DuPont™ Tedlar® Polyvinyl Fluoride Films

Adhesive and Lamination Guide

General

This guide is intended to assist the manufacturer in the selection of adhesives for laminating DuPont™ Tedlar® polyvinyl fluoride (PVF) film to a variety of substrates. Lamination and quality control guidelines are also included for laminating Tedlar® PVF film to:

- Aluminum
- Galvanized steel
- Vinyl fabric
- Thermoplastic sheet
- Vinyl wall covering

This information is believed to be the best currently available and is offered to help with your own experimentation and evaluations. This information will be revised as additional information becomes available.

Adhesive Storage

Tedlar® adhesives are best used within two years from date of manufacture. Best used dates are guidelines to insure the material maintains its viscosity and appearance. In the event material has exceeded two years from date of manufacture, it may be assessed for use in the following manner:

1. Insure the material is at room temperature
2. Insure the material is mixed (10 – 15 minutes gentle agitation on drum roller is suitable)
3. Collect a small sample of adhesive in a clear vessel to inspect visually for presence of non-soluble gel particles (do not use adhesive if non-soluble gel particles are visible)
4. Adhesive may be adjusted to the desired viscosity by thinning with toluene

Protect the adhesives from temperature and humidity extremes. If adhesives are exposed to temperatures below 4°C (40°F), they must be brought to room temperature, 22°C (70°F), and thoroughly mixed as separate units. Additional mixing is required when blending the compounds.

Flexible Product Adhesives

Over the last 25 years DuPont has developed a family of adhesives used for laminating Tedlar® PVF film to a wide range of substrates. These adhesives are characterized by excellent resistance to moisture and UV radiation.

DuPont flexible product adhesives are versatile acrylic adhesives developed specifically for laminating Tedlar® PVF film to a variety of substrates. With these adhesives, high-quality, long-lasting bonds can be achieved to meet demanding quality control specifications of manufacturers.

A blend of acrylic adhesive 68070 and Epon™ 828 is used to bond Tedlar® PVF film to aluminum and galvanized steel in various gauges.

Acrylic adhesive 68080 is a liquid that can be pre-applied to Tedlar® PVF film to facilitate lamination of products for interiors, such as vinyl wall coverings, and for exteriors, such as architectural siding, awnings, flexible sign faces, and fabric structures.

Adhesive Characteristics

DuPont flexible product adhesives have varying degrees of activation temperature, amine reactivity, and hardness. Key characteristics of these adhesives are shown below:

	68080	68070
Increasing hardness	←	
Increasing amine reactivity		→
Increasing activation temperature	←	
Lamination temperature	149 – 210°C 300 – 410°F	135 – 210°C 275 – 410°F

Solvent Composition

	68080	68070
Toluene, %	55	70
Isopropanol, %	45	30

Product Advantages

These flexible product adhesives have superior durability that resists light, moisture degradation and discoloration. These adhesives are used in a wide variety of substrates and broad range of conditions over many years of service.

Product Limitations

Tedlar® adhesives are best used within two years from date of manufacture. See guidance on Adhesive Storage.

68070 has been observed to interact with some components in a flame-retardant vinyl causing yellowing.

68070/Epon™ 828 mixtures only have an 8-hour pot life. 68080 is incompatible with 68070.

Ketone solvents should be avoided in diluting the adhesives as yellow discoloration will result.

Caution: DuPont does not warrant the "lamination." The performance of the "system" is the sole responsibility of the applicator. DuPont will provide consultation and our best information in assisting the customer to achieve satisfactory lamination.

Safety Precautions

These products are FLAMMABLE AND CONTAIN HARMFUL VAPORS. Store containers away from heat, sparks, and open flames. Keep containers closed when not in use. Before using these products, read the Safety Data Sheet.

Laminate Adhesive Selection Guide

Metals	68070/Epoxy
Thermoplastics:	
Polycarbonate	68080 or 68070
ABS	68080 or 68070
PVC Film	68070/Epoxy, 68080
Vinyl Siding	68080
Vinyl Wall Covering	68080

Flexible Adhesive Application

Heat the adhesive to room temperature and mix according to instructions. Dilute with toluene to desired viscosity. Apply adhesive using spray gun, brush, dipping, extrusion, rollers, doctor blade/wire wound rod, reverse roller coater, roller coater or gravure coating. Lamination can proceed as soon as the adhesive is dry. Toluene and/or methyl ethyl ketone (for cleanup only) may be used to clean up equipment.

Note: Trial laminations should be made to test adhesive suitability. Adhesives, especially non-DuPont, must be tested for the specific application. Some epoxies may not bond well to the Tedlar® PVF film. The harder polyester adhesives do not bond well to Tedlar® PVF film. Isocyanate curing agents generally enhance adhesion. Some phenolic materials or curing agents may cause staining of the Tedlar® PVF film.

Lamination Guidelines

Adhesives, thinned to a desired viscosity with toluene, can be applied to the film using a variety of coating methods. The coated film is normally passed through an oven where the solvent is evaporated to obtain a non-blocking adhesive coating. Thorough drying is essential as residual solvent may cause blocking in the roll. Drying temperatures of 77–104°C (170–220°F) coordinated with proper film web speed and tension are presently being used with success. Excessive machine direction (MD) film stretching and transverse direction (TD) film shrinkage can result from improperly controlled oven temperature and film web tension.

Laminating DuPont™ Tedlar® PVF Film to Aluminum

Lamination is accomplished by cleaning the metal, depositing a controlled conversion coating on the metal, coating the metal with a solvent-based adhesive, evaporating the solvent, heating the metal to 195–205°C (383–401°F) to activate the adhesive, combining with Tedlar® PVF film in nip rolls and quenching the laminate.

Materials
Film – Tedlar® PVF film type TWH15BL3 and colors
Adhesive – DuPont™ 68070, Epon™ 828
Metal – Aluminum

Adhesive Mixing and Application
The adhesive is prepared by the following formula by weight:

Adhesive 68070	29
Epon™ 828	1

While stirring the 68070, slowly add Epon™ 828. Blend the mixture for approximately 5 minutes with a suitable mechanical mixer. Adjust adhesive coater to lay down 37–50 µm (1.5 to 2.0 mil) wet adhesive equivalent to 6–7.5 µm (0.23 to 0.30 mil) of dry adhesive. Adjust viscosity by diluting with toluene.

During normal operation, the rate of solvent evaporation is slight enough to have no effect on the percent solids. If prolonged halts in coating occur, the viscosity must be checked and adjusted with toluene to the original value. Pot life of the mixed adhesive is 8 hours.

The solvent is removed and adhesive activated in an oven of such length that the metal is in the oven from 30 to 90 seconds. The metal temperature must be 195–205°C (383–401°F) at the end of the oven followed by immediate lamination.

Lamination
The laminating equipment consists of a pair of combining or "nip" rolls that are unaffected by the operating temperature of 175°C (347°F). A nip pressure of 87–175 N/cm (50–100 lb/in) of width must be used. A film wrap of at least 90° on the upper nip roll must be used to prevent wrinkling.

Laminating DuPont™ Tedlar® PVF Film to Galvanized Steel

Lamination is accomplished by cleaning the metal, depositing a controlled conversion coating on the metal, coating the metal with a solvent-based adhesive, evaporating the solvent, heating the metal to activate the adhesive, combining with Tedlar® PVF film in nip rolls and quenching the laminate.

Materials
Film – Tedlar® PVF film type TWH15BL3 and colors
Adhesive – DuPont™ 68070, Epon™ 828
Metal – Hot dipped galvanized steel, generally G-90, is used.

The steel must have good forming quality and preferably minimum spangle, temper rolled, lock forming quality or extra smooth spangle. The metal must be free of white rust to enable proper surface treatment and adhesion. Prior to lamination the metal being used must have all mill oils removed.

The optimum thickness metal to be laminated is 18 gauge (0.0516").

Laminates on metal, 22 gauge (0.0366") or lighter, may be made on any standard type of galvanized, including commercial quality, regular spangle. Better forming quality is preferred.

Metals heavier than 22 (0.0366") gauge must be minimum spangle or spangle-free surface. Commercial quality, regular spangle steel is not acceptable in gauges heavier than 22 gauge (0.0366"). Care should be taken when laminating metal heavier than 22 gauge (0.0366") and formed to a radius of less than 3 mm (1/8") to prevent splitting.

Adhesive Mixing and Application
The adhesive is prepared by the following formula by weight

Adhesive 68070	29
Adhesive Epon™ 828	1

While stirring the 68070, slowly add Epon™ 828. Blend the mixture for approximately 5 minutes with a suitable mechanical mixer. Adjust the coater to lay down 37–50 µm (1.5–2.0 mil) wet adhesive equivalent to 6–7.5 µm (0.23–0.30 mil) of dry adhesive.

During normal operation, the rate of solvent evaporation is slight enough to have no effect on the percent solids. If prolonged halts in coating occur, the viscosity must be checked and adjusted with toluene to the original value. The pot life of the mixed adhesive is 8 hours.

The solvent is removed and adhesive melted in an oven of such length that the metal is in the oven from 30 to 90 seconds. The metal temperature must be 195–205°C (383–401°F) at the end of the oven followed by immediate lamination.

Lamination
The lamination equipment consists of a pair of combining or "nip" rolls that are unaffected by the operating temperature of 175°C (347°F). A nip pressure of 10–20 kg/cm (50–100 lb/in) of width must be used. A film wrap of at least 90° on the upper nip roll must be used to prevent wrinkling.

Laminating DuPont™ Tedlar® PVF Film to PVC for Outdoor Applications

Since there are many formulations of PVC, optimum laminating conditions may vary with the PVC formulation. The following is given as a suggested starting point for lamination studies and has given good results with a number of PVC films.

Materials
For opaque laminates, pigmented Tedlar® PVF film, such as TWH15BL3 white film, can be used. Under the pigmented films, a higher proportion of epoxy can be used, and a 68070/Epon™ 828 ratio of 18/1 by volume (14/1 by weight) can be used.

Adhesive Application
Apply 7.5–12.7 µm (0.3 to 0.5 mil) (measured on dry resin) of adhesive to the DuPont™ Tedlar® PVF film or PVC. Dry the adhesive at 66–71°C (150–160°F), film temperature. After drying, the adhesive will appear practically dry to touch and only slightly tacky. If the PVC is coated, note that the adhesive solvent contains toluene, which attacks vinyl, but under the above conditions it will probably be flashed off so fast that this will not cause trouble. Note also that ketones should not be used for dilution as they can cause yellowing of the 68070 adhesive.

Lamination
Combine the Tedlar® PVF film and PVC in a nip roll, with a glue line temperature of at least 79°C (175°F) but preferably not over 121°C (250°F). Some people have accomplished such laminations with roll temperatures of about 121°C (250°F).

Laminating DuPont™ Tedlar® PVF Film to Thermoplastic Sheet

Materials
Film – Any Tedlar® PVF film
Adhesive – DuPont™ 68070 or 68080
Plastic – Polystyrene, Polymethacrylate, Polycarbonate, Acrylonitrilebutadiene-styrene (ABS)

Adhesive Application

Adhesive	% Solids	ft²/mil/gal	Recommended Thickness
68070	34	460	6–7.5 dry µm (0.2–0.3 dry mil)
68080	30	370	6–7.5 dry µm (0.2–0.3 dry mil)

Apply the adhesive, thinned with toluene to a desired viscosity, to the film using adhesive coating equipment. Pass the coated film through an oven evaporating the solvent obtaining a non-blocking adhesive coating.

Thorough drying is essential as residual solvent may cause blocking in the roll. Drying temperatures of 77–104°C (170–220°F) coordinated with proper film web speed and tension are presently being used with success. Excessive MD film stretching and TD film shrinkage can result from improperly controlled oven temperature and film web tension.

Lamination

Laminating adhesive-coated Tedlar® PVF film to thermoplastic sheet is easily accomplished at the extruder. The operation consists of combining the film with the hot sheet at the first nip of the take-off stack. Stack temperatures of 149°C (300°F) or higher are necessary to heat activate the adhesive and adequately bond the film. The unwind roll of Tedlar® PVF film should be positioned so that the film wraps the top roll 30° or more and tension across the sheet is uniform. Press Operations: 1-1/2 minutes, minimum lamination temperatures: 135–149°C (275–300°F), 100–150 psi; cool to 38°C (100°F) before removing from press.

Laminating DuPont™ Tedlar® PVF Film to Vinyl Wall Covering

Wall covering having excellent stain resistance and cleanability is possible with Tedlar® SP PVF film. Lamination is accomplished by combining adhesive coated Tedlar® SP PVF film with preheated vinyl in heated nip rolls. The finished product is recommended for interior applications only.

Film Types

Tedlar® type TTR5JAM8 and TTR10AM8 coated with 6–7.5 µm (0.2–0.3 mil) dry 68080 acrylic adhesive from DuPont. CTRWCAM919 is available and is already adhesive coated.

Lamination

Laminating adhesive-coated Tedlar® PVF film to vinyl has been successfully demonstrated on various types of equipment familiar to the wall covering industry. The operation consists of combining the film with the vinyl in hot nip rolls, heating the composite to 149–177°C (300–350°F) and embossing. The unwind roll of Tedlar® PVF film should be positioned so that the film wraps the top nip roll at least 90° and tension across the sheet is uniform.

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