General Properties of Tedlar® PVF Films

DuPont™ Tedlar® polyvinyl fluoride film provides durable, long-lasting protection to surfaces in a variety of applications including transportation, aerospace, building and construction, graphics and signage, and photovoltaics. Tedlar® film is strong and flexible, has good resistance to chemicals and aggressive cleaning agents, and has outstanding resistance to weathering outdoors including excellent hydrolytic and UV stability.

Summary of Properties

Tedlar® PVF films are made from polyvinyl fluoride homopolymer, with structure shown in Figure 1. The polymer is highly inert, making it resistant to a variety of acids, bases, solvents, staining agents, and hydrolysis. It does not absorb visible or UV light substantially and is highly resistant to photolytic degradation. It is strong, flexible, and fatigue-resistant. The polymer is made without plasticizers and therefore does not promote growth of mold and mildew and maintains its properties well over long periods of time in thermal aging. It has high dielectric strength and dielectric constant.

Outdoor weathering has been performed on Tedlar® for more than 20 years, delivering as-installed aesthetics on a variety of metal, hardboard, fabric, and plastic substrates. Pigmented film erodes gradually without any unsightly chalking. It is resistant to a large variety of cleaners and solvents, making it easy to remove environmental contamination or graffiti.

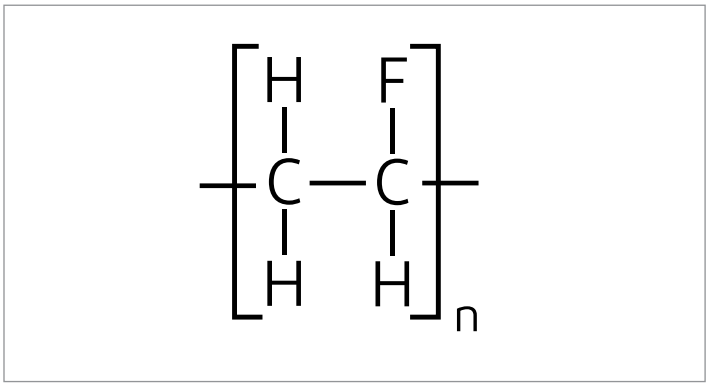

Figure 1: The structure of polyvinyl fluoride

Tedlar® PVF films are available in a variety of colors, including fully transparent and UV-blocking transparent. They are available as biaxially oriented or unoriented cast film. Typical thicknesses range from 13 to 100 µm. The surface of the film is available in the pristine state or treated to promote adhesion. In the pristine state, the film will not adhere to other materials making an excellent film for release market. In the treated state, it can be bonded using a wide variety of adhesives.

The product codes for Tedlar® films are typically an 8-digit alphanumeric code. The individual characters describe the key product parameters (color, thickness, surface treatment, gloss, and orientation), documented in Table 1. For example, TWH15BL3 is a nominal 38 µm (1.5 mil) thick, low gloss, type 3 white film with both sides treated to promote adhesion. TTR10AH8 is a nominal 25 µm (1 mil) thick, high gloss, unoriented transparent film with one side treated to promote adhesion.

The amount of orientation is a key parameter for the film. The mechanical properties of the different types of films are summarized in Figure 2. Type 3 oriented films are most commonly used due the good balance of strength, elongation, and reasonably low shrinkage. Type 1 films are typically used when high shrinkage is needed for processing the film, for example, with a high shrinkage substrate. Type 5 oriented films have lower strength and higher elongation and are used in applications where deep draw and texturing are required. Unoriented Type 8 films have the lowest strength and highest elongation and is used in applications with the highest depth of draw. Type 8 films can also be made with the highest gloss and distinctness of image for aesthetic applications.

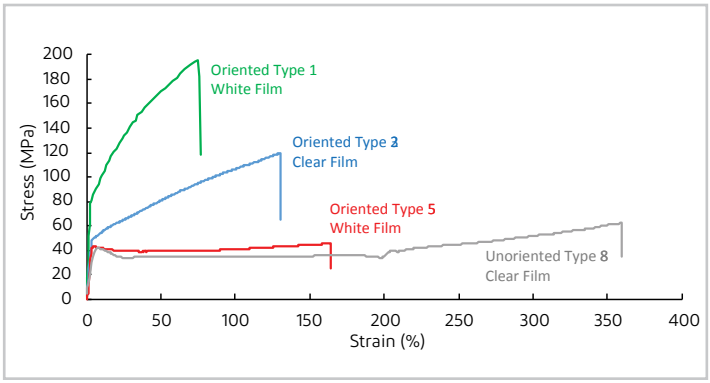

Figure 2: Typical mechanical properties of Tedlar® films.

For oriented films, the gloss is controlled by additives in the film. As a result, the appearance is well maintained through processing and elongation of the film. For cast films, the gloss is typically imparted by casting on a textured web or embossing into the film during downstream processing.

Without the surface treatment, the fluoropolymer film will not adhere well to adhesives, making it useful for release applications. The surface treatment creates chemically active sites that can bond to a wide variety of adhesive chemistries.

Tedlar® PVF film performs well in temperatures ranging from approximately -70 to 105 °C. It can be used with intermittent short-term peaking up to 204 °C in processing or for release applications. Some typical properties of Tedlar® films are shown in Table 2.

Table 1: Product code description for Tedlar®

Product Code Position	Description
1	• 'T' for pure Tedlar® film • 'C' for film that is pre-coated with adhesive on one side.
2-3	Two letters indicate the color of the film. For example, WH is white, TR is transparent, etc.
4-5	Two numbers indicate the nominal thickness of the films in ten-thousandths of an inch. A film with '10' is a nominal 1.0 mil (25 µm) film.
6	Surface treatment • 'B' for both sides treated • 'A' for one side treated • 'S' for non-treated, pristine surface.
7	Gloss level • 'H' for high gloss • 'G' for glossy • 'S' for satin • M' for medium gloss • 'L' for low gloss
8	The orientation of the film. Types 1-5 are oriented film, and Type 8 is unoriented film. Lower numbers indicate higher orientation.

Table 2: Typical properties of Tedlar®

Property	Typical Value	Test Method
Physical Properties		
Density of Clear Film (TTR10BG3)	1.4 g/cc	ASTM D1505
Density of White Film (TWH20BS3)	1.7 g/cc	ASTM D1505
Moisture Absorption	< 0.5% for most types	Water Immersion
Water Vapor Permeability at 39 °C, 100% RH (TWH15BL3)	1.3 g· mm/m² • d	ASTM F1249
Refractive Index of Clear Films	1.46	ASTM D542
Optical Transmission of Clear Films	93 %	ASTM D1003
Coefficient of Friction, Film on Metal	0.18 – 0.21	ASTM D1894
Shore Hardness	D60 – D70	ASTM D2240
Impact Strength	45 – 89 J/mm	ASTM D3420
Tear Strength (Propagated)	5.9 – 24 N/mm	ASTM D1922
Tear Strength (Initial)	100 – 200 N/mm	ASTM D1004
Falling Sand Erosion, on PET Backing	4 – 8 L/µm	ASTM D968
Tensile Modulus	2.1 – 2.6 GPa	ASTM D882
Yield Strength	34 – 41 MPa	ASTM D882
Ultimate Strength	55 – 110 MPa	ASTM D882
Strain at Break	90 – 250 %	ASTM D882
Thermal Properties		
Coefficient of Thermal Expansion	5 – 10 x 10^{-5} m/m· K	ASTM D696
Specific Heat Capacity	1.0-1.1 kJ/kg*K	ASTM E1269
Lower Glass Transition Temperature	-15 to -20 °C	Various
Upper Glass Transition Temperature	40 to 50 °C	Various
Peak Melting Temperature	190 to 210 °C	ASTM E1269
Relative Thermal Index – Electrical Strength	140 °C	UL 746B
Relative Thermal Index – Mechanical Impact	120 °C	UL 746B
Relative Thermal Index – Mechanical Strength	125 °C	UL 746B
Temperature Range (continuous use)	-70 to 105 °C	

Table 2: Typical properties of Tedlar® *(continued)*

Property	Typical Value		Test Method
Electrical Properties			
	TTR20SG4	**TWH20BS3**	
Corona Endurance, 60 Hz at 1 kV/mil (hrs)	2.5	6.2	ASTM D2275
Dielectric Constant, 1 kHz at 22 °C	8.5	11.0	ASTM D150
Dielectric Strength, 60 Hz (kV/mm)	130	140	ASTM D150
Dissipation Factor, 1kHz at 22 °C (%)	1.6	1.4	ASTM D150
Dissipation Factor, 1kHz at 70 °C (%)	2.7	1.7	ASTM D150
Dissipation Factor, 10kHz at 22 °C (%)	4.2	3.4	ASTM D150
Dissipation Factor, 10kHz at 70 °C (%)	2.1	1.6	ASTM D150
Volume Resistivity at 22 °C (Ω cm)	4×10^{13}	7×10^{13}	ASTM D257
Volume Resistivity at 100 °C (Ω cm)	2×10^{10}	1.5×10^{11}	ASTM D257
Hot-Wire Ignition	0 PLC		UL 746A
High Amp Arc Ignition	0 PLC		UL 746A
Comparative Tracking Index	0 PLC		UL 746
Chemical Properties			
Acid Resistance	Excellent		Immersion
Base Resistance	Excellent		Immersion
Solvent Resistance	Excellent		Immersion
Stain Resistance	Excellent		Stain Resistance Test
Cleanability	Excellent		Cleaning Test
Weathering	Excellent		South Florida Exposure

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