

# **Release Film Applications**

### **Description**

*Tedlar*<sup>®</sup> polyvinyl fluoride (PVF) film has outstanding mechanical properties; inertness to a variety of chemicals and solvents; and antistick properties that make it an excellent release film for epoxies, phenolics, polyesters, and rubber compounds. *Tedlar*<sup>®</sup> does not contain silicones, which can cause adhesion and delamination problems in finished parts. *Tedlar*<sup>®</sup> also has good temperature resistance. In most applications, *Tedlar*<sup>®</sup> can withstand temperatures in excess of 177°C (350°F) for several hours. *Tedlar*<sup>®</sup> release films are available in 25, 38, and 51  $\mu$ m (1, 1.5, and 2 mil) thicknesses as clear, translucent, or opaque white film and in several surface finishes, as shown in **Table 1**.

Property	Release Films									
	TTR10SG3	TPC10SM3	TMR10SM3	TML10SM3	TWH10SS3	TUW10SG1	TTR15SG5	TWH15SL3	TWH20SS3	TST20SG4 TTR20SG4
Nominal Thickness, µm (mil)	25 (1.0)	25 (1.0)	25 (1.0)	25 (1.0)	25 (1.0)	25 (1.0)	38 (1.5)	38 (1.5)	51 (2.0)	51 (2.0)
Gloss	High	Medium	Medium	Medium	Satin	High	High	Low	Satin	High
Color	Clear	Translucent	Translucent	Translucent	White	Translucent White	Clear	White	White	Clear
Specular Gloss at 60 $^\circ$	65	17	8	17	15	48	40	10–15*	22	65
Surface Roughness min., avg., µm (µin)	0.18 (7)	0.39 (15)	0.64 (25)	0.39 (15)	0.25 (10)	0.15 (6)	0.31 (12)	0.41 (16)	0.21 (8)	0.25 (10)
Tenacity, min.** MPa kpsi	90 13	62 9	62 9	62 9	83 12	97 14	62 9	55 8	62 9	62 9
Web Strength** N/m, width Ib/in, width	2275 13	1575 9	1575 9	1575 9	2100 12	2450 14	2275 13	2100 12	3150 18	3150 18
Elongation (MD) min., %**	95	115	100	115	75	75	160	90	110	125
Approximate Yield m²/kg ft²/lb	28.6 140	28.6 140	28.6 140	28.6 140	24.4 119	28.6 140	19.1 93	17.9 87	12.2 60	14.3 70

 Table 1

 Physical Properties of Tedlar® PVF Release Films

\*At 85°

\*\*Room temperature

Tedlar® is a registered trademark of DuPont.

# Applications and Film Types Printed Circuit Boards

Within the broad family of *Tedlar*<sup>®</sup> PVF film products, a variety of films have been specially formulated to serve the needs of the printed circuit board industry. Whether the application is in laminate production, mass lamination, or multilayer fabrication, these *Tedlar*<sup>®</sup> release films provide outstanding release from phenolic and epoxy resins as well as copper and caul plate surfaces, either hot or cold.

TPC10SM3 is a widely used release product for FR-4 epoxy-glass systems. Besides its ease of release, high tensile strength, and tear resistance, the film imparts a matte finish to the cured resin surface. This is accomplished by the addition of inert pigments to the film during manufacture to achieve a desired surface roughness. The resulting transfer of this texture from the *Tedlar*<sup>®</sup> to the resin surface enhances the adhesion of legend inks, protective masks, and additional layers of resin or prepreg to the laminate.

TMR10SM3 is offered where an even rougher surface texture is desired and also provides a broader operating range due to its higher thermal stability.

TML10SM3 with its unique low volatile formulation offers enhanced performance in multilayer lamination processes. It has been specifically designed for multilayer fabrication applications; it is generally not suitable for bulk laminate manufacturing.

All of the above *Tedlar*<sup>®</sup> printed circuit release products are designed to minimize plate scumming and to withstand normal epoxy and phenolic press cycles and temperatures without embrittlement or charring.

Films such as TTR20SG4 and TMR20SM3 are frequently used for release in the manufacture of flexible or rigid-flex printed wiring boards due to their conformability, toughness, and inertness to bonding adhesives. All *Tedlar*<sup>®</sup> films can also be obtained with one side treated to accept adhesives or other bonding materials for the fabrication of specialty release laminates.

# Molded Parts

Aircraft manufacturers and their subcontractors use TTR10SG3 and TTR20SG4 in hand lay-up and vacuum bagging operations for curing epoxy and polyester prepreg parts where inspection of the part before or after application of heat and pressure is desirable. When it is essential to be able to tell if all the release film has been stripped from the part, a pigmented film may be preferred. Of the standard types of *Tedlar*®, TTR20SG4 has the best formability for this operation. TTR15SG5, a specialized film, has, by comparison, even better formability and is recommended for more severe applications. Some shops have found thinner TTR10SG3 to work satisfactorily.

Tapes and perforated *Tedlar*<sup>®</sup> are available from converters for special applications.

## **Electrical Applications**

Electrical equipment manufacturers have used a variety of *Tedlar*<sup>®</sup> films to contain resin overflow during autoclave curing of motor windings and coils. Most popular among these films have been TWH20SS3 and TTR20SG4 because of their high tensile strengths. TWH10SS3, TTR10SG3, TPC10SM3, and TMR10SM3 are used in applications where a thinner film is suitable. TUW10SG1, a Type 1 film, can be used in situations where high shrinkage is desirable. Translucent TUW10SG1 permits inspection of the part and is very visible if not stripped.

#### Uses in the Rubber Industry

Transparent TTR10SG3 and TTR20SG4, as well as translucent TPC10SM3 and TMR10SM3, are often used as substrates for screen-printed transfer labels to identify rubber hoses and fan belts. *Tedlar*® film has a higher use temperature than triacetate and is not affected by moisture, unlike nylon films. For this reason, TMR10SM3 is frequently used as a release film to prevent sticking to the mandrel during steam curing of fan belts. The rubber industry has found TTR10SG3 to be a good processing aid in the resurfacing of rubber laminating and printing rolls. TWH10SS3 is used in patching and vulcanizing kit manufacturing.

## **Precautions**

### Static

In unwinding, sheeting, or handling operations on thin plastic films, static charges can be built up. Static discharges across the film result in "etching" the surface, making it susceptible to sticking in those areas. It may be necessary to add commercial static eliminator bars or grounded metallic tinsel to the handling equipment for control of static discharge. TPC10SM3 and TMR10SM3 have the least tendency toward static buildup.

## **Thermal Degradation**

Thermal degradation of *Tedlar*<sup>®</sup> PVF film results in embrittlement, browning, and finally, charring of the film. Acidic conditions catalyze the degradation. If press plates become contaminated with charred *Tedlar*<sup>®</sup>, repeated use will cause repeated charring. If charring occurs, press plates should be cleaned thoroughly and given an alkaline rinse of a dilute water solution of sodium carbonate or sodium bicarbonate.

## **Catalysts and Resins**

*Tedlar*<sup>®</sup> is being successfully used with a wide variety of epoxy resins. However, the presence of boron fluoride type complex catalysts in the final cure cycle can cause sticking and, at higher temperature conditions, decomposition of the film.

## Disposal

The preferred option for disposal is landfill. Incineration is not recommended because it may produce hydrogen fluoride or other acidic combustion products. In addition, white grades of *Tedlar*<sup>®</sup> film may liberate volatile antimony compounds when burned. Treatment, storage, transportation, and disposal must be in accordance with applicable federal, state/provincial, and local regulations.

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