

# 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  |
|----------------------------------|--|--|--|---|
| <b>PHYSICAL</b>                  | 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 <sup>2</sup> d                                | ASTM E-96  | 39.5°C, 80% RH  |
|                                  | Refractive Index   | 1.46 n <sub>D</sub>                                    | 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 <sup>3</sup> psi                          | ASTM D-882   | 22°C (72°F)   |
|                                  | Ultimate Tensile Strength                                    | 8–16 x 10 <sup>3</sup> 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)   |
| <b>CHEMICAL</b>                  | Chemical Resistance  | No visible effect                                      | 1 yr immersion in<br>Acids<br>Bases<br>Solvents<br>2 hr immersion in<br>Acids<br>Bases<br>Solvents<br>Soil Burial—5 yr | 25°C (77°F)<br>25°C (77°F)<br>25°C (77°F)<br>Boiling<br>Boiling<br>Boiling<br>— |
|                                  | Gas Permeability   | Strength and appearance not affected                   |  |   |
|                                  | Carbon Dioxide   | 11.1 cc/(100in <sup>2</sup> )(24 hr)(atm)(mil)         | ASTM D-1434  | 24°C (75°F)   |
|                                  | Helium   | 150 cc/(100in <sup>2</sup> )(24 hr)(atm)(mil)          | ASTM D-1434  | 24°C (75°F)   |
|                                  | Hydrogen   | 58.1 cc/(100in <sup>2</sup> )(24 hr)(atm)(mil)         | ASTM D-1434  | 24°C (75°F)   |
|                                  | Nitrogen   | 0.25 cc/(100in <sup>2</sup> )(24 hr)(atm)(mil)         | ASTM D-1434  | 24°C (75°F)   |
|                                  | Oxygen   | 3.2 cc/(100in <sup>2</sup> )(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 <sup>2</sup> )(hr)(mil)                     | ASTM E-96, modified  | 24°C (75°F)   |
|                                  | Acetone  | 10,000 g/(100m <sup>2</sup> )(hr)(mil)                 | ASTM E-96, modified  | 24°C (75°F)   |
|                                  | Benzene  | 90 g/(100m <sup>2</sup> )(hr)(mil)                     | ASTM E-96, modified  | 24°C (75°F)   |
|                                  | Carbon Tetrachloride   | 50 g/(100m <sup>2</sup> )(hr)(mil)                     | ASTM E-96, modified  | 24°C (75°F)   |
|                                  | Ethyl Acetate  | 1000 g/(100m <sup>2</sup> )(hr)(mil)                   | ASTM E-96, modified  | 24°C (75°F)   |
|                                  | Ethyl Alcohol  | 35 g/(100m <sup>2</sup> )(hr)(mil)                     | ASTM E-96, modified  | 24°C (75°F)   |
|                                  | Hexane   | 55 g/(100m <sup>2</sup> )(hr)(mil)                     | ASTM E-96, modified  | 24°C (75°F)   |
|                                  | Weatherability   | Excellent  | Florida exposure   | Facing South at 45° to horizontal   |
|                                  | <b>THERMAL</b>   | Aging  | 3000 hr  | Circulating Air Oven  |
| Heat Sealability                 |  | Some varieties—see Heat Sealability Technical Bulletin |  |   |
| Linear Coefficient of Expansion  |  | 2.8 x 10 <sup>-5</sup> 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  |  |   |
| <b>ELECTRICAL</b>                | Corona Endurance (hr)  | TTR20SG4    TWH20BS3<br>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 <sup>13</sup> 7 x 10 <sup>14</sup>              | ASTM D-257   | 22°C (72°F)   |
|                                  |  | 2 x 10 <sup>10</sup> 1.5 x 10 <sup>11</sup>            | ASTM D-257   | 100°C (212°F)   |

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## GENERAL PROPERTIES

### 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**

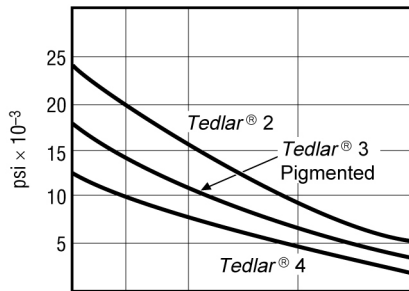
| Description                             | Units                                     | 1.0 mil<br>UV Screening<br>Transparent<br>Type 3 | 1.0 mil<br>Transparent<br>Type 3                       | 1.5 mil<br>Low Gloss<br>White<br>Type 3 | 2.0 mil<br>Satin White<br>Type 3 | Test Method                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

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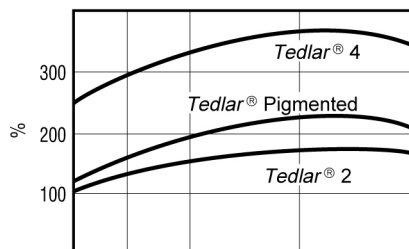
## GENERAL PROPERTIES

### PHYSICAL PROPERTIES VS. TEMPERATURE

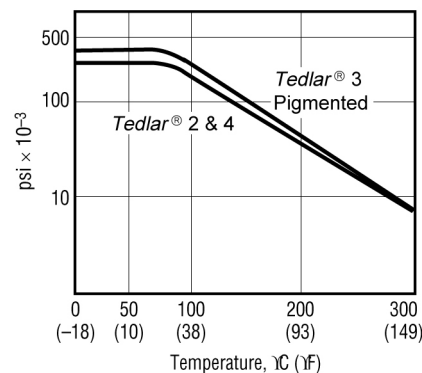
#### Tensile Strength



#### Elongation



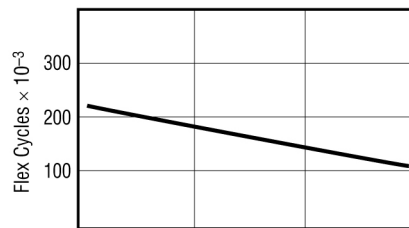
#### Tensile Modulus



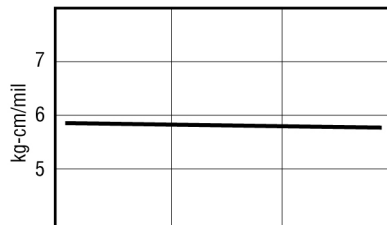
### HYDROLYTIC STABILITY

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  $163^{\circ}\text{C}$  ( $325^{\circ}\text{F}$ ).

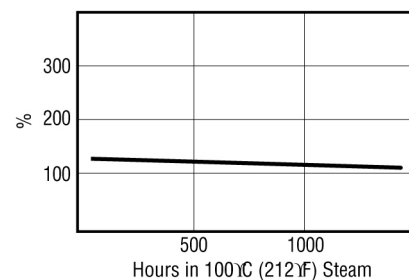
#### Flex Life



#### Impact Strength\*

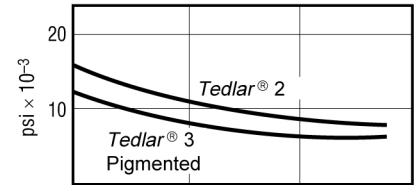


#### Elongation

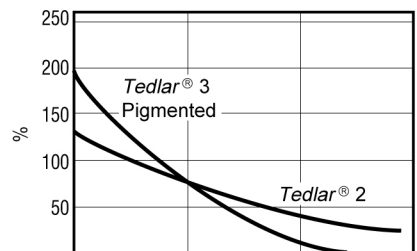


### THERMAL AGING

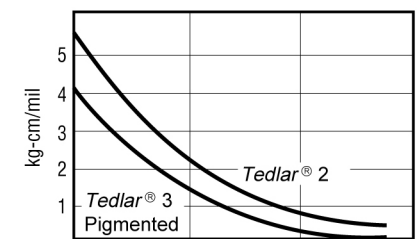
#### Tensile Strength



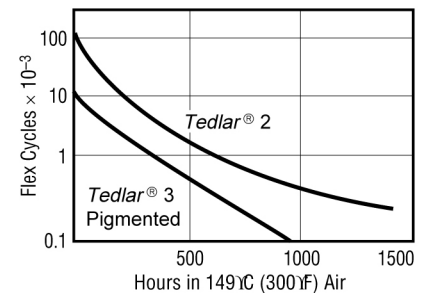
#### Elongation



#### Impact Strength\*



#### Flex Life



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

[www.tedlar.com](http://www.tedlar.com)

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