



## Trends in Adhesives and Tapes

### Bonding Dissimilar Materials Using Adhesives and Tapes

By: Brent White, Global Marketing Manager and Shari Loushin, Senior Technical Service Specialist – Structural Adhesives at 3M Company

The options available to engineers for projects that require fastening and joining have expanded dramatically since mechanical fasteners were an industry standard. From attaching a transparent lid to the body of a washing machine to manufacturing automobiles and airplanes, adhesives are rapidly becoming the preferred choice of engineers for assembly projects.



CAPTION: Adhesives are an alternative to mechanical fasteners for all kinds of assemblies, including large surface lamination (pictured above). In large surface lamination assemblies, adhesives can cover the full surface area, are flexible when dry, and bond quickly with little or no fixturing.

#### Adhesive Trends

Adhesives are developed to meet and exceed an engineer's process and performance needs; including speed, durability and level of customizability for process time considerations. Adhesives can be formulated with multiple viscosities and even made into tapes and films.



**CAPTION:** As an alternate to mechanical fasteners, Acrylic Foam Tapes offer immediate handling strength and the ease and convenience of a tape solution.

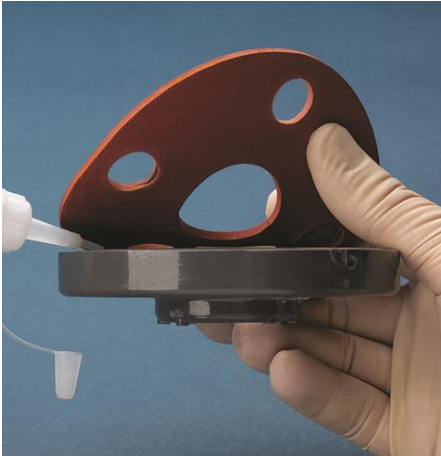
Though easy to apply manually, the option to automate adhesive application is open to engineers as well. This is a growing trend because engineers across industry lines are always looking for new ways to lower production and labor costs. Even two-part adhesives can be applied automatically from specially designed cartridges. These cartridges use dispensing applicators and static mix nozzles to ensure full mixing of the precise ratios of adhesives with the touch of a button. Such units can be bench-mounted for foot pedal control and controlled shot sizes. For even larger applications, meter-mix equipment is manufactured to be customized and interfaced with robotic application heads.

Other advancements continue to be made in developing adhesives based on specific industry trends and demands. For example, low-odor adhesives are on the market in order to fill a need for more comfortable work environments. In order to align with sustainability initiatives, some adhesives are manufactured without the use of volatile organic solvents. With design factors in mind, using adhesives can replace rivets and weld lines, and enable lightweight and cost efficient designs.

Recent trends and developments in adhesives include adhesives that are flexible to allow differential thermal expansion of substrates, using adhesives to bond dissimilar materials, and adhesives that can accommodate low-surface energy materials.

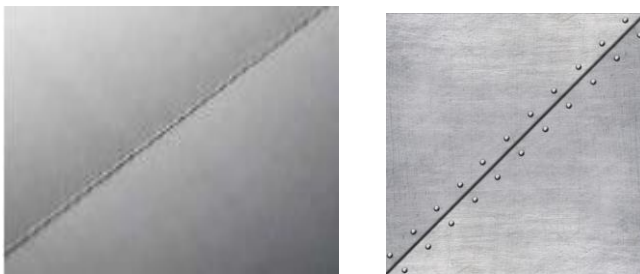
### Bonding Multiple Materials: Challenges and Adhesive Solutions

Materials with different coefficients of thermal expansion (CTEs) will contract and expand differently under temperature variations. Mechanical fasteners do not have the flexibility to allow expansion or contraction of these materials during temperature variations without causing damage, or unsightly bulging. With that in mind, certain adhesives are made to be flexible to accommodate movement caused by thermal expansion of the substrates. Because adhesives do not require puncturing holes in metals that may have protective coatings or paint, the metal underneath remains protected from exposure to the elements. In this way, adhesives prevent damage induced by thermal expansion and maintain protective coatings on materials, lengthening the life of the joint and the product.



CAPTION: Adhesives can be used to bond difficult substrates such as silicone gaskets.

Using composite materials in projects can lead to bonding challenges, which drives the need for adhesives and adhesive development. Mechanical fasteners including rivets and bolts are not ideal for joining composites, as drilling holes can damage the substrates, which can lead to money and time being wasted on repairs or replacement. Furthermore, drilling holes in the material causes the load-bearing stress to be concentrated entirely at the fastening point, which can lead to early failure. An adhesive bond transfers the load over the whole joint area, therefore distributing the load bearing stress evenly throughout. Additionally, adhesives increase product quality and longevity by improving the fatigue performance of riveted joints<sup>1</sup>.



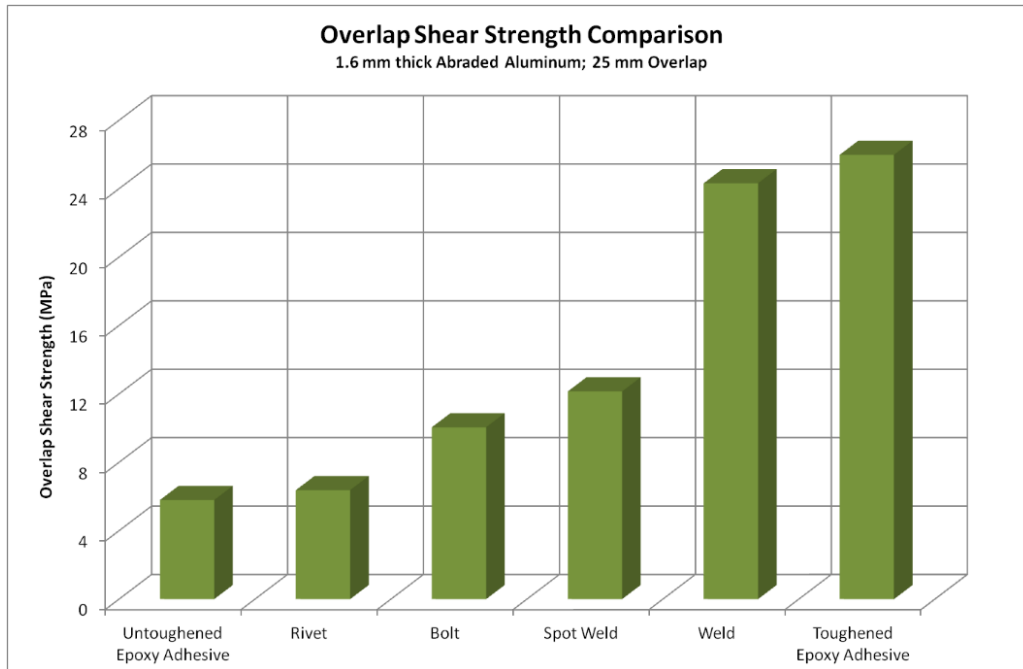
CAPTION: Adhesives eliminate the risk of damaging the substrate by drilling holes, and transfer the load-bearing weight throughout the entire surface area of the substrate.

Using mechanical fasteners for these types of projects can limit the engineer's options for materials, or require engineers to increase the thickness of the material, whereas using adhesives allows thinner or lighter materials to be selected. For example, SMC, plastics or thinner gauged aluminum or steel can be substituted where steel has been traditionally used for cowlings or enclosures. This reduces cost spent on material, and opens up manufacturing options that may not be available when restricted to using thick materials. Adhesives work to lower costs in other ways as well, through increasing productivity and efficiency in production.

---

<sup>1</sup> F. Moroni and A Pirondi, "Technology of Rivet: Adhesive Joints," *Hybrid Adhesive Joints*, 79-94 (2011).

With adhesives there is no grinding off weld marks, adding sealant to make the design waterproof or straightening warped pieces, so throughput becomes faster.



**CAPTION:** This chart shows the capability of adhesives versus other common fastening methods.

Bonding materials often requires extensive surface preparation, especially when one or more of the materials is oily or has low surface energy. In cases like this, special adhesives including polypropylene, polyethylene, thermoplastic polyolefin (TPO), polytetrafluoroethylene (PTFE), polybutylene terephthalate (PBT), polystyrene, ethylene propylene diene monomer (EPDM) rubber and silicone are available. These adhesives are developed to accommodate hard to bond materials, so engineers can eliminate or drastically reduce tedious surface preparation steps by choosing the correct adhesive for the substrate. These hard to bond surfaces will require testing to find an optimal solution, so the best route is to work with an adhesive supplier to determine the best product for the project at hand.

#### Advice for Engineers from 3M Assembly Solutions

When selecting an adhesive, it's important to ask the following questions:

1. Assembly – What type of assembly is required? It could be a simple as attaching trim or a gasket, to mounting panels to framework, or full surface lamination.
2. Substrate – What are the materials that need to be assembled? For example, joining dissimilar materials may require a more flexible adhesive to accommodate difference in movement.
3. Process- How can adhesive or tape bonding be implemented in the manufacturing process? This could be manual or automated assembly depending upon part sizes, volume and other factors.
4. End-use – How and where is the final product used? For example there may be environmental requirements for the assembly like extreme temperature, UV or chemical exposures.

5. **Cost-** Can improvements be made in the assembly process? Often use of adhesives and tapes can help reduce labor, process steps, or enable using less expensive materials for the assembly.

Making the transition from mechanical fasteners to adhesives often comes with a qualification period for the engineer, because he or she will need to test out different types of adhesives with varying qualities and strengths to determine which is appropriate for the project. Choosing a partner that will help narrow down adhesive options is a smart move because it can reduce the time and costs associated with this phase of the project.

From applications as large as mounting a highway sign to as small as attaching a golf club's head to its shaft, adhesives are opening up doors for assembly projects in every industry. Because adhesives can differ so much in strength and purpose, it is imperative for an engineer to partner with the right provider who can assist in these assembly challenges and provide insight on the best solutions. A good provider will also give advice on testing protocol and perform screening tests, to help the engineer avoid incurring additional expense, or wasting money and time on adhesives that will not fit a particular project.

Visit [3M.com/assemblysolutions](http://3M.com/assemblysolutions) for more information on how 3M can help solve your assembly challenge.

**Technical Information:** The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

**Product Use:** Many factors beyond 3M's control and uniquely within user's knowledge and control can affect the use and performance of a 3M product in a particular application. Given the variety of factors that can affect the use and performance of a 3M product, user is solely responsible for evaluating the 3M product and determining whether it is fit for a particular purpose and suitable for user's method of application.

**Warranty, Limited Remedy and Disclaimer:** Unless an additional warranty is specifically stated on the applicable 3M product packaging or product literature, 3M warrants that each 3M product meets the applicable 3M product specification at the time 3M ships the product. 3M MAKES NO OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY IMPLIED WARRANTY OR CONDITION ARISING OUT OF A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE. If the 3M product does not conform to this warranty, then the sole and exclusive remedy is, at 3M's option, replacement of the 3M product or refund of the purchase price.

**Limitation of Liability:** Except where prohibited by law, 3M will not be liable for any loss or damage arising from the 3M product, whether direct, indirect, special, incidental or consequential, regardless of the legal theory asserted, including warranty, contract, negligence or strict liability.



**Industrial Adhesives and Tapes Division**

3M Center, Building 225-3S-06  
St. Paul, MN 55144-1000  
800-362-3550 • 877-369-2923 (Fax)  
[www.3M.com/assemblysolutions](http://www.3M.com/assemblysolutions)

3M is a trademark of 3M Company.  
© 3M 2016