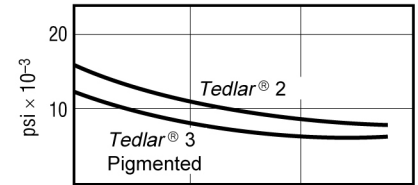


Elongation

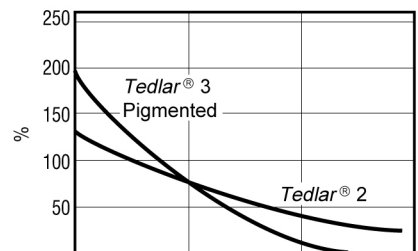


THERMAL AGING

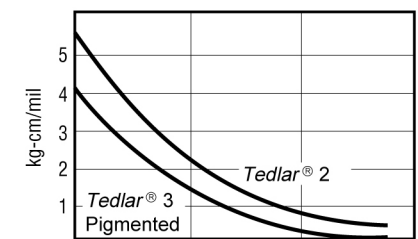
Tensile Strength



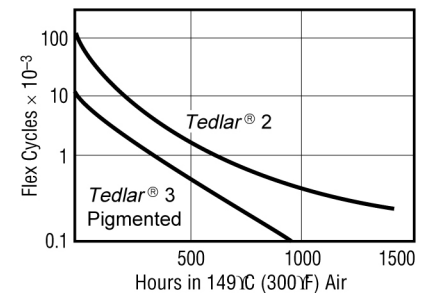
Elongation



Impact Strength*



Flex Life



For more information on DuPont™ Tedlar® PVF films, please visit our websites:

www.tedlar.com

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