Properties of Tedlar®

July 2020
What is Tedlar®?

Tedlar® is a DuPont registered trademark for a highly versatile polyvinyl fluoride (PVF) film that provides a long-lasting finish to a wide variety of surfaces exposed to harsh environments; while its inert, non-stick properties make it an excellent release film.
Why Tedlar®?

**Interiors**
- Cleanability
- Chemical/solvent resistant
- Stain/graffiti resistant
- Excellent flame & smoke rating
- Long term protection
- Endurable style
- Excellent formability
- Does not support the growth of Mold and Mildew
- Heat sealable
- Ink & print receptive

**Exteriors**
- UV & weather stability
- Chemical resistance
- Stain/dirt resistant
- Temperature stability
- Colour stability
- Range of surface gloss
- Low toxicity & volatiles
- Bendability
- Low gas/vapor permeability
- Sound transmitting

Does not support the growth of Mold and Mildew
Tedlar® PVF Applications

Proven applications, globally, for over 50 years

Aerospace & Transportation

Building & Construction

Healthcare

Industrial

Composite Release

Photovoltaics

Signage
Overview of Properties

• UV Durability & Weathering
• Processing and Corrosion Resistance
• Chemical Resistance
• Cleanability & Stain Resistance
• Mold, Mildew, and Bacteria
• Flame and Smoke
• Elongation and Formability
UV Durability – 15-year Exposure Test in Florida

Tedlar® Florida Weathering Data: Color Change

- TBB15BL3-Beyberry
- TBN15BL3
- TCC15BL3-Charcoal
- TCM15BL3-Island Ivory
- TDS15BL3-Doeskin
- TGN15BL3-Surf Green
- TGO15BL3-Geogian Gold
- TGY15BL3-Granite Gray

Tedlar® PVF Film shows minimal color changes after repeated exposure to UV
Tedlar® Clear Films Have Superior Performance

Our clear films have superior performance in properties critical for architectural protection (TAP15BM3) and graphics (TGP10BG3).

- Higher retention of UV protection
  - Prevent color change and loss of adhesion
- Better retention of elongation
  - Crack and peel resistance of clear topcoat
### Accelerated Weathering of TGP10BG3 on Colored Prints

<table>
<thead>
<tr>
<th>Time in QUV-UVA</th>
<th>Bare Digital Print</th>
<th>TGP10BG3</th>
<th>PVDF Clear Film</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial</strong></td>
<td><img src="image1" alt="Initial Bare Digital Print" /></td>
<td><img src="image2" alt="Initial TGP10BG3" /></td>
<td><img src="image3" alt="Initial PVDF Clear Film" /></td>
</tr>
<tr>
<td><strong>3000 hr</strong></td>
<td><img src="image4" alt="3000 hr Bare Digital Print" /></td>
<td><img src="image5" alt="3000 hr TGP10BG3" /></td>
<td><img src="image6" alt="3000 hr PVDF Clear Film" /></td>
</tr>
<tr>
<td><strong>6000 hr</strong></td>
<td><img src="image7" alt="6000 hr Bare Digital Print" /></td>
<td><img src="image8" alt="6000 hr TGP10BG3" /></td>
<td><img src="image9" alt="6000 hr PVDF Clear Film" /></td>
</tr>
<tr>
<td><strong>8000 hr</strong></td>
<td><img src="image10" alt="8000 hr Bare Digital Print" /></td>
<td><img src="image11" alt="8000 hr TGP10BG3" /></td>
<td><img src="image12" alt="8000 hr PVDF Clear Film" /></td>
</tr>
</tbody>
</table>
Superior Processability & Corrosion Resistance

Tedlar® PVF Film vs. PVDF Coating:

Salt spray 2,000hrs (0T bending)

0T bending test (magnification by 40 times)

Tedlar® PVF film has excellent formability, allowing for Zero T-Bend without microcracking even after applying a salt spray. Polyvinylidene fluoride (PVDF) coatings crack when trying to achieve extreme bends, but the elongation properties of Tedlar(R) film allow for unlimited designs.
Chemical Resistance

**Tedlar® PVF Film vs. PVDF Coating:**

**Acid and Alkali Immersion Test**

<table>
<thead>
<tr>
<th>PVDF Coated Steel</th>
<th>Tedlar® Film Laminate</th>
</tr>
</thead>
<tbody>
<tr>
<td>5% HCl, 168 hrs</td>
<td>5% HCl, 1,000 hrs</td>
</tr>
<tr>
<td>10% NaOH, 336 hrs</td>
<td>10% NaOH, 1,000 hrs</td>
</tr>
</tbody>
</table>

- **Not immersed area**
- **Immersed area**

**Bubbling on the surface**

- **Notimmersed area**
- **Immersed area**

- **Only** Tedlar® PVF film provides superior protection to steel!
Tedlar® PVF film has excellent solvent resistance allowing it to withstand detergents and commercial grade cleaners.
Chemical Resistance
Tedlar® PVF Film vs. Vinyl: Acetone Test

Tedlar™ Wallcovering

Standard Vinyl Type II Wallcovering

- Acetone was applied to both wallcoverings in equal amounts and let to rest for ~4 hours.
- The acetone evaporated from the Tedlar™ Wallcovering while remaining on the standard.
- A dry cloth was then used to wipe the surfaces clean.
- The coloring from the standard wallcovering was removed in the area where the acetone sat.
- The Tedlar™ Wallcovering remained unharmed.
Cleanability of Permanent Marker
Tedlar® PVF Film vs. Competitive: Solvent Cleaners

**Before Cleaning**

Tedlar® TGP10BG3

Competitor PVDF

Premium Cast PVC

**After Cleaning**

Tedlar® PVF film did not show any ghosting and was not damaged during cleaning.

M = MEK
T = Toluene
A = Acetone
X = Xylene

Ghosting

Ghosting and Film damage
Cleanability of Permanent Marker
Tedlar® PVF Film vs. Competitive: Mustard Test

Tedlar™ Wallcovering

- Yellow mustard was applied to both wallcoverings and allowed to sit for ~4 hours.
- A dry cloth was then used to wipe the surface.
- The standard wallcovering was cleaned with a wet cloth and then bleach was applied, but did not come clean.

Standard Type II Vinyl Wallcovering

- The Tedlar™ Wallcovering only needed to be cleaned with a wet cloth.
Cleanability of Permanent Marker
Tedlar® PVF Film vs. Competitive: Iodine Test

- Iodine was applied in equal amounts to both wallcoverings and allowed to rest for 4 hours.
- During that time the iodine seeped into the surface of the standard wallcovering.
- The iodine on the Tedlar™ Wallcovering stayed on the surface.
- A dry cloth was used to wipe the Tedlar™ Wallcovering clean.
- Not even bleach could clean the standard wallcovering.
Staining Agents and Required Cleaning Methods

All products were applied to Tedlar® PVF film and allowed to set for 24 hours. Utilizing the following methods, all products were successfully removed from the Tedlar® film.

<table>
<thead>
<tr>
<th>Dry Cloth Cleaning</th>
<th>Wet Cloth Cleaning</th>
<th>Detergent</th>
<th>Solvent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid Solutions*</td>
<td>Coffee</td>
<td>Ketchup</td>
<td>Ballpoint pen</td>
</tr>
<tr>
<td>Acetone</td>
<td>Grape juice</td>
<td>Black crayons</td>
<td>Spray paint</td>
</tr>
<tr>
<td>Butanone</td>
<td>Mustard sauce</td>
<td>Brown shoe polish</td>
<td></td>
</tr>
<tr>
<td>Ethyl alcohol</td>
<td>Red wine</td>
<td>Lipstick</td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td>Tea stains</td>
<td>White board marker</td>
<td></td>
</tr>
<tr>
<td>Glycol</td>
<td>Worcestershire sauce</td>
<td>Oily pen</td>
<td></td>
</tr>
<tr>
<td>Toluene</td>
<td>Chocolate syrup</td>
<td>Asphalt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brake fluid</td>
<td>Mercurochrome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Iodine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sodium hydroxide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mold, Mildew and Bacteria

Tedlar® PVM Film does not support the growth of mold, mildew. This is because Tedlar® does not have any nutrients to support growth and is chemically inert.

- Mold and mildew testing: ASTM G21: Standard Practice For Determining Resistance Of Synthetic Polymeric Materials To Fungi
- Tedlar™ Wallcoverings are also UL Greenguard Gold certified and verified UL mold & mildew resistant.
# Mold Resistance

Tedlar® PVF surface shows mold-resistant Grade 1 after material aging.

<table>
<thead>
<tr>
<th></th>
<th>Tedlar® PVF</th>
<th>EVOH</th>
<th>PP</th>
<th>PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before aging</td>
<td>Grade 1</td>
<td>Grade 0</td>
<td>Grade 0</td>
<td>Grade 4</td>
</tr>
<tr>
<td>After aging</td>
<td>Grade 1</td>
<td>Grade 2</td>
<td>Grade 4</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Aging condition: 85°C/85% humidity, 1000 hours

**Definition of Grades:**
- Grade 0 = No Growth
- Grade 1 = Taces of growth (less than 10%)
- Grade 2 = Light growth (10 to 30%)
- Grade 3 = Medium growth (30 to 60%)
- Grade 4 = Heavy growth (60% to complete coverage)
Flame and Smoke

- Tedlar® PVF film has long been recognized as a safe material for the interior of transportation vehicles due to its low flammability and smoke development.
- Components containing Tedlar® as a protective film have performed well against current industry test protocols.
- Certified by FAA and EASA with excellent Fire Resistance
- Class A Rating for Interiors: ASTM E84 Class A and NFPA 286

Tedlar® film is used extensively on cabin interior walls and ceilings of commercial aircraft.
Elongation and Formability

Tedlar® PVF film is strong, flexible and fatigue-resistant. Its resistance to failure by flexing is outstanding. Since the surface aesthetics are imparted by the film formulation, the aesthetics do not change when stretching the film for most film types.

Typical stress versus strain curves for a variety of film orientations. Lower orientation causes lower strength but greater formability.