



Tedlar®

polyvinyl fluoride film

General Properties

Summary of Properties

General

Unique properties of *Tedlar** PVF 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 3 and in clear Types 2 and 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 for surfacing fiberglass-reinforced polyester panels and truck trailer bodies. *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 development. The film can also be printed on and laminated to a variety of substrates.

Type 5 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 sides 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 antistick 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 lamination.

Outdoor weathering tests on *Tedlar*® 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 0.5 to 2.0 mil.

Table 1
General Properties of *Tedlar*® PVF Films

| Property | | Typical Value | Test Method | Test Condition |
|------------|--|---|----------------------------------|-----------------------------------|
| PHYSICAL | Bursting Strength | 29–65 psi | Mullen, ASTM D-774-67 | 22°C (72°F) |
| | Coefficient of Friction (Film/Metal) | 0.18–0.21 | ASTM D-1894-78 | 22°C (72°F) |
| | Density | 1.37–1.72 g/cc | ASTM D-1505-68 | 22°C (72°F) |
| | Impact Strength | 10–20 in lb/mil | Spencer ASTM D-3420-80 | 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-E-80 | 39.5°C, 80% RH |
| | Refractive Index | 1.46 n _D | ASTM D-542-50 Abbé Refractometer | 30°C (86°F) |
| | Tear Strength | | | |
| | Propagated | 15–60 g/mil | Elmendorf-ASTM D-1922-67 | 22°C (72°F) |
| | Initial (Graves) | 260–500 g/mil | ASTM D-1004-66 | 22°C (72°F) |
| | Tensile Modulus | 300–380 x 10 ³ psi | ASTM D-882-80, Method A | |
| | | | 100% elong./min—Instron | 22°C (72°F) |
| | Ultimate Tensile Strength | 8–16 x 10 ³ psi | ASTM D-882-80, Method A | |
| | | | 100% elong./min—Instron | 22°C (72°F) |
| CHEMICAL | Ultimate Elongation | 90–250% | ASTM D-882-80, Method A | |
| | | | 100% elong./min—Instron | 22°C (72°F) |
| | Ultimate Yield | 6000–4900 psi | ASTM D-882-80, Method A | |
| | | | 100% elong./min—Instron | 22°C (72°F) |
| | Chemical Resistance | No visible effect | 1 yr immersion in | |
| | | | Acids | 25°C (77°F) |
| | | | Bases | 25°C (77°F) |
| | | | Solvents | 25°C (77°F) |
| | | | 2 hr immersion in | |
| | | | Acids | Boiling |
| | | | Bases | Boiling |
| | | | Solvents | Boiling |
| | | | Soil Burial—5 yr | — |
| | Gas Permeability | Strength and appearance not affected | | |
| | Carbon Dioxide | 11.1 cc/(100 in ²)(24 hr)(atm)(mil) | ASTM D-1434-75 | 24°C (75°F) |
| | Helium | 150 cc/(100 in ²)(24 hr)(atm)(mil) | ASTM D-1434-75 | 24°C (75°F) |
| | Hydrogen | 58.1 cc/(100 in ²)(24 hr)(atm)(mil) | ASTM D-1434-75 | 24°C (75°F) |
| | Nitrogen | 0.25 cc/(100 in ²)(24 hr)(atm)(mil) | ASTM D-1434-75 | 24°C (75°F) |
| | Oxygen | 3.2 cc/(100 in ²)(24 hr)(atm)(mil) | ASTM D-3985-80 | 24°C (75°F) |
| | Vapor Permeability (at part. press. of vapor at given temp.) | | | |
| | Acetic Acid | 45 g/(100 m ²)(hr)(mil) | ASTM E-96-80, modified | 24°C (75°F) |
| | Acetone | 10,000 g/(100 m ²)(hr)(mil) | ASTM E-96-80, modified | 24°C (75°F) |
| | Benzene | 90 g/(100 m ²)(hr)(mil) | ASTM E-96-80, modified | 24°C (75°F) |
| | Carbon Tetrachloride | 50 g/(100 m ²)(hr)(mil) | ASTM E-96-80, modified | 24°C (75°F) |
| | Ethyl Acetate | 1000 g/(100 m ²)(hr)(mil) | ASTM E-96-80, modified | 24°C (75°F) |
| | Ethyl Alcohol | 35 g/(100 m ²)(hr)(mil) | ASTM E-96-80, modified | 24°C (75°F) |
| | Hexane | 55 g/(100 m ²)(hr)(mil) | ASTM E-96-80, 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 Bulletin TD-14 | | |
| | 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 | | TTR20SG4 TWH20BS3 | | |
| | Corona Endurance (hr) | 2.5 6.2 | ASTM Suggested T method | 60 cPs, 1000 V/mil |
| | Dielectric Constant | 8.5 11.0 | ASTM D-150-81 | 1 Kc at 22°C (72°F) |
| | Dielectric Strength (kV/mil) | 3.4 3.5 | ASTM D-150-81 | 60 cPs, kV/mil |
| | Dissipation Factor (%) | 1.6 1.4 | ASTM D-150-81 | 1000 cPs, 22°C (72°F) |
| | | 2.7 1.7 | ASTM D-150-81 | 1000 cPs, 70°C (158°F) |
| | | 4.2 3.4 | ASTM D-150-81 | 10 Kc, 22°C (72°F) |
| | | 2.1 1.6 | ASTM D-150-81 | 10 Kc, 70°C (158°F) |
| | Volume Resistivity (ohm-cm) | 4 x 10 ¹³ 7 x 10 ¹⁴ | ASTM D-257-78 | 22°C (72°F) |
| | | 2 x 10 ¹⁰ 1.5 x 10 ¹¹ | ASTM D-257-78 | 100°C (212°F) |

Physical and Thermal Properties

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

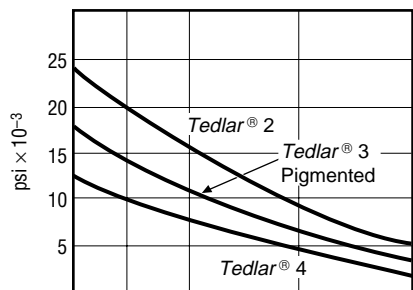
225°F), with intermittent short-term peaking up to 204°C (400°F). Some physical and thermal properties of representative *Tedlar*® PVF films are summarized below.

Table 2
Typical Properties of *Tedlar*® PVF Films

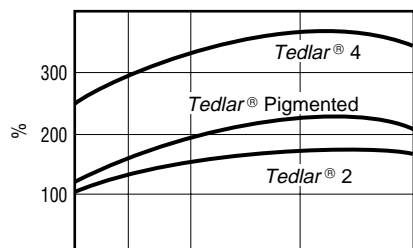
| | | 1.0 mil UV Screening Transparent Type 3 | 1.0 mil Transparent Type 3 | 1.5 mil Low Gloss White Type 3 | 2.0 mil Satin White Type 3 | |
|---|---------------------------|--|-----------------------------------|---|----------------------------------|--|
| Description | | | | | | |
| Designation | Units | TUT10BG3 | TTR10BG3 | TWH15BL3 | TWH20BS3 | Test Method |
| Physical Properties | | | | | | |
| Area Factor | ft²/lb m²/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 | Instron ASTM D-882-80 Method A—100%/min |
| Tensile Modulus (MD) | kpsi MPa | 310 2,138 | 301 2,075 | 305 2,103 | 385 2,655 | Instron ASTM D-882-80 Method A—10%/min |
| Ultimate Elongation, Min. (MD) | % | 95 | 95 | 90 | 110 | Instron ASTM D-882-80 Method A—100%/min |
| 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-774-67 (1971) |
| 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-1922-67 (1978) |
| Tear Strength— Propagating (TD) | g/mil kN/mil | 19.0 7.3 | 17.4 6.7 | 18.6 7.2 | 26.6 10.3 | Elmendorf ASTM D-1922-67 (1978) |
| Tear Strength— Initial (MD) | g/mil kN/m | 373 144 | 423 163 | 333 129 | 506 195 | Graves ASTM D-1004-66 (1981) |
| Tear Strength— Inital (TD) | g/mil kN/m | 435 168 | 478 185 | 264 102 | 377 146 | Graves ASTM D-1004-66 (1981) |
| 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-3420-80 |
| Specific Gravity | — | 1.37 | 1.39 | 1.46 | 1.71 | ASTM D-1505-68 (1979) |
| Coefficient of Friction Film/Metal | — | 0.21 | 0.21 | 0.18 | 0.18 | ASTM D-1894-78 |
| Coefficient of Abrasion | — | — | — | 385 | — | ASTM D-658-81 |
| Moisture Absorption | % | <0.5 | <0.5 | <0.5 | <0.5 | ASTM D-570-81 |
| Moisture Vapor Transmission | g/m²d | 30.1 | 30.2 | 24.5 | 16.9 | ASTM E-96E-80 |
| 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 Bulletin TD-14 | | | — |
| 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-696-79 (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 | |
| Shrinkage, Max. (TD) | % at °C | 6 at 150 | 5 at 170 | 5 at 170 | 5 at 170 | ASTM D-1204-78 |
| 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 |

Physical Properties vs. Temperature

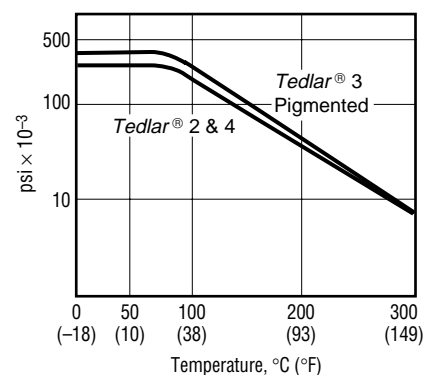
Tensile Strength



Elongation



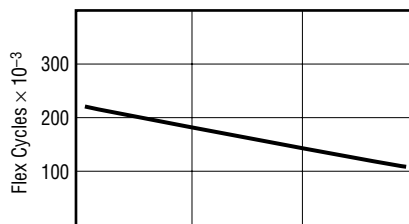
Tensile Modulus



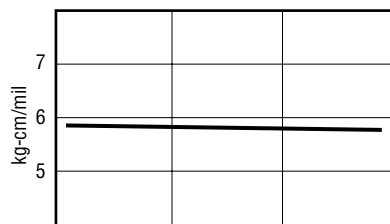
Hydrolytic Stability

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).

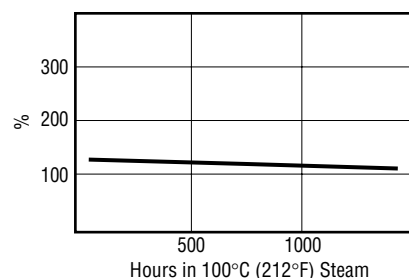
Flex Life



Impact Strength*

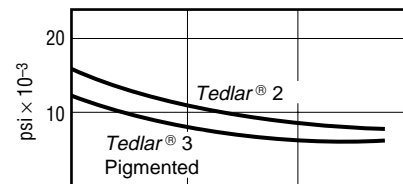


Elongation

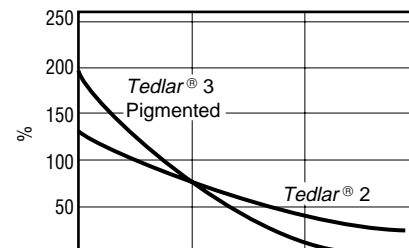


Thermal Aging

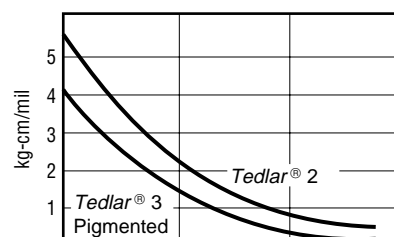
Tensile Strength



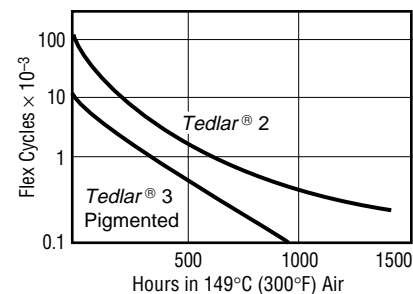
Elongation



Impact Strength*



Flex Life



*DuPont pneumatic tester

For more information on Tedlar® PVF films:

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Note: We believe this information is the best currently available on the subject. It is offered as a possible helpful suggestion in experimentation you may care to undertake along these lines. It is subject to revision as additional knowledge and experience are gained. DuPont makes no guarantee of results and assumes no obligation or liability whatsoever in connection with this information. This publication is not license to operate under, or intended to suggest infringement, of any existing patents.

CAUTION: Do not use in medical applications involving permanent implantation in the human body. For other medical applications, see "DuPont Medical Caution Statement," H-50102.



Tedlar®
Only by DuPont