DUPONT®

Tedlar®

polyvinyl fluoride film

Overlaminating Films for Transit Vehicle Interiors

This guide illustrates the functionality of *Tedlar*® polyvinyl fluoride (PVF) overlaminating films for transit vehicle interiors. It is intended to assist designers, specifiers, builders, and property owners in the selection of *Tedlar*® coated substrates for their specific applications.

Tedlar® PVF overlaminate films can be used to protect a wide variety of materials used in the interior of transit vehicles, including aluminum, melamine (e.g., Formica*), thermoplastic, and fiberglass reinforced polyester (FRP) surfaces and structures. Unique properties of *Tedlar*® include excellent resistance to weathering, outstanding mechanical properties, and inertness to a wide variety of chemicals, solvents, and staining agents. A surface protected with *Tedlar*® is easy to clean with standard cleaning agents and solvents. In addition, the inertness of the *Tedlar*® overlaminate may improve the flame and smoke performance of the final construction.

There are two main classes of *Tedlar*® films: extruded films and cast films. Extruded films are biaxially oriented, whereas the cast films are essentially unoriented. As shown in **Table 1**, oriented films have high tensile strength and moderate elongation.

Tedlar® SP is the designation for the unoriented film. Due to its high elongation and moderate yield stress, *Tedlar*® SP can be subjected to high levels of forming without significant recovery stresses. This makes *Tedlar*® SP compatible with the wide range of forming techniques and materials used to produce components for the transit industry.

In addition, the *Tedlar*® SP specifically designed for overlaminating transit interior components takes advantage of the unique multilayering capability of the *Tedlar*® SP process. This multilayer feature allows us to build pigments and UV screening packages into a base layer covered with a clear top

Table 1
Typical Properties of *Tedlar*® PVF Overlaminating Film

Property	Test Method	Film Type: Oriented, Transparent, Glossy	Film Type: Unoriented, Opaque White, Low Gloss
Nominal Thickness	ASTM D374-79	1 mil	2 mil
Unit Weight, g/m²	ASTM D4321-83	35	67
Ultimate Tensile MD; TD, kpsi	ASTM D882-83	15; 20	4.5; 4.5
Ultimate Elongation MD; TD, %	ASTM D882-3	140; 130	200; 170
Shrinkage MD; TD, % at 170°C (338°F)	ASTM D1204-84	8; 4	2; 2
Taber Abrasion, g (CS-10, 1 kg, 1000 cycles)	ASTM 1044-82	0.054	0.018
Specular Gloss, 60°	ASTM 2457-70	65	10
Total Haze	ASTM D1003-61	6	N/A

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*Formica-brand decorative laminate is manufactured by the Formica Corporation, Cincinnati, OH.

layer that is virtually all PVF polymer. This pure PVF surface provides exceptional stain and coining resistance. These multilayer films also show improved abrasion resistance versus standard *Tedlar*® film as measured by Taber abrasion. *Tedlar*® SP is available in a wide range of gloss levels.

Cleanability

Cleaning the interior of a transit vehicle is a balance between choosing a solvent that is aggressive enough to remove a wide range of staining agents, yet mild enough that it doesn't permanently damage the substrate being cleaned. Surfaces coated with *Tedlar*® PVF can make this selection easier. The inert polyvinyl fluoride surface resists stains and protects the surface from the most aggressive cleaning material. This protection not only makes vehicles look cleaner longer, but it can eliminate multiple cleaners and lower maintenance costs. **Table 2** shows a wide selection of staining agents and the removal method that completely removes the stain in accordance with ASTM D2299.

We recognize that there are a wide range of "graffiti removers" available on the market today. While they may be very effective in removing stains, many of these cleaners permanently damage the surface being cleaned. Surfaces overlaminated with *Tedlar*® will resist attack from these "graffiti removers," allowing for easy and safe cleaning.

Table 2
Stain Removal Test—*Tedlar*® SP PVF Film on Thermoplastic Sheet

	Stain Removal Agent					
Staining Agent*	**Dry Cloth**	**Wet Cloth**	**Mild Detergent**	**Full-Strength Lestoil****	**91% Isopropanol**	**AGR-15 Graffiti Remover*****
Ketchup	S	R				
Mustard	S	S	S	R		
Chocolate Syrup	R					
Coffee	S	R				
Tea	S	R				
Grape Juice	S	R				
Red Wine	S	R				
Lipstick	S	R				
Mercurochrome	S	R				
Black Crayon	S	S	S	R		
Felt Marker	U	U	S	S	S	R
Spray Paint	U	U	U	S	S	R

*Stained specimens were baked in an oven at 50°C (122°F) for 16 hr prior to cleaning.
**Manufactured by Procter & Gamble Company, Cincinnati, OH 45201.
***Manufactured by BAF Industries, Santa Ana, CA 92704; contains petroleum distillates.
U = Stain unaffected
S = Some shadow remained after cleaning
R = Stain completely removed

Fire and Smoke

Tedlar® PVF film has long been recognized as a safe material for the interior of transportation vehicles. For example, *Tedlar*® film is used extensively on interior walls and ceilings of commercial aircraft. Components containing *Tedlar*® as a protective film have performed well against current industry test protocols. **Table 3** shows some representative test data for *Tedlar*® film and panels containing *Tedlar*® overlaminates.

Tedlar® film was tested according to Article 15, Part 1120 of the New York State Uniform Fire Protection and Building Code in March 1995. Registration with the New York Department of State was under way at the time this bulletin was published.

Application Methods

Tedlar® PVF overlaminating film can be applied through a number of sheet-lamination, press, and in-mold decorating processes. Laminated sheet stock can be formed using standard forming processes. Adhesives are available to promote adhesion to a wide range of substrates.

Table 3
Smoke and Flame Characteristics of *Tedlar*® PVF Film and Typical Construction Containing *Tedlar*® PVF

Test Method	*Tedlar*® 1.0 mil Clear	*Tedlar*® 2.0 mil White	1-mil *Tedlar*® Coated Melamine Laminate	1-mil *Tedlar*® over PVC/Acrylic	4-mil *Tedlar*® on Aluminum	2-mil *Tedlar*®/ Nomex® Composite
MVSS 302	Pass	Pass				
UL 94	94HB					
Flame Spread ASTM E-162						
F(s)	11.8		1.2			
Q	1		4.1			
I(s)	12		5			
Smoke Density ASTM E-662						
Nonflaming D(s) 90 sec/4 min	1/1		0.2/63			
Flaming D(s) 90 sec/4 min	1/2		12/20	27/142		20/26
ASTM E-84 (Steiner Tunnel)						
Flame Spread					20	
Smoke Density D(s)					45	
OSU Rate of Heat Release FAR 25.853C						
2 min Total (Kw-min/m^2)						31
Peak (Kw-min/m^2)						31
Smoke Density D(s) at 4 min						48

For more information on *Tedlar*® PVF films:

DuPont *Tedlar*®
P.O. Box 88
Sheridan Drive and River Road
Buffalo, NY 14207-0088

(800) 255-8386

FAX: (716) 879-4545

Europe

DuPont de Nemours Int'l SA
2, chemin du Pavillon
P.O. Box 50
CH-1218 Le Grand-Saconnex
Geneva, Switzerland
(022) 7175111

Canada

DuPont Canada, Inc.
P.O. Box 2200, Streetsville
7070 Mississauga Road
Mississauga, Ontario, Canada
L5M 2H3
(905) 821-5193

Japan

DuPont Kabushiki Kaisha
Tedlar® PVF Film
4th Floor Chiyoda Honsha Bldg.
5-18, Sarugaku-cho 1-chome
Chiyoda-Ku, Tokyo 101 Japan
(011) 81-3-5281-3428

Asia Pacific

DuPont Asia Pacific Ltd.
TST P.O. Box 98851
1122 New World Office Bldg.
(East Wing)
Salisbury Road, TST
Kowloon, Hong Kong
(011) 852-3-734-5345

DuPont Singapore PTE Ltd.
1 Maritime Square #07-01
World Trade Center
Singapore 099253
65-273-2244

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