



# 3M™ Acrylic Foam and Acrylic *Plus* Tapes for Exterior Trim Attachment

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Note: The purpose of this guide is to provide basic information to product users for use in evaluating, processing, and troubleshooting their use of certain 3M products. The information provided is general or summary in nature and is offered to assist the user. The information is not intended to replace the user's careful consideration of the unique circumstances and conditions involved in its use and processing of 3M products. The user is responsible for determining whether this information is suitable and appropriate for the user's particular use and intended application.

# Part Design

## Materials

### General Description

A wide variety of plastics are used in the manufacture of parts that are attached to automobiles. Examples of plastic parts include claddings, body side moldings, rocker panels, running boards, wheel flares, hood shields, nameplates and window clips. Plastics allow automotive engineers greater freedom in the styling and manufacturing of components and gives them the opportunity to combine several complex parts into one integrated piece. Plastic parts also contribute to a lighter vehicle, helping to improve gas mileage.

This document will highlight the following:

- General properties of the plastics and typical applications
- Initial tape recommendation for the substrate/application

Substrate	General Properties and Typical Applications	Initial Tape Recommendations
Thermoplastic Polyolefin (TPO) (i.e., PP/EPDM)	<ul style="list-style-type: none"> <li>• Typically used in the making of claddings, body side moldings, rocker panels, running boards and wheel flares</li> <li>• Lightweight, injection moldable and paintable</li> </ul>	<ul style="list-style-type: none"> <li>• 3M™ Acrylic Foam Primerless Application of Exterior Trim Parts (3M Primerless Tapes)<sup>1</sup></li> <li>• 3M™ Acrylic Foam and Acrylic Plus Tapes<sup>2</sup></li> </ul>
Thermoplastic Urethane (TPU)	<ul style="list-style-type: none"> <li>• Generally offers a broader range of properties and is easier to mold, but is more expensive and heavier than TPO</li> </ul>	<ul style="list-style-type: none"> <li>• 3M Acrylic Foam and Acrylic Plus Tapes<sup>2</sup></li> </ul>
Polypropylene (PP)	<ul style="list-style-type: none"> <li>• Commonly used in the manufacture of small body side moldings</li> </ul>	<ul style="list-style-type: none"> <li>• 3M Primerless Tapes<sup>1</sup></li> <li>• 3M Acrylic Foam and Acrylic Plus Tapes<sup>2</sup></li> </ul>
Polyvinyl Chloride (PVC)	<ul style="list-style-type: none"> <li>• Most commonly used for narrow moldings or roof slats</li> </ul>	<ul style="list-style-type: none"> <li>• 3M Acrylic Foam and Acrylic Plus Tapes<sup>2</sup></li> <li>• Oils and/or plasticizers in PVC parts may affect tape adhesion, so testing is recommended</li> </ul>
Acrylonitrile-Butadiene-Styrene (ABS)	<ul style="list-style-type: none"> <li>• Commonly used in the manufacture of nameplates or chrome-plated applications</li> </ul>	<ul style="list-style-type: none"> <li>• 3M Primerless Tapes</li> <li>• 3M Acrylic Foam and Acrylic Plus Tapes<sup>3</sup></li> </ul>
Polycarbonate (PC)	<ul style="list-style-type: none"> <li>• Used in the manufacture of hood shields, turn signals and occasionally wheel flares</li> </ul>	<ul style="list-style-type: none"> <li>• 3M Primerless Tapes</li> <li>• 3M Acrylic Foam and Acrylic Plus Tapes<sup>3</sup></li> </ul>
Acrylic	<ul style="list-style-type: none"> <li>• Used in the manufacture of hood shields, head lamps and tail lamps</li> </ul>	<ul style="list-style-type: none"> <li>• 3M Primerless Tapes</li> <li>• 3M Acrylic Foam and Acrylic Plus Tapes<sup>3</sup></li> </ul>
Nylon	<ul style="list-style-type: none"> <li>• Commonly used in the manufacture of window clips</li> </ul>	<ul style="list-style-type: none"> <li>• 3M Acrylic Foam and Acrylic Plus Tapes<sup>2</sup></li> </ul>
Reaction Injection Molded (RIM)	<ul style="list-style-type: none"> <li>• The most commonly used RIM processable material is polyurethane</li> </ul>	<ul style="list-style-type: none"> <li>• 3M Acrylic Foam and Acrylic Plus Tapes<sup>3</sup></li> </ul>

<sup>1</sup> May bond to substrate without adhesion promoter

<sup>2</sup> Requires adhesion promoter; contact a 3M application engineer for testing to determine the proper adhesion promoter

<sup>3</sup> May require adhesion promoter

# Part Design

## Part Processing

### General Overview

The production processes of automotive components can have an effect on tape performance. Below are key part processes and their relation to tape application and performance.

### Injection Molding

One consideration in the taping of injection-molded parts is to apply adhesion promoter soon after the parts are removed from the mold. This takes advantage of the residual heat to more quickly flash off the adhesion promoter solvent and helps ensure that the part is free of any plant contaminants.

Mold release agents can adversely affect the adhesion of tape to a part. If a mold release agent is used, a more stringent cleaning method is required prior to adhesion promoter application. Contact a 3M application engineer for recommendations.

### Extrusion

Extruded parts typically undergo some level of shrinkage after the process. If the tape is applied before this shrinking has completed, the liner can ripple and buckle as the tape does not shrink along with the part. If the tape is applied before shrinkage has stopped, it should be laminated with a percentage of stretch equal to the percentage of part shrinkage expected after tape lamination. Stretch should not exceed 4%.

Extrusion allows for the taping of parts in one continuous process if desired. In addition to handling the shrinkage mentioned above, the process needs to allow time for the adhesion promoter solvent to flash off prior to tape lamination.

Heat-bonding may be used in place of an adhesion promoter on some substrates.

### Painting

When plastic parts are exposed to paint bake oven conditions, they can often undergo dimensional changes when measured in free-state. These changes can cause problems with tape-attached parts if the resulting fit to the vehicle is poor. A part may measure “in spec” when measured with a check fixture, but could be imparting excessive backload to the tape when applied to the vehicle.

Overspray of paint to the backside of automotive trim may cause tape adhesion issues and needs to be addressed before tape is applied. The problem with overspray is that adhesion characteristics for both tape and adhesion promoters are different for painted surfaces vs. raw plastic. There are several options to address this:

1. **Paint the backside:** A completely painted backside provides a uniform surface on which to laminate tape. Some 3M™ Acrylic Foam Tapes, 3M™ Acrylic Plus Tapes and 3M™ Acrylic Foam for Primerless Application of Exterior Trim Parts do not require an adhesion promoter when applied to many flexible clearcoat paints. This can be an added benefit of this option.
2. **Limit or eliminate paint overspray:** This can often be accomplished by using a paint rack design that minimizes overspray. Other options include masking the tape land area prior to painting or removing the overspray after the paint cycle.
3. **Taping to the overspray:** This typically is not recommended due to the nature of paint overspray – it is unintended paint contact so overspray often does not have adequate anchorage to the part substrate. If good anchorage is assured, tape can be applied to these surfaces, but may require different adhesion promoters for the different surfaces. Contact a 3M application engineer for recommendations.

# Part Design

## Tape Land Area

### General Description

Tape land refers to the areas on a trim component where 3M™ Acrylic Foam, Acrylic Plus Tapes and Primerless Tapes will be applied. The tape land surface, width, shape, and fit to the vehicle body all affect the performance of the tapes as well as the robustness of the application.

### Recommendations

#### Best Practice

The tape land should be a flat, smooth surface, parallel to its mating surface, and wide enough to accommodate the full width of the tape. If the part design includes a hider lip, the tape land should be designed to allow the tape to stand proud of the hider lip by at least 0.5mm.



#### Tape Land Width

Tape should align with the center of the tape land area. The tape land area is ideally wider than the tape by >2mm (0.08 in). Tape placement tolerances should be taken into account to ensure that the entire width of the tape will be fully supported by the land area and the edge of the tape will not “ride up” onto any hider lips. A visual check should be conducted to verify that there are no areas where the tape overhangs the land area.

#### Surface Irregularities

Cross-sectional cupping and crowning of the land area can affect tape wet-out and pressurization to both the part and the sheet metal. Although 3M Acrylic Foam Tapes will compensate for minor surface irregularities, most irregularities tend to disrupt the match of the mating surfaces and may cause a bridging of the bonding surfaces. This results in reduced surface bonding area and substandard applications. Gate areas should be trimmed flush with the part surface, and sinks/cupping should be eliminated from the tape land area.

#### Part Weight-to-Tape Ratio

The tape land area must also be able to accommodate the width needed to support the required tape-to-weight ratio. A starting guideline for part weight-to-tape ratio is 2.3 grams/cm<sup>2</sup>. Lower and higher ratios may be considered depending on paint systems and/or the complexity of the part designs. Please contact your 3M application engineer during the design phase to determine desired tape land width.

#### Turning Curves and Corners

Some tape lands include a curved portion or require the tape to turn a 90° corner. While gradual sweeps are possible, turning the tape around a corner, in the width direction, where the inside edge of the tape is changing radius at a different rate than the outside edge, can create issues with the tape’s ability to conform to the part and cause liner pop-off. Sharp turns will require a die-cut part. Contact your 3M application engineer for additional information.

#### Locator Pins

Many tape-attached parts have locator pins to assist with the correct placement of the part onto the vehicle. When designing parts with locator pins, the proximity of the locator pins to the tape land should still allow for full wet-out of the tape to the vehicle surface. If the locator pins are positioned too close to the tape land, they may interfere with the wet-out of the tape to the mating surface, resulting in lower adhesion and/or part lift.

## Tape Width Selection Guide

Application	Initial Weight-to-Tape Ratio <sup>A</sup>	Initial Width <sup>B</sup>	Number of Tape Strips	Minimum Width	Caliper	Commonly Used Products
TPO/TPU <sup>C</sup> Claddings	1.5 gm/cm <sup>2</sup>	16 mm	2-6 (1 strip every 50-75 mm of part width)	12 mm	1.5 mm	3M™ Acrylic Foam Tape RPX1015 3M™ Acrylic Plus Tape PT1500 3M™ Acrylic Foam Tape 5567
TPO/TPU <sup>C</sup> Moldings	1.5 gm/cm <sup>2</sup>	12 mm	2	9 mm	1.1 mm	3M™ Acrylic Foam Tape RPX1011 3M™ Acrylic Plus Tape PT1100 3M™ Acrylic Foam Tape 5344
Fascia Trim	2.3 gm/cm <sup>2</sup>	12 mm	1-2	6 mm	1.1 mm	3M™ Acrylic Foam Tape RPX1011 3M™ Acrylic Plus Tape PT1100 3M™ Acrylic Foam Tape 5344
Sills and Large PVC Moldings	2.3 gm/cm <sup>2</sup>	12 mm	2	6 mm	1.1 mm	3M™ Acrylic Foam Tape RPX1011 3M™ Acrylic Plus Tape PT1100 3M™ Acrylic Foam Tape 5344
Small PVC Moldings and Slats	Full Coverage	Full Coverage	1	Full Coverage		3M™ Acrylic Foam Tape 5314
Nameplates	Full Coverage	Full Coverage	1	Full Coverage		3M™ Die-Cuttable Tape Series DC2000

<sup>AB</sup> Please refer to OEM Design Guidelines to confirm weight-to-tape ratio does not differ from recommendation listed above

<sup>C</sup> TPO and PP/EPDM are both terms to call out various grades of filled PP. Speak with your Application Engineering Representative for more information

## Non-Optimal Design

### Curved Vehicle Surface and Part Cross Section

In some instances, the mating surface on the vehicle may be curved requiring a similar curvature in the part cross section. As a result, the tape land will lie in multiple planes, and achieving full wet-out of the tape to the vehicle will be more difficult. Curved part designs require more precision in both the part molding process and the sheet metal tolerances. Contact your 3M application engineer for assistance.

If a curved cross section is necessary, the part should be designed so the tape land is parallel to the mating surface. If the tape land is not parallel to the mating surface, mismatch will occur resulting in one or more of the following issues:

- Minimal contact of the tape to the vehicle surface
- Internal stresses
- Lifting/gapping

Switching to a thicker tape or a more pliable substrate can help to alleviate these concerns.



Rigid part and thin tape  
Lifting and gapping occur



Less rigid part and thicker tape  
Minimize lifting and gapping

## Ribbed Designs

3M does not consider ribbed tape land designs a “best practice” for the following reasons:

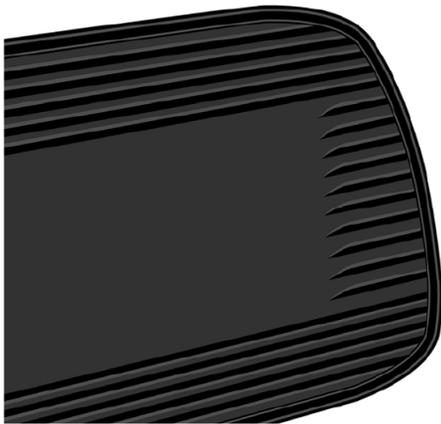
- Reduced contact area between tape and part
- Concentrated stress at the adhesive-part interface
- Difficulty in manufacturing flat rib-top surfaces potentially reduces the tape to part contact area further
- Increased need for tape placement accuracy
- Edge of tape should be supported by the tape land area to ensure full wet-out of tape to sheet metal
- Rib tops are often 1-2 mm wide – a tight laminating tolerance is needed to ensure placement of tape edge on rib top

The following items need to be considered when designing a part with ribbed tape lands:

- Maximize rib width (some successful applications have 2.5 mm ribs with 4.5 mm outside ribs)
- Maintain the tape area to part weight ratio by calculating the sum of the widths (top flat area only) of the ribs
- Minimum recommended rib width is 0.75 mm on the middle ribs and 1.0-1.5 mm on the outside ribs
- The width of each rib will be a function of the height and the draft in tooling within the mold
- The edge of the tape must be supported. Tape placement tolerances must be considered to avoid unsupported edges of the tape, which can lead to liner removal issues
- The top of the rib should be flat, not curved or pointed

The use of 3M Primerless Tapes with Ribbed Tape Lands:

- Laboratory Testing shows that 3M Primerless Tapes may be an option with ribbed tape lands – although flat lands are always recommended wherever possible
- It is recommended that part lands at either end of the part – or in areas of high stress – be kept flat or use complete tape coverage with a die-cut part to ensure a robust bond to the difficult landing area
- Work with a 3M application engineer to evaluate the difficulty of your application and determine a test and validation procedure to confirm product capability



Cross Section

# Part Design

## Clearances

### General Overview

A part that is to be adhesively attached must be designed to allow for tape wet-out contact on the vehicle surface without interference. The tape cannot adhere to a surface it cannot touch. Parts should be designed with adequate clearances in mind.

### Recommendations

#### Hide Lips

Hide lips are frequently used on the A-line of a part to assist in blocking the visibility of the tape. When used, the recommendation is the tape stands proud of the hider lip at least 0.5 mm (0.02 in.)



#### Feature Lines and Recessed Areas

Some designs call for the body side molding to follow along a feature line on the door. The part must be designed for this purpose or it may have physical interference that could prevent adequate contact of the tape to the vehicle. Care should be taken to take to account for sheet metal, part, and locator tolerances.

### Troubleshooting

#### Wet-Out Testing

Having the tape stand proud of the hider lip will allow for good contact and pressurization of the tape to the body surface. To determine if there is adequate clearance, a wet-out test can be performed (see [wet-out measurements](#) in pressurization section of this document).

# Lamination of Tape to Part

## Cleaning

### General Description

The part surface and work area where the tape is to be applied to the part should be clean. Lubricants, mold releases, skin oil, airborne dust, etc., can contaminate the trim component or the tape and reduce the adhesion performance of the tape to the part.

### Recommendations

#### Cleaning Method:

Clean the surface of the trim component no more than 20 minutes prior to tape lamination. The best practice is to clean the substrate using a 50/50 mixture of isopropyl alcohol and water\* with a clean, non-abrasive cloth. The cleaning should remove all contaminants and leave no residue.

#### Drying Time:

After cleaning, allow adequate time for the trim component to dry prior to tape lamination.

*\*Important Note: State Volatile Organic Compound (VOC) regulations may prohibit the use of this alcohol/water solution. You should check with your state environmental authorities to determine whether use of this solution is restricted or prohibited. When using solvents, extinguish all ignition sources, including pilot lights, and follow the manufacturer's precautions and directions for use.*

### Troubleshooting

#### Cleaning Method:

In some cases, a 50/50 mixture of isopropyl alcohol and water may not consistently remove all contaminants, such as mold releases or oils. This may result in failure of the tape to the substrate. A stronger solvent should be evaluated for the cleaning process as well as for compatibility with the substrate.

It is very important when using 3M™ Acrylic Foam and Acrylic Plus Tape for Primerless Attachment, to confirm a clean and dry substrate prior to tape lamination.

#### Drying Time:

If tape is laminated to a wet trim component, the residual solvent may contaminate the adhesive surface of the tape. This may result in an adhesion failure of the tape to the part.

#### Adhesion Promoters (when required):

Cleaning with a contaminated cloth can compromise the application of adhesion promoters. If the part surface is not clean, the adhesion promoter may fail to adhere to the substrate.

#### Tape Lamination:

Cleaning with a contaminated cloth can also compromise the lamination of the tape to the trim component. If the part surface is not clean, adhesion failure of the tape to the part may occur.

If the cleaned trim component is not kept protected from contaminants, or if cleaning occurred more than 20 minutes prior to tape lamination, adhesion failure of the tape to the part may occur due to contamination.

# Lamination of Tape to Part

## Painting

### General Description

The processability and performance parameters for 3M™ Acrylic Foam, Acrylic *Plus*, and Primerless Tapes in paint/bake applications are still being evaluated and are always addressed with tier suppliers on a case-by-case basis. Standard 3M™ Acrylic Foam Tape (AFT) products can only be used in low bake (less than 90°C [194°F]) paintable applications, while 3M™ Acrylic *Plus* Tape Series EX4000, EX4300 and PT1000 products have been shown to be able to withstand the temperatures in some high bake ovens (up to 137°C [280°F]). 3M™ Acrylic Foam Tape RPX1000 Series has been shown to withstand temperatures up to or at 90°C (194°F).

### Best Practice

#### Masking

The best and recommended option to tape a painted part is the masking option. Using this method, the tape land areas of the parts are masked prior to the paint/bake operation, the masking tape is removed after the paint/bake process, and the tape land areas are cleaned, primed – if required -- (using 3M-recommended adhesion promoter) and then taped. Masking the parts prior to the paint/bake operation ensures a clean tape land area that is free of paint over spray and other contaminants.

### Acceptable Options

#### Taping Parts Prior to the Paint/Bake Operation

This discussion will focus on 3M Acrylic *Plus* Tapes Series EX4000, EX4300 and PT1000 in paint/bake applications and not 3M AFTs. One option is to apply a recommended 3M™ Adhesion Promoter to the tape land area and then tape the parts with 3M Acrylic *Plus* "T version" tape prior to the paint/bake operation. The 3M™ Liner GL-3 or ML-1 used on 3M Acrylic *Plus* Tapes Series PT and EX as well as the levelwound versions of the 3M Primerless tapes do not have silicone on the backside, so paint over spray will bond better to these liners and not flake off in the assembly plant.

Each paint/bake application must be evaluated and considered on a case-by-case basis. Any paint process that allows defective parts to be reworked and repainted should be processed through the paint/bake process the highest number of passes allowed. It is important that finished parts are inspected visually, tested to specific part specifications and cycle tested on assembled doors. This testing is recommended prior to the approval of any tape application that goes through a paint/bake process.

\* Note: 3M continues to evaluate other liner constructions and product formulations to improve the performance of 3M Acrylic *Plus* tapes in paint/bake applications.

#### Painting the Tape Lands Prior to Tape Applications

Another option is to paint the entire tape land area with paint primer, base coat and clear coat, prior to tape lamination. On some flexible paint systems, 3M Acrylic *Plus* tapes and 3M Primerless Tapes bond very well. 3M AFTs may be used with the appropriate 3M Adhesion Promoter. Again, each application will have to be thoroughly tested to ensure a good bond has been achieved.

#### Paint Racks Designed to Shield Paint Overspray

The final option is to design the paint racks such that they shield the parts from overspray. 3M Primerless Tapes may be an option for parts processed in this manner. A 3M recommended adhesion promoter may also be applied prior to tape lamination when using 3M Acrylic Foam and Acrylic *Plus* Tapes.

## Risk Factors

Several concerns need to be considered with paintable applications, including the following:

### Paint Overspray

3M does not recommend applying tape to paint overspray. The tape overspray typically has a weak bond to the substrate and reduces the bond strength to the component.

3M Acrylic *Plus* Tapes and 3M Primerless Tapes have very aggressive adhesives that require the use of a two-sided silicone liner. In most instances, the flexible paint systems will not bond well to the silicone on the backside of the liner. During liner removal, poor paint anchorage to a liner may result in paint flaking and subsequent contamination of the tape adhesive.

\* Note: Paint overspray will bond better to 3M™ Liner GL-3 or ML-1 used on 3M Acrylic *Plus* “T-liner” Tape versions.

Another concern with paint overspray is the amount of overspray that ends up on the edges of the tape. A very heavy amount of overspray on the edge of the tape may interfere with the performance of the tape, while a variable amount of overspray may lead to a bond line that is not visually consistent.

### Product Performance

Testing has shown that 3M™ Acrylic *Plus* Tapes may have better wet-out and equal or better adhesion performance than 3M™ Acrylic Foam Tapes after exposure to high temperature paint/bake cycles. Note that there is a time/temperature/paint exposure relationship, in that additional exposures to the paint/bake process may have detrimental effects on the performance of 3M Acrylic *Plus* Tape. To address any potential application concerns, paint-baked parts with 3M Acrylic Tapes will have to be tested per part specification and part cycle testing requirements.

### Product Wrinkling

We have observed 3M Acrylic *Plus* Tapes wrinkling after exposure to some paint/bake operations. This product wrinkling results when the liner lengthens during the bake process and then shrinks back slightly after the parts are cooled. The tape surface underneath the liner is softened during the bake cycle and then disrupted by the movement of the liner. After the part is cooled, the liner deformities on the tape are permanently set. Stretching the tape 3-4% during lamination, which is within our normal tape processing guidelines, can help minimize the formation of wrinkles. In some applications, no product wrinkling is observed after the paint/bake process.

# Lamination of Tape to Part

## Surface Preparation

### General Description

3M has an extensive portfolio of attachment products including 3M Primerless Tapes that may be suitable options for medium surface energy (MSE) or low surface energy (LSE) substrates without the use of an adhesion promoter. Refer to the [Part Design – Materials chart](#) for additional information. Contact a 3M application engineer to discuss tape selection.

If it is found that the current line of 3M Primerless Tapes are not appropriate for your application, an adhesion promoter may be needed. An adhesion promoter is a resin system in a solvent carrier that is applied to a substrate to improve tape adhesion to a substrate. Adhesion promoters are required on some substrates to meet performance requirements. The substrate is the determining factor as to which adhesion promoter to use.

### Promoter Selection

Testing is required before a determination of promoter use or a recommendation can be made. Substrate samples can be submitted to 3M Automotive application engineering for evaluation.

### Recommendations

#### Application Method

The bonding surface should be clean and dry.

When a promoter is required, shake promoter well before using. The adhesion promoter can be applied by a gravity-fed wipe, felt-tipped applicator or a similar applicator. Applicator heads should be cleaned or replaced regularly.

#### Adhesion Promoter Wet Coating Thickness

Apply a thin, uniform coating of promoter to the bonding surface. The recommended wet coating thickness is 0.05 mm (0.002 inches).

#### Adhesion Promoter Drying Time

Drying time will vary depending on the adhesion promoter used, coating thickness, and environmental conditions. Generally, when applied at recommended wet thickness, a 5- to 60-second dry time should be effective.

#### Tape Lamination

For best results, tape should be applied to the prepared surface within one hour. Be sure the primed surface remains free from contaminants prior to tape lamination.

\* Note: Cleaning the part after application of the promoter may disrupt the newly created surface and is not recommended.

### Adhesion Promoter Troubleshooting

#### Application Method

Wiping on the adhesion promoter assures good contact of the solvent with the substrate, allowing the surface to swell and the chemical component to bond to the substrate. If the substrate surface is not clean or the promoter is not wiped on, adhesion failure may be seen between the promoter and substrate.

#### Wet Coating Thickness

If the promoter is applied too thickly, the promoter may split, with some promoter staying with the substrate and some staying with the tape. It is designed to adhere to substrates and tape, not to itself.

### **Drying Time**

If tape is laminated to wet promoter, the new surface designed to adhere to the tape is not formed. Adhesion failure of the tape to the promoter may occur.

### **Tape Lamination**

If the primed surface is not kept protected from contaminants, or if more than one-hour elapses before tape lamination, the tape may not adhere to the promoter due to contamination.



# Lamination of Tape to Part

## Tape Application

### General Description

3M has an extensive portfolio of attachment products including 3M Primerless Tapes that may be suitable options for medium surface energy (MSE) or low surface energy (LSE) substrates without the use of an adhesion promoter. Refer to the [Part Design – Materials chart](#) for additional information. Contact a 3M application engineer to discuss tape selection.

To allow customers the ability to validate the authenticity of 3M products, 3M has transitioned to an enhanced liner on many 3M™ Acrylic Foam and Acrylic Plus Tapes. The 3M branded liner is intended to instill customer confidence in the product quality, comfort in knowing they are receiving the right product, and certainty that they are delivering the right product and performance to their customers. Several competitive products on the market today also take advantage of a red liner, and on occasion, our application engineering teams have identified applications where the customer thought they were using 3M products, but were actually being supplied with a non-3M product. All 3M Automotive Attachment Tapes with the standard red liner feature a subtle 3M logo mark on the liner. If you have any questions as to whether or not your particular tape selection features the branded liner, please refer to the Technical Data Sheet for that product. 3M™ Acrylic Foam Tape RPX1000 Series tapes feature a 3M branded, break resistant liner for more durable use in automated or manual assemblies.

It is recommended that a quick check be made during tape application to ensure that your application is indeed leveraging the strength and brand promise of 3M Attachment Tapes.

Proper tape lamination to an automotive trim component is done by getting 100% contact of the adhesive surface to the part while minimizing any unwanted force, such as stretch, imparted to the tape. This is ideally achieved using roller pressure from one end of the tape to the other as the tape is being applied.

### Recommendations

#### Pressure

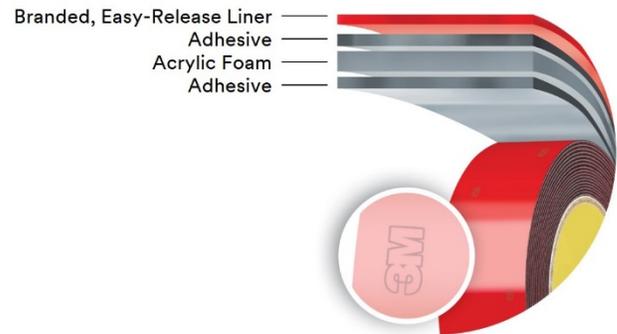
Pressure is needed to provide intimate contact between the tape and the bonding surface. 3M recommends 10-50 N/cm<sup>2</sup> (14.5-72.5 psi) of roller pressure.

Alternatively, immediate compression during lamination can be used to gauge adequate pressurization.

#### Stretch

Forces that create stretch during lamination should be minimized. Excessive stretch results in the liner pulling back from the ends of the tape, liner pop-off or a change in the liner thickness. Several processing parameters affect tape stretch:

- **Pressure:** Excessive pressure can induce stretch in the tape. Noticeably more pressure than that required to achieve 100% tape wet-out should be avoided.
- **Tension:** Minimizing tension along the tape path will minimize stretch in the laminated tape. Areas to keep in mind include: limiting the number of idler rollers, minimizing rotational friction and idler drag, selecting materials that provide good release from 3M adhesives, and maintaining the proper tension on the unwind hub.
- **Speed:** Constant speed serves to minimize tension and stretch. Rapid acceleration can increase stretch, and high speeds may adversely affect start/stop positions.
- **Laminating Roller Diameter:** 3M recommends using a roller 5 cm (2 in) or larger in diameter. The theoretical stretch caused by the roller is determined by the following formula:  $(2 \times \text{Tape/Liner Thickness} / \text{Roller Diameter}) \times 100\% = \% \text{Stretch}$ . Based on this, increasing roller diameter reduces the stretch.



## Temperature

The recommended temperature range for applying 3M™ Acrylic Foam Tapes 3M™ Acrylic Plus, and 3M Primerless Tapes is 18 - 38°C (64.4 – 100.4°F). 3M Acrylic Foam Tape RPX1000 series tapes offer confident application on part over a wide range of temperatures, as low as 5°C (41°F) and up to 40°C (104°F).

## Troubleshooting

### Contamination

During the tape to part lamination process, it is important to avoid contact with the adhesive face of that tape – especially in the application of 3M Primerless Tapes. Sweat, oils, lotion, etc. can create contamination on the adhesive surface that can hinder the bond between the adhesive and substrate. In lamination processes where contact with the tape face cannot be avoided, it is recommended that the operators wear lint free gloves (e.g. Kimberly –Clark™ Purple Nitrile Examination Gloves).

### Pressure

Inadequate pressure will lead to reduced contact, or wet-out, to the bonding surface. A wet-out test can be run to determine the level of contact and assist in troubleshooting (see section on [wet-out procedures](#) in the pressurization section).

Excessive pressure can induce stretch in the tape or cause the tape to take a compression set, which means the tape does not recover to its original thickness.

Alternatives to roller pressure exist, such as platen-type pressurization where the entire tape area would receive the pressurization force at the same time. This is more often used in pressurizing small sections of tape. While this can be successful, it increases the potential for air entrapment under the tape. This occurs when the perimeter of the tape makes contact before the center, which eliminates a path for air to escape. If there are concerns, a wet-out test can be used to evaluate a given tape lamination process.

### Stretch

As stated above, excessive stretch in the tape can cause liner to pull back or liner pop off and may impact the tape thickness. The above outline of process parameters indicates methods of reducing stretch. In some cases, typically extrusions, automotive components may undergo some shrinkage.

If this occurs after tape is applied, liner can ripple and buckle as the tape does not shrink along with the part. This can be overcome by intentionally stretching the tape during application. “Stretch lamination” should be done such that the percent stretch applied to the tape matches the percent shrink expected in the part. Stretch of the tape in these cases should not exceed 4%.

### Temperature

Temperatures outside the recommended range, 18 - 38°C (64.4 – 100.4°F) for most 3M Acrylic Foam Tapes and 3M Acrylic Plus Tapes and 5°C-40°C (41°F-104°F) for 3M Acrylic Foam Tape RPX1000 Series, have the potential of causing issues with tape application. Lower temperatures cause the foam core and adhesive to become stiffer and less compliant, making full contact with the surface more difficult. Higher temperatures soften both the foam and adhesive. While this makes pressurization easier, it may also allow the tape to stretch more.

# Lamination of Tape to Part

## Tabbing

### General Description

Some taped parts are required to have a tab on the liner to facilitate liner removal by line operators. This is most commonly done using an extended liner tab, heat-bond tab, or pressure sensitive adhesive (PSA) tab. A PSA tab will not work on the siliconized liner of 3M Acrylic Foam Tape RPX1000 series.

### Recommendations

The most reliable tabbing method is the extended liner, followed by the heat-bond tab and then a PSA tab.

#### Extended-Liner Tabs

Extended-liner tabs are produced by leaving a small excess of tape past the end of the part. The tape is then removed from this area, leaving just the liner to be used as the tab. This is considered the most reliable because it does not require any secondary process to form the tab, and the liner is continuous. Pre-cut strips or die-cuts with extended liners can be also be ordered through a 3M preferred converter.

#### Heat-Bond Tabs

Heat-bond tabs are formed by using heat and pressure to bond a film to the top surface of the liner near the end of the part. The most common heat-bond tapes used for this purpose are [3M™ Tabbing Tape 5400](#) and [3M™ Tabbing Tape 5081](#). These are typically applied using a liner tabbing machine, such as the [Straub™ Liner Tabbing Machine WL-50](#). The parameters of temperature, pressure, and dwell time are controlled to ensure a good bond of tabbing tape to the liner. Done properly, the tabbing tape forms a permanent bond to the liner. The table below shows the recommended process conditions for both tabbing tapes:

	3M™ Tabbing Tape 5400	3M™ Tabbing Tape 5081
Temperature	149 - 204°C (300 -400°F)	150 - 170°C (302 -338°F)
Time	0.2 – 2.0 sec	1 – 2 sec
Pressure	68 – 413 kPa (10 – 60 psi)	Up to 551 kPa (80 psi*)

\*Amount of pressure required is determined by firmness of substrate.

*Note: Regional variations exist for recommended heat bond tabbing tape. Speak with your application engineering representative for more details.*

If one or more of the heat-bond settings (temperature, time or pressure) is too low, the tabbing tape will not adequately bond to the liner surface and the tabbing tape will peel from the liner during removal.

Excessive temperature and/or time may cause the liner to shrink or melt, which can cause the tabbed area of the liner to release from the tape and increase the chance of tape contamination.

Excessive pressure coupled with higher temperatures could cause the 3M™ Acrylic Foam and Acrylic Plus Tapes to take a compression set – not allowing it to return to its original thickness. The reduced thickness may limit the ability of the tape to make full contact with the vehicle.

The liners used on 3M™ Acrylic Plus Tape Series EX4000, EX4300 and PT1000 and 3M Primerless Tapes are not receptive to heat-bond tabbing without additional processing. See section on “3M™ Acrylic Plus Tape Tabbing” for further information.

## Pressure Sensitive Adhesive (PSA) Tabs

PSA tabs are made using a pressure sensitive adhesive tape bonded to the end of the liner. For 3M™ Acrylic Foam Tapes, the most commonly used PSA tapes are [3M™ Tapping and Splicing Tape 5300](#) and [3M™ Splicing Tape 4240](#). 3M™ Acrylic Plus Tapes and 3M Primerless Tapes require the use of [3M™ Tapping and Splicing Tape 5699](#). Accurate placement and full contact are required when using a PSA tab. The reliability can be increased greatly with the use of an “over-under” tab – one that is folded and applied such that it contacts both sides of the liner.



PSA tabs require more precise placement in order to be reliable. PSA tabs should be applied such that the adhesive makes full contact, especially out to the leading edge of the liner. Ideally the tab should be oriented at an angle to encourage the liner to be pulled from one corner.

Under tabs are significantly more reliable than PSA tabs applied only the top surface of the liner. In this tab, the leading edge of the liner is lifted and the tab is applied to the underside of the liner.

Note: If a PSA tab is used with 3M Acrylic Plus Tape or 3M Primerless Tapes, it is highly recommended that an under or over-under tab is utilized.

### Quality Checks

When evaluating tab performance, care should be taken to minimize the amount of liner that is lifted and to achieve full contact of the liner with the tape when replaced. This will minimize the likelihood of adhesive contamination due to liner lifting during shipment.

\* Straub is a trademark of Straub Design Company.

## Heat-Bond Tapping on 3M Acrylic Plus and Primerless Tapes

Standard rolls of 3M Acrylic Plus Tapes and 3M Primerless Tapes will not accept a heat-bond tab with traditional methods. If no other tapping options exist, there are two solutions available:

### Tabbable Tapes

Tabbable tapes have been introduced to address this issue. These tapes, available in either planetary or levelwound rolls, employ a secondary liner that is removed during tape lamination to the part. The top surface of the liner that stays with the tape is receptive to standard heat-bond tapping methods. 3M recommends the use of [3M™ Tapping Tape 5081](#) with these products (see previous “Heat-Bond Tabs” section).

3M™ Acrylic Foam Tape PX5000 and Acrylic Plus Tape EX4500 are available in a tappable version in levelwound roll form.

### Liner Scuffing

The easy-release coating on 3M Acrylic Plus Tape and 3M Primerless Tape liners can be removed effectively by scuffing the surface with a Scotch-Brite® Wheel or 3M™ Radial Bristle Disc. This quick operation can then be followed with the standard heat-bond tapping operation. The [3M™ Tabber/Abrader UW500](#) performs these operations in a single step. This equipment is available through your 3M application engineer.

Note: Debris generated by this operation should be handled similar to plant dust.

# Lamination of Tape to Part

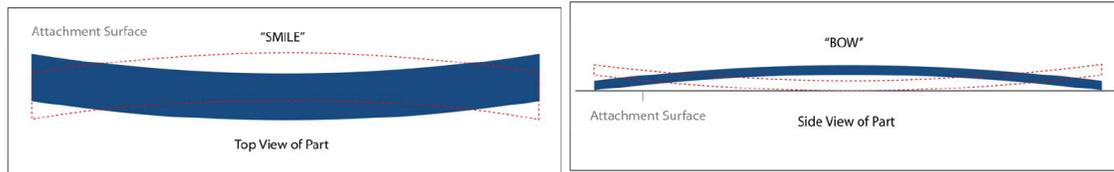
## Quality Checks

### General Description

To increase robustness of tape-attached trims, the following quality checks are recommended.

### Part Dimensional Check

Dimensional checks of finished parts should be made in the free-state (no clamps). Parts should be within tolerance for smile and bowing. Parts exceeding tolerance will transfer larger than designed forces to the tape bond-line and/or lead to insufficient wet-out. Part lifting and/or adhesion failure may occur in the final application as a result. The severity is dependent on the modulus of the part and the degree to which the part is out of dimensional tolerance.

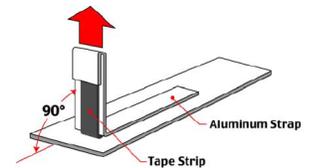


### Tape Adhesion to Part

Monitoring the tape-to-part adhesion is an important ongoing quality test. Determining the level of adhesion between the tape and part is by nature a destructive test and therefore needs to be done on an audit basis.

#### Procedure

An aluminum foil strip equal to or greater than the width of the tape is first laminated by hand to the tape after removing the liner. The strip is made with an overhang on the end of the part. After a fixed dwell time, this overhanging foil strip is pulled at a 90° angle away from the surface of the part at a constant rate (typically 12 inches per minute). Ideally this is done in a tensile load cell device with an appropriate fixture that allows the part to move such that the peel front remains at 90° to the part. The average peel force over a fixed length of peel is reported. Both the average peel force and the resulting mode of failure are important indicators of the lamination quality.



The peel force is a function of tape width. Significant reductions to the average peel force and/or a change to an adhesive failure mode (no tape residue on the part surface) indicates a potential problem with the tape lamination process.

### Tape to Tape-Land Area Relationship

Tape should align with center of tape land area. Ideally, the tape land area is wider than the tape by > 2 mm (0.07 in). A visual check should be conducted to verify that there are no areas where the tape overhangs the tape land or is applied to a hider lip. Overhang will result in a reduction in the amount of tape that effectively supports the part in application. Additionally, interference with a hider lip could cause problems during part installation inhibiting wet-out. Measurements using a steel ruler can be taken of exposed land area along part to verify alignment.

The ends of the tape should not extend beyond the tape land area. Excess tape could wrap around the part and adhere to the A surface. Unsupported tape makes it difficult to remove the liner.

### Compression of Tape

Visually check for any areas on the tape where over-compression (crushing) may have occurred. Areas with a significant reduction in tape thickness indicate over-compression. Tape in these areas will not perform as intended with the potential for reduced wet-out and stress-handling capabilities.

### **Liner Conditions**

The release liner should be smooth and aligned with the edges of the tape. Wrinkling and misalignment produce the potential for contamination of the adhesive surface and are indicators of problems during lamination.

### **Entrapped Air**

Entrapped air (indicated by easily deformed high spots on the surface of the tape) is undesirable as the tape will not have full wet-out to the part tape land area. Reduced stress-handling capabilities will result.

### **Tabs**

Tab effectiveness can be monitored by lifting the liner from the tape by the tab. When this is done on production parts, effort should be made to minimize the amount of liner lifted and realign the liner to the tape before packing. Best practice is to test dummy parts that are disposable to avoid the risk of contaminating the tape surface of a production part.



# Lamination of Tape to Part

## Packaging

### General Description

Packaging is an important factor in ensuring the quality of the parts received at the end use customers without damage to the tape.

### Best Practice

#### Plastic Returnable Containers

Packaging taped parts in rigid plastic containers is the preferred packaging option. Taped parts in these containers should be separated by foamed inserts so the parts do not contact each other and cause damage or initiate peel on the tape liner. Packing with a slight amount of pressure keeps the taped parts stable during shipping. Special attention should be taken to protect the tabbed ends of the parts in order to prevent liner lifting. Care should be taken to remove extra debris/contaminants from returned containers.

### Acceptable Options

#### Corrugated Boxes

Corrugated boxes are commonly used for packaging taped automotive parts. Taped parts in corrugated containers should be separated by sleeves/inserts and should be packaged with a slight amount of pressure so the parts do not contact each other during shipment. Corrugated containers can be dirty and/or dusty and should be inspected prior to use.

### Risk Factors

#### Packaging/Shipping Die Cuts and Taped Parts – Cold Weather

Die cuts and taped parts should be packaged in such a manner that they are well secured. Liner pop off is commonly observed when die cuts contact each other, especially in cold weather conditions. Use of silicone liners may potentially reduce liner pop off during cold weather shipment.

Note: If parts are not packaged separately, parts may potentially adhere together during shipment.

Small parts shipped in bulk should be packaged in a plastic bag that is wrapped as tightly as possible and fits securely in the shipping container. If parts and packages are loosely packed, liner pop-off will be likely, especially in cold weather conditions.

# Lamination of Tape to Part

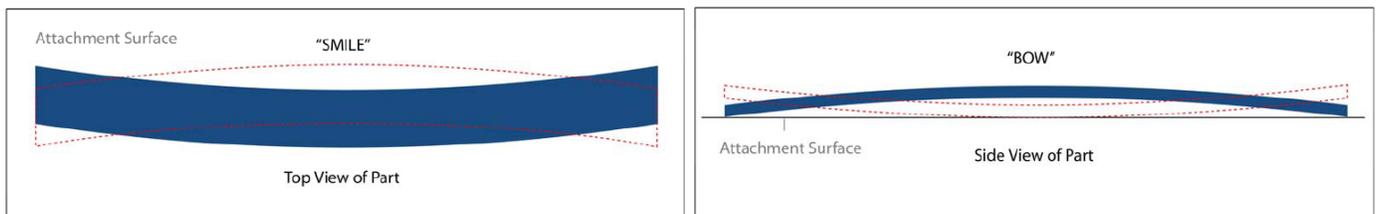
## Finished Part Dimensional Tolerance

### General Description

Dimensional tolerances play an important role in the success of the attachment exterior trim components. The level of tape wet-out and residual stress on the tape bond line is greatly affected by the degree in which the part profile matches the vehicle's sheet metal.

### Overall Part Dimensions

As previously mentioned, dimensional checks of finished parts should be made in the free-state (*no clamps*). Parts should be within tolerance for smile and bowing. Parts exceeding tolerance will transfer larger than designed forces to the tape bond-line and/or lead to insufficient wet-out. Part lifting and/or adhesion failure may occur in the final application as a result. The severity is dependent on the modulus of the part, the degree to which the part is out of dimensional tolerance, and the adhesion characteristics to the paint system involved.



In most cases, the deformed part is forced into its designed shape on the OEM assembly line as it is applied to the vehicle. When this occurs, any residual stress in the part is transferred to the tape bond line. Lowering this residual stress level will improve the application robustness.

### Tape Land

The tape land area should be flat and parallel to the mating sheet metal. Cross-sectional cupping and/or crowning of the land area can affect tape wet-out and pressurization.

### Hider Lip

Hider lips are designed to disguise the edges of the tape from sight. The dimensional height of the hider lips must be at least 0.5 mm (0.02 in) less than the uncompressed thickness of the tape. This difference allows for proper compression and wet-out of the adhesive to the mating surface. Failure to maintain this height difference can result in reduced adhesion, gapping, and/or part failure.



# Placement of Part on Vehicle

## Storage Conditions and Temperature

### General Description

Automotive trim parts that are tape-attached typically require storage and temperature conditions similar to non-taped parts. There are some unique conditions to be aware of that are specific to tape-attached parts.

### Contamination

Contamination from dust or fluids will adversely affect tape performance. Care should be taken to minimize exposing the parts to these contaminants while in storage or on the line. Parts should also be packed and/or sequenced such that the liner remains in contact with the tape. Tape with a liner that has been removed (or popped off) is very susceptible to contamination. 3M recommends that the liner not be removed from the tape until the part is ready to be applied.

### Part Temperature

The recommended temperature range for both the vehicle surface and the part during application is 18 - 38 °C (64.4 - 100°F). Additional heat is not required for 3M pressure sensitive adhesives. There are some situations where part heating may be advantageous:

#### Part Workability

A heated trim component is typically more pliable and therefore conforms easier to the vehicle body. This is especially true of extruded PVC moldings. If there is some mismatch between the trim component and the sheet metal, preheating the part can improve its flexibility and allow for better fit and contact with the vehicle.

#### Cold Part Storage

Parts that are stored cold and installed prior to returning to ambient temperature present two potential issues. A colder part is less flexible and this may affect its ability to conform to the vehicle. Also, a cold part brought into the ambient plant conditions may develop condensation on the surface. Moisture on the tape surface can reduce short-term adhesion performance. In both of these situations, part heating may be required prior to application.

# Placement of Part on Vehicle

## Cleaning

### General Description

The vehicle surface and installation area where the part is to be applied should be clean. Lubricants, mold release, skin oil, airborne dust, etc., can contaminate the body or the trim component and reduce the adhesion performance of the tape to the vehicle. To increase the robustness of the process, the vehicle surface should be cleaned with Scotch-Brite® High-Performance Cleaning Cloths or a 50/50 mixture of isopropyl alcohol and water\* with a clean, non-abrasive cloth.

**\*Important Note:** *State Volatile Organic Compound (VOC) regulations may prohibit the use of this alcohol/water solution. You should check with your state environmental authorities to determine whether use of this solution is restricted or prohibited. When using solvents, extinguish all ignition sources, including pilot lights, and follow the manufacturer's precautions and directions for use.*

### Recommendations

#### Cleaning Method

The best practice is to clean with an automated 3M™ Scotch-Brite™ High Performance Cleaning Cloth, (dry system). Scotch-Brite cloths, which do not require the use of solvents, should be indexed after every three to seven vehicles, or when visually soiled. The frequency of indexing will depend on the amount of contamination and the size of the vehicle surface cleaned. Clean the vehicle surface no more than 20 minutes prior to trim component installation.

Cleaning equipment should be linked to the electronic factory feedback system to notify operators that the equipment is not operational or not indexing properly.

#### Alternate Cleaning Methods

An acceptable alternative is an automated solvent wipe with a clean, non-abrasive cloth. The solvent wipe cloth should be indexed after every vehicle and poses environmental and time-to-dry concerns. After cleaning with a solvent wipe system, allow adequate time for the vehicle body to dry prior to application of the trim component.

If cleaning equipment cannot be hooked into the electronic factory feedback system, each piece of equipment should have an alarm to notify operators that the equipment is not operational or the solvent dispenser has run dry or is empty (if using the solvent system).

Both of these systems can be performed manually. If a facility cleans by hand, the operators should wipe the entire portion of the vehicle to which trim is to be applied.

### Troubleshooting

#### Drying Time (solvent system)

If the trim component is applied to a wet vehicle body, the residual solvent may contaminate the adhesive surface of the tape. This may result in failure of the tape to the vehicle.

#### Vehicle Contamination

Cleaning with a contaminated cloth can compromise the adhesion of the tape to the vehicle. If the vehicle surface is not clean, this may result in lifting or failure of the part to the vehicle.

If cleaning occurred more than 20 minutes prior to application of the trim component, lifting of the part from the vehicle may occur due to contamination.

# Placement of Part on Vehicle

## Liner Removal

### General Description

It is important that the correct technique be used when removing 3M™ Acrylic Foam Tapes, 3M™ Acrylic Plus Tape, and 3M primerless tape liners to minimize the potential of tearing the liner or breaking a liner splice.

To address the expressed need by customers to be able to validate the authenticity of 3M products, 3M has transitioned to an enhanced liner on many 3M Acrylic Foam and Acrylic Plus Tapes. The 3M branded liner is intended to instill customer confidence in the product quality, comfort in knowing they are receiving the right product, and certainty that they are delivering the right product and performance to their customers. Several competitive products on the market today also take advantage of a red liner, and on occasion, our application engineering teams have identified applications where the customer thought they were using 3M products, but were actually being supplied with a non-3M product. All 3M Automotive Attachment Tapes with the standard red liner feature a subtle 3M logo mark on the liner. If you have any questions as to whether or not your particular tape selection features the branded liner, please refer to the Technical Data Sheet for that product. 3M™ Acrylic Foam Tape RPX1000 Series tapes feature a 3M branded, break resistant liner for more durable use in automated or manual assemblies.

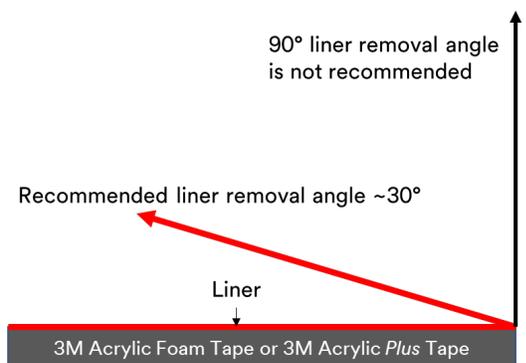


It is recommended that a quick check be made during tape application to ensure that your application is indeed leveraging the strength and brand promise of 3M Attachment Tapes.

### Recommendations

The liner should be removed at an angle less than 90 degrees to the direction of peel of the liner. This means that the position of one's hand, while removing the liner, must remain ahead of the point where the liner is in contact with the tape surface. This position should be maintained during the entire time of liner removal. If the direction of pull on the liner is perpendicular to the direction of the tape, the shear force imparted on the liner can cause a tear or a splice to fail. Splice failure can be identified by a clean tear in the liner usually at an angle of approximate 45 degrees across the tape width or at the location of a tape splice.

\* NOTE: This procedure does not apply to those applications where the liner is removed after the part is positioned on the vehicle.



### Special Cases

In some applications, such as a taped-on wheel flare, the part will be positioned on the vehicle prior to the removal of the liner. The part is typically held in place by positioning pins. In these situations, the removal of the liner at the recommended angle is not possible. Additionally, the liner may be required to withstand removal while being pinched between the part and the sheet metal. Specialty liners with higher strength and tear resistance are recommended for these applications. 3M™ Acrylic Foam Tape RPX1000 Series tapes feature a tear-resistant liner engineered for more robust automation applications. Please contact your 3M application engineer for product recommendations.

# Placement of Part on Vehicle

## Part Positioning

### General Description

This section will describe the critical parameters involved in the initial positioning of the part on the vehicle surface.

### Recommendations

#### Time between Cleaning and Placement

Over time, environmental dust and oils will tend to contaminate the cleaned vehicle surface. 3M suggests a best practice of 20 minutes or less between [cleaning](#) the vehicle surface and placement of the part on the vehicle. This recommendation is based on typical OEM assembly plant conditions. If the application is in an unusually dirty environment, the time between cleaning and application should be reduced appropriately. If a dry wipe system is used, the part can be positioned on the vehicle immediately following cleaning. If solvents are used in the cleaning process, time for the solvents to fully evaporate must be allowed before part placement.

#### Liner Removal

Check for complete [removal](#) of the liner from the 3M tape before placement of the part on the vehicle. The removal of the liner should immediately precede part placement to minimize potential uncovered adhesive surface contamination. Operators should not touch the adhesive surface as oils from skin and/or debris from clothing or gloves can easily transfer and reduce performance via adhesive contamination.

#### Alignment of Part

Proper alignment between the vehicle sheet metal and the part is needed to ensure the proper location of the trim component. [Proper location](#) is critical because the contour of the molding is designed to match a specific area and contour of the sheet metal. Alignment must be achieved before any contact occurs between the adhesive and the metal surface. Initial adhesion is normally high enough to make realignment of the part difficult. Damage to the part and/or adhesive surface can result from attempts to realign the part after contact and is not recommended.

Automated [fixturing](#) is often used to locate and provide initial pressurization of the part on the vehicle surface by referencing hard points such as wheel wells, doorsills, etc. Manual installations often use locator pins to aid in the location process. Manual installations that do not use locator pins rely on the operator to determine the correct position and increase the potential for misalignment.

### Troubleshooting

#### Poor Adhesion

Contamination from dust and oil on either the painted sheet metal surface or the exposed adhesive surface of the tape can result in lower adhesion. To minimize this risk:

1. Verify that liner removal is taking place immediately prior to placement and that the entire liner has been removed.
2. Verify that the adhesive surface is not making contact with anything prior to application.
3. Check that the sheet metal cleaning process is operating properly and is completed less than 20 minutes prior to part application.
4. Verify that the part is not crashing on the sheet metal surface and interfering with adhesive contact.

If manually aligned, check for proper locator pin location and/or potential crashing.

#### Misalignment

Misalignment can result from improper positioning of the tool. To minimize this risk:

1. Check that tool is properly locating designed sheet metal hard points.
2. Verify that the tool accommodates all vehicle trim levels and option packages.
3. Verify that the tool is properly calibrated.

If the part is being manually located, check that the locator pins are properly aligned.

# Placement of Part on Vehicle

## Part Location Fixtures

### General Description

Often, a tape-attached part is placed on a vehicle with assistance of a mechanical fixture used to locate and pressurize the part. This section addresses the recommendations for a part application fixture.

### Recommendations

#### Part Nest

The part nest on the mechanical fixture must hold the part securely without applying any stress, inducing cupping, or causing interference. It must also allow the part to be released from fixture without imposed stress. The nest should be designed to function with parts throughout the range of dimensional tolerances. The surface of the nest that comes in contact with the part should be coated such that no damage is caused to Class A surface.

#### Locating

Proper part placement on the vehicle depends on a consistent locating mechanism. The fixture must be designed such that it mates with the vehicle, keying on a constant location point such as door opening or wheel well. This location point must be held through the application cycle of the fixture.

#### Fixture Balance

The fixture needs to be balanced properly, so the operator can use it easily, and allow the proper introduction of the part to the vehicle in a level and controlled manner.

#### Ejector Pins

Ejector pins are internal to the nest, located below the surface at the resting position. They are used to assist with ejecting the part onto the vehicle. These pins should fire with enough pressure to allow the part to make contact with the body of the vehicle, and with enough pressure to allow sufficient initial tack to hold the part in place until rollers are applied. The pins should be coated so as not to cause any damage to the Class A surface of the part. The number and location of pins will be specific to each application. Confer with a 3M application engineer for recommendations.

#### Cylinder Firing Sequence

Pneumatic cylinders are typically used to power the ejector pins. They need to fire in sequence so that stress is not imparted to the taped part. This sequence will be application specific. Confer with a 3M application engineer for recommendations.

#### Pressurizing

The rollers that apply pressure to the part to adhere it to the vehicle must be positioned to deliver the required pressure to the tape-vehicle interface to ensure the best wet-out and adhesion. Pressure is best applied with smooth, clean rollers directly over the tape location. For larger parts, such as a cladding with multiple tape strips, the best practice is to pressurize the tape on the vertical center of the part before pressurizing the top and bottom sections. Rollers should be checked regularly for signs of wear.

Exercise caution when pressurizing. Rule of thumb is approximately 10-50 N/cm<sup>2</sup> (14.5-72.5 psi). Too much pressure can crease or oil-can the sheet metal. Too much pressure can also induce part flex. A flexed part can give a false reading of proper wet-out and, after roll-down, will spring back to its neutral position and induce stress on the bond to the vehicle.

Pressurization is recommended as part of the application fixture. Often a secondary roller station is used to ensure wet-out and pressurization.

## Roller Station

Stationary roller stands can be used either as primary pressurization or as a secondary operation after initial pressurization is applied by the fixture. As a secondary means of pressurization, the roller station has a broader processing window and provides greater assurance for adequate part adhesion.

When used as primary means of pressurization, the same items mentioned under the pressurization section apply. Rollers must be positioned properly, in the correct vertical position as well as normal to the vehicle, to deliver the required pressure to the tape-vehicle interface in order to ensure the best wet-out and adhesion. Pressure is best applied with smooth, clean rollers.

As with other forms of pressurization, exercise caution when pressurizing. Too much pressure can crease or “oil-can” the body or induce part flex. A flexed part can give a false reading of proper wet-out, and after roll-down, will spring back to its neutral position and induce stress on the bond to the vehicle.

## Troubleshooting

### Surface Contact Testing

A common method of evaluating part application is to conduct a [wet-out test](#). When observing the tape contact area to determine if there are considerable areas lacking wet-out, consider the following checklist of items:

- **Hider Lip:** Does the area of non-wet run along the edge where the hider lip is? If so, check the clearance of the hider lip. Tape should be at least 0.5mm proud of the hider lip.



- **Pressure – Location:** Check to see the rollers are in good condition to apply pressure directly to the tape land areas.
- **Pressure – Amount:** Check the air pressure gauge to determine if the proper amount of pressure is being delivered. The pressure setting should provide a minimum of 10 N/cm<sup>2</sup> (14.5 psi) and should not exceed 50 N/cm<sup>2</sup> (72.5 psi) width of tape at the part-vehicle interface.
- **Ejector Pin:** Does the area of non-wet correspond with a particular ejector pin? If so, check to see all pins are firing and in proper sequence.
- **Part Mismatch:** Hold a part to the vehicle with the liner still on – determine if there is any obvious part mismatch.

# Pressurization

## Time, Roller Angle and Location

### General Description

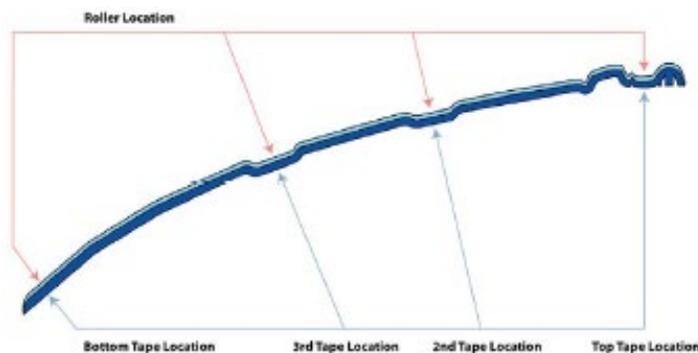
This section will outline potential considerations for the pressurization step of the application process.

### Time Allowed for Part Placement and Pressurization

The exterior part should be positioned on the vehicle surface immediately following the removal of the liner and pressurization should occur immediately.

### Roller Angle and Location

The roller angle should be perpendicular to the tape surface as shown in the cladding example in Figure 1 below. The midpoint of the roller should be directly over the tape land area. Trial tests should be run in the plant at the beginning of a launch to ensure the rollers are at the proper angle and location to achieve wet-out following the application of the part to the vehicle. Once the correct angle and roller location are determined, the dimensions should be documented for repeatability and future reference.



**Figure 1:** This figure shows the location of the rollers is directly over and perpendicular to the strips of tape on this cladding application.

### Roller Pressurizing Force

The initial guideline for the part-bonding pressure to is 10-50 N/cm<sup>2</sup> (14.5-72.5 psi). The actual pressure required to achieve wet-out will be dependent upon both the part section modulus and geometric mismatch of the part to the sheet metal. Adequate tape wet-out should be verified by testing per the [wet-out test method](#). In extreme cases, increasing the pressure will not achieve the desired wet-out result. If the pressurization force is too large, there can be deformation of the part and/or sheet metal. The intent in this process is to pressurize 100% of the tape land area and achieve at least 80% wet-out of the adhesive to the vehicle surface.

For cladding operations, it is better to pressurize the middle tape land areas first, and then pressurize the top and bottom tape land areas next. Pressurizing in this manner will reduce the potential of creating stress on the tape bond line and result in a successful application.

### Troubleshooting

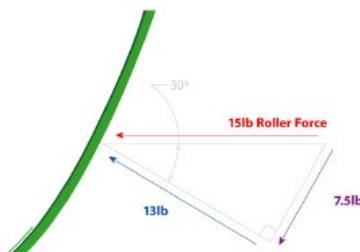


Figure 2 shows an incorrect application of roller force, as the roller is not positioned directly over and perpendicular to the tape land area. 14.5 pounds is applied from the roller, but only 13 pounds of force is normal to the cladding surface and 7.5 pounds of shear force is applied to the cladding.

# Pressurization

## Wet-Out Measurement

### General Description

Wet-out tests are used to aid in design validation and manufacturing process of a tape-attached trim component. Wet-out testing confirms sufficient contact of the tape to the vehicle. Key elements for successful wet-out include part match to vehicle, roller angle, location, and pressure.

### Recommendations

The recommended minimum wet-out is 80%. Applications demonstrating less than 80% wet-out are questionable and are candidates for further process and/or design improvements. Any single area without wet-out shall represent no more than 15% of the total tape surface area. Examples of wet-out test results are included below.

### Plant Wet-Out Test Procedure for PSA-Attached Moldings

1. Apply a very thin coating of water-based paint to the vehicle body, where the parts will be attached, using a closed foam paintbrush.

Note: If the application uses 3M™ Acrylic Plus Tape Series EX4000, EX4300, EX4500, or PT1000, 3M™ Acrylic Foam Tape Series RPX1000 or 3M™ Die-Cuttable Tape Series DC2000, adding UV dye (1 packet per 8 oz. bottle) to the water-based paint will enhance the visual effect under a UV light. Packets of UV dye ([link to SDS](#)) can be obtained from PPG Aerospace/PRC Desoto @ 317-290-1600.

Alternative materials (such as dry erase markers) can be used, although they should be evaluated for effectiveness and clean removal on an inconspicuous area of the vehicle.

2. Allow the paint to become dry to the touch. To verify dryness, check for paint transfer to your fingertips. Do not touch the part interface area when checking for dryness. The paint is ready when none transfers to your finger. Depending on the ambient temperature and humidity, drying should be complete in about three to five minutes at room temperature, or more quickly if body heaters, fans, etc. are used in process. It is important to wait for the paint to be sufficiently dry before beginning the test. Paint that is too wet or too dry will not accurately determine wet-out. Some guidelines for identifying paint that is too dry are found below:
  - "Too-dry" Time Guide: Do not conduct a test when the paint has been on the vehicle for more than 20 minutes.
  - "Too-dry" Visual Guide: Do not conduct a test when the paint is over-dried, or when the paint has a "flaked" appearance on the adhesive surface of the tape after testing.

3. Ensure that any automated surface cleaning operations are disabled for the test vehicle(s) if the test paint needs to be applied before this stage on the production line to allow for proper drying.

4. Remove the tape liner, and process the part using the normal production process.

5. Remove the part, being careful not to touch the tape. The paint will transfer to areas of the tape that are being adequately pressurized, yielding a "footprint" of areas that achieve proper wet-out. Cover the adhesive surface with clear packaging tape to avoid damaging the wet-out imprint.

Look at the tape surface and determine which areas have paint transfer. To determine wet-out, a grid made up of 1 mm x 1 mm squares may be used to measure percent tape wet-out to the body. (Examples of [Wet-out Test Results](#) can be found later in this bulletin.)

6. Upon completion of the test, remove the water-based paint from the vehicle using water and clean cloths. Using solvents or cleaners other than water makes cleaning more difficult.
7. Prepare the bonding surface of the body for the production part by cleaning with a 50/50 alcohol/water\* wash, or use Scotch-Brite® High Performance Cleaning Cloths.

**\*Important Note:** State Volatile Organic Compound (VOC) regulations may prohibit the use of this alcohol/water solution. You should check with your state environmental authorities to determine whether use of this solution is restricted or prohibited. When using solvents, extinguish all ignition sources, including pilot lights, and follow the manufacturer's precautions and directions for use.

## Troubleshooting

If the wet-out test does not meet the 80% minimum, verify the following:

### Roller Angle/Location/Pressure

Incorrect roller angle, location, or pressure can result in unacceptable wet-out test results. Please refer to the [“Pressurization: Time, Roller Angle and Location Guidelines”](#) for additional information.

### Paint too Wet or Dry

It is important to wait for the paint to be sufficiently dry before beginning the test. Paint that is too wet or too dry will not accurately determine wet-out. Some guidelines for identifying paint that is too dry are were shared in step 2 above.

### Proper Application of Wet-Out Test Material to Vehicle

When applying the wet-out test paint, it is important to ensure full coverage of the vehicle body where the molding will be attached. Improper coverage can produce poor wet-out results.

### Sheet Metal Quality

If vehicle sheet metal is outside tolerance, this may result in poor fit of the part to the vehicle and, thus, poor wet-out results.

### Part Match to Vehicle

Components of part match to the vehicle that can negatively affect wet-out test results include: mismatch to the sheet metal, incorrect tape placement, part/hider lip crash, and incorrect part location. Please refer to [Part Design Guidelines](#) for additional information.

### Heat Trim Component

Heating above ambient temperature is not required for 3M pressure sensitive adhesives, but in some instances heat should be applied to the trim component. A heated trim component is typically more pliable and will conform easier to the vehicle surface. This can improve tape contact to the vehicle. The component supplier should be consulted regarding optimum installation temperature.



# Pressurization

## Pressure Measurement

### General Description

Adequate pressure must be applied to a tape-attached part to assure contact with the vehicle and part retention. Delivered pressure between the tape/body interface can be evaluated several ways. This document outlines the use of pressure-indicating film and a Tekscan™ sensor to evaluate pressure.

### Pressure-Indicating Film

Pressure-indicating film works using permanent color changes to show distribution and degrees of pressure, with color intensity proportional to applied force. An internet search of “pressure-indicating film” will provide multiple potential vendors.

### Advantages of Using the Film

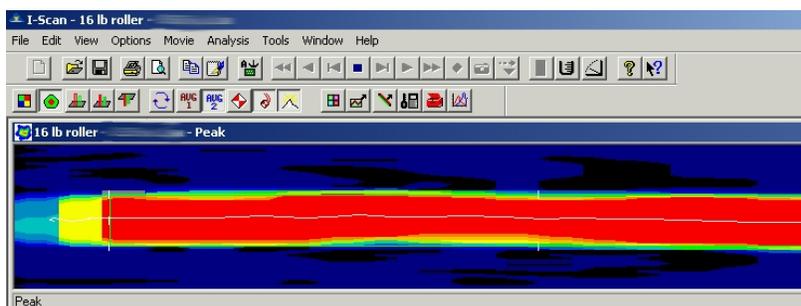
Pressure-indicating films are easy to use and assembly-plant friendly. There are no additional or specialized tools needed for use. They are lightweight, portable and thin – 4-8 mils (0.1-0.2 mm). These physical properties allow them to be adapted to multiple configurations (nameplate, body side molding, cladding, etc) where they can conform to curved surfaces and be used in tight-fitting spaces. The films provide a permanent record of the pressure reading and are an accepted industry measurement (ASTM F2467).

### Disadvantages of Using the Film

The films must be handled with care so as not to activate the developing sheet prior to being placed on the surface. The pressure reading provided is approximate or relative; it is qualitative, not quantitative.

### Computerized Measurement

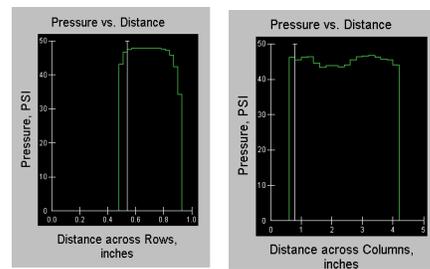
The Tekscan™ sensor unit is one brand of computerized equipment that measures pressure quantitatively through a pressure sensor and allows a more complete analysis of delivered pressure. There are several ways to look at the data with this unit. The main applicable functions are the ability to view the peak load transfer path and pressure distributions.



Peak load transfer path is mapped as a line on the scan.

The peak load transfer path shows the distribution of pressure along the length of the part as well as indicates the path of the peak load. Under standard conditions, it is expected for the peak load line to be the centerline of the part.

Looking at the pressure across the columns and rows shows the pressurization down the length of the part and across the width of the part. In the case illustrated above, there is a 40psi minimum requirement; and the graphs verify that minimum pressure was achieved across and down the entire part.



### **Advantages of Computerized Measurement**

The computerized tool provides quantitative data that can be analyzed multiple ways. The pressure map can be captured and played back in static and dynamic modes. Specific areas can be isolated and studied quantitatively.

### **Disadvantages of Computerized Measurement**

There are different sensors for different load ranges. They can be overloaded and thus destroyed, or they can be oversized and thus not provide good resolution. The sensors can also be damaged with improper handling and may be difficult to fit into low clearance areas. The cost of a computerized unit is not trivial and may add up quickly, depending on what options are chosen.

Tekscan is a trademark of Tekscan, Inc.



## Contact Information

The information provided in this technical document is intended as a guide for this product. For more information or help in selecting a 3M product for an application, please contact your 3M application engineering representative or [connect with a 3M expert](#).

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