Accelerating Automotive Assembly with Norbond® Attachment Tapes

NORBOND®

Saint-Gobain® Tape Solutions

North America | South America | Europe | Asia

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Permanently bonded assemblies in automotive exterior applications—such as emblems and decals, wheel weights and body side molding—require a high-performance, durable and reliable attachment technology amenable to high-speed automotive manufacturing processes. While alternative joining methods are available, such as mechanical fastening and liquid adhesive, foam bonding tapes have become the preferred technology for reliably, efficiently and cost-effectively bonding automotive exterior components.

1. Wheel balancing weights
2. Side mirrors
3. Emblems, nameplates and logos
4. Antennas, aeroflaps, roof ditch molding
5. Brake shims
6. Body side moldings
7. B-pillar covers / pillar appliqué
8. Door sill trim, step trim and door edge molding
9. Windshield and cowl grills
10. Rain sensors/ parking sensors
11. Wheel flares
12. Window lace, window frame and brake light spoiler
13. Headlight washer
14. Rocker panel
15. Trunk and bumper molding

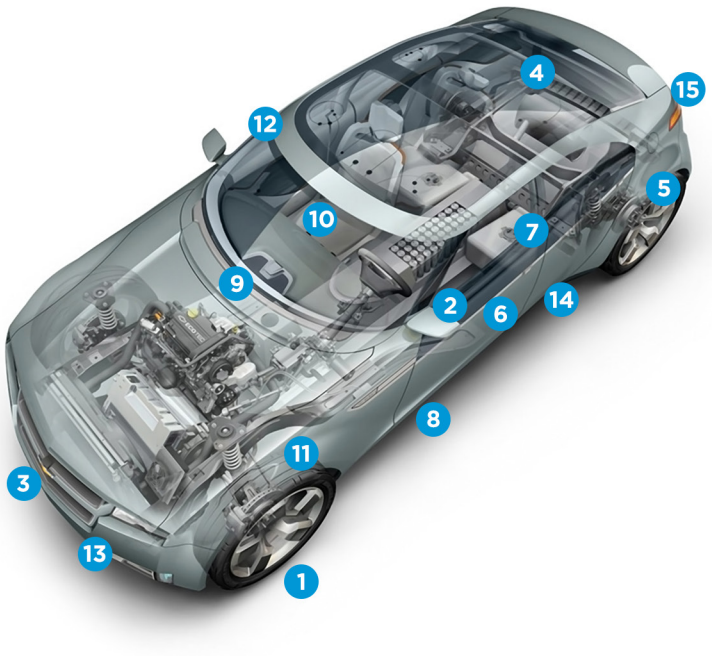

Figure 1. Automotive exterior and body components requiring high performance, durability and reliable attachment.

Source: **Saint-Gobain**.

Saint-Gobain Norbond Attachment Tapes are engineered to provide durable, long-lasting security in a range of vehicle applications by combining elastomeric foam cores with a durable pressure-sensitive acrylic adhesive. **Norbond** Attachment Tapes provide excellent resistance to a wide variety of conditions and are the optimum tapes for exterior applications.

Tape Bonding Methods

Well-engineered **Norbond** Attachment Tapes can solve many of the assembly problems encountered with other attachment technologies. Adhesive tape attachment is faster and easier compared to liquid adhesives. Tape attachment does not require special equipment beyond assembly line presses for applying adequate pressure to the tape. Foam attachment tapes should be applied with 15 PSI pressure for at least five seconds. Rolls of attachment tape or pre-cut tape pads contoured to the bond area are easy to dispense. **Norbond** Attachment Tape solutions adapt to automation to reduce labor costs and increase bond consistency by eliminating human errors. Cleaning the surface with isopropyl alcohol (IPA) or an IPA and water mixture is always recommended. Abrasive cleaning can be an effective alternative to ensure a clean surface for bond integrity.

Tape attachment methods provide a neat, clean appearance without creating holes or stress concentrations, reducing chances of leaks, corrosion and damaged surfaces.

Norbond Attachment Tapes provide several advantages for bond integrity:

- The joint load is distributed across a wider surface area. This eliminates stress concentrations and minimizes material property differences, such as mismatches in elastic modulus and thermal expansion coefficient.
- Adhesives and foam are flexible and are therefore resilient to light impacts and are more forgiving compared to more brittle assembly methods.
- Foam's flexibility allows the tape to conform to body contours and shapes, providing a more complete bond and better load distribution.
- Foam accommodates dimensional variations and mismatch arising from stack-up tolerances.
- There are no residual stresses from fasteners or thermal curing shrinkage, which is important when bonding long trim parts, where fasteners might lead to buckling or distortion depending on thermal expansion coefficients.
- Bond strength increases after initial assembly, reaching peak strength after 72 hours as additional adhesive bonds form.

Norbond Attachment Tapes offer several performance benefits, including:

- Vibration and shock isolation
- Good thermal and acoustical insulation
- Sealing, in addition to bonding
- Non-conductive joints, which are important for bonding dissimilar metals and alloys
- Reduction or elimination of rattling noise from mechanical fasteners
- A clean, neat appearance
- Improvement in manufacturing throughput
- Streamlined automotive body surfaces to minimize parasitic drag

Types of Norbond Foam Attachment Tapes

Foam attachment tapes are a type of double-coated or double-sided tape. Adhesive material types can include acrylic, silicone and rubber (polyisoprene); adhesive technologies include pressure-sensitive adhesives, heat-activated adhesives and hot-melt adhesives. **Norbond** Attachment Tapes utilize acrylic PSA coatings.

Tape nomenclature is usually based on the core or carrier material. Foam bonding tapes have a carrier or backing consisting of flexible foam. **Saint-Gobain** provides two types of bonding tapes, **Norbond** Acrylic Foam Attachment Tapes and **Norbond** PUR (Polyurethane) Foam Attachment Tapes.

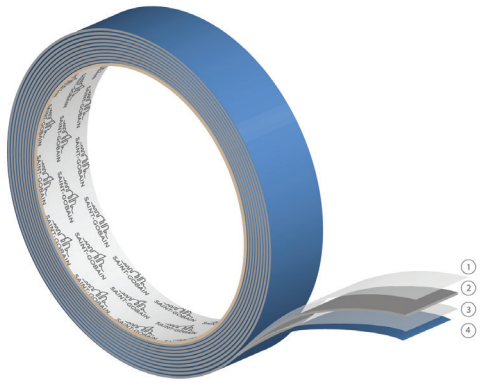

Figure 2. Construction of automotive foam attachment tape. Represented in this figure are: (1) Face-side adhesive, (2) foam core, (3) liner-side adhesive and (4) removable release liner.

Source: **Saint-Gobain**.

Foam Attachment Tape Performance Properties

Understanding the tensile properties of foam bonding tapes is important in selecting the optimal **Norbond** Foam Attachment Tape for an assembly application. Polyurethane (PUR) foam cores have a higher tensile break strength compared to acrylic foam. Acrylic foams have higher flexibility or ductility based on their elongation values. High elongation allows **Norbond** Acrylic Foam Tapes to accommodate larger strains before breaking, which is useful in bonding large flat components to body panels where CTE mismatches occur. The area under the stress-strain curve provides an indication of toughness, so acrylic foam backings should be tougher than the PUR foam backings. **Norbond** PUR Attachment Tape is often better for bonding small parts like emblems where a higher tensile strength is required.

Evaluation of adhesive properties and bond strength depends on the mode of loading. Loads across the joint can be applied in tensile (pluck), peel and lap shear modes. Specific adhesion tests simulate these field conditions. Adhesion strength will vary with the type of substrate, applied pressure, temperature and surface pre-treatment. Polypropylene, polyethylene and thermoplastic olefin substrates have low-energy surfaces that impair surface wetting, a prerequisite for sound adhesive bonds. Activator coatings, corona treatments and similar surface treatments can increase surface energy and wettability. Consult the foam tape manufacturer for specific recommendations. **Saint-Gobain**, a well-respected foam attachment tape manufacturer, has a long history of developing automotive exterior bonding systems. Choosing **Saint-Gobain** as your partner in developing the attachment systems for your automotive body and exterior components can ensure the success of a design project.

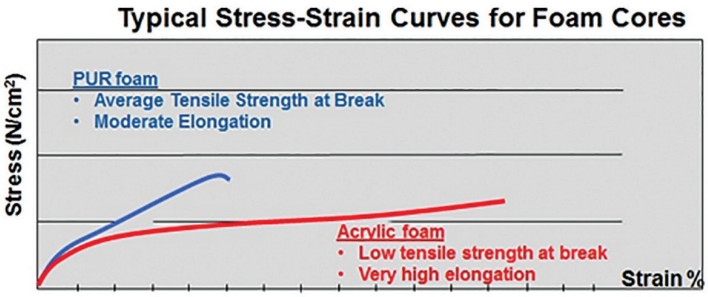

Figure 3. Typical stress-strain behavior curves for **Norbond** polyurethane (PUR) and acrylic foam backings.

Source: **Saint-Gobain**.

Once the engineer understands joint loading from stress analysis studies, the optimal bonding tape materials can be selected based on the peel, tensile and shear adhesion properties. A single or primary loading mode may occur in some cases, while multimodal loading occurs in others. Small parts such as emblems, nameplates, shark fin antennas and sensors have high tensile and shear loads, so polyurethane would provide the best bonding performance. Long, narrow, flexible components such as body side moldings, fender or wheel flares, window frames, rocker panels and pillar appliqués experience peel stresses, so an acrylic attachment foam would be recommended. **Norbond** Acrylic Foam Attachment Tapes have superior UV resistance compared to **Norbond** PUR Foam Tapes. Polyurethane foam has higher compressibility, cushioning and dampening characteristics, which make **Norbond** PUR Foams more effective in reducing noise, vibration and harshness (NVH).

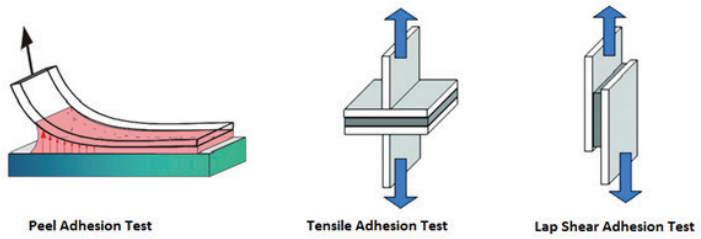

Figure 4. Adhesion bond test modes: peel, tensile (pluck) and lap shear.

Source: **Saint-Gobain**.

Attachment Tape	Average Continuous Peel Adhesion (N/cm)	Peak Dynamic Tensile Adhesion (kPa)	Peak Dynamic Shear Adhesion (kPa)
Acrylic Foam	39	530	650
Polyurethane Foam	14	840	850

Figure 5. Adhesion properties of acrylic and foam attachment tape samples in peel, tensile and shear tests on painted panels simulating automotive body panels.

Source: **Saint-Gobain**.

Tape Carrier Type	Distinct Advantages	General Performance	Typical Applications	Saint-Gobain Product Offering
Acrylic Tapes	UV Resistance	High Peel Adhesion	**Body Side Molding**	**Norbond** Z2000 Series Acrylic Tape
	Viscoelastic	High Elongation	**Longer Parts**	**Norbond** Z3000 Series Acrylic Tape
	Low Water Vapor Transmission Rate	Stress Relaxation	**Differential Expansions**	
Urethane Tapes (PUR)	Compressibility Cushioning / NVH	High Shear Resistance	**Emblems**	
	Die Cutting	Great Tensile Adhesion	**Wheel Weights**	**Norbond** Z500 Series PUR Tape
		Conformability		

Figure 6. Performance, advantages and typical applications of acrylic and polyurethane foam attachment tapes.

Source: **Saint-Gobain**.

Design Tips and Next Steps

- Early in the design process, consult with experienced application engineers from **Saint-Gobain**. Leverage the materials, design and manufacturing knowledge from these experts to start the development and material selection processes on the path toward success.
- Design the components for exterior attachment with the largest bonding surface possible while avoiding any surface irregularities or voids.
  - Bonding surfaces should be smooth and clean for optimal bond strength.
  - Design the curvature of the part to match the mating body surface.
  - Ribbing or webbing is sometimes designed into a body part to reduce material cost, add stiffness or provide a uniform wall thickness for molding. Designing the part with a rib-free low profile and a larger bond area might be a better option.
  - Hider lips on the edges of parts should be shallow enough so they do not reduce the effective application pressure or contact the clear coat when assembly pressure is applied.
  - Keep the **Norbond** Attachment Tape as close to the edge as possible to avoid ingress of water behind the part and possible freezing.
  - Positioning pins or locating features can aid in proper part placement, but they should be designed to not interfere with the bonding surface.
  - Tapes should be applied starting from one corner to avoid bubbles or folds that reduce the effective contact area.
- Wettability of the bonding surfaces is important. Primers or adhesion promoters can increase surface energy and wetting. Some primers also contain coupling agents and catalysts. Consult with **Saint-Gobain** for recommendations.
  - Body parts made of polypropylene (PP), polyvinylchloride (PVC), ethylene propylene diene monomer rubber (EPDM), thermoplastic olefin (TPO) and thermoplastic polyurethane (TPU) materials typically require a primer coating. **Norbond** Z3000 is an excellent option to consider for primerless bonding to these types of LSE substrates.
  - Body parts made of acrylic, nylon, polyamide, acrylonitrile-butadiene-styrene (ABS), reaction injection molded or thermoset polyurethane and polycarbonate materials sometimes require a primer coating. **Norbond** Z2000 is an excellent option to consider for primerless bonding to these types of MSE substrates.
  - When bonding dissimilar materials, consult with **Saint-Gobain** to determine if a differential foam attachment tape with different adhesives on each side is suitable.
- The minimum **Norbond** Tape thickness is related to the maximum dimensional changes in the part (or the difference in expansion between the part and panel), which is a function of the operating temperature ranges and the coefficients of expansion of the workpieces.

Conclusion

Delivering the highest quality and longest lasting foam attachment tapes for automotive exterior attachment applications is just a call or click away. Visit the **Saint-Gobain** Tape Solutions website for more information, or call 518-642-2200.

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