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Securing a new bond

As the global solar and PV industries expand there is an increase in production materials, processes and tools available to the manufacturer. The increased competition further encourages companies to differentiate their offerings. **LORD Corporation** discusses how structural adhesives provide a viable alternative to current fixing methods and suggests that for the solar industry it is a perfect bond.

The challenge for solar power panel manufacturers is they must manufacture a product that can withstand more than excessive thermal and mechanical stress but must also endure harsh environmental conditions, sunlight, wind, rain. On top of this the product must operate continuously under these conditions. The reality for solar power panel manufacturers is finding methods to meet these operating parameters and is crucial to the overall performance of their product.

According to a recent report from the Solar Energy Industries Association (SEIA) and GTM Research, "The U.S. solar energy industry had a banner year in 2010, with the industry's total market value growing 67-percent from $36-billion in 2009 to $60-billion in 2010. The report states, "Solar was a bright spot in the U.S. economy last year as the fastest growing energy sector."

As the demand for solar power installations continues to increase across the globe, manufacturers are looking for new methods to help cut production and installation costs, allowing them to extend the savings to the consumer. As a solution that can potentially streamline costs, decrease maintenance, and improve durability and life expectancy of solar panels, manufacturers are transitioning from traditional mechanical fasteners to high-performance structural adhesives.

A Viable Alternative

As an alternative to mechanical fasteners, structural adhesives offer the advantages of reduced stress points, leaks and corrosion; resistance to extreme environmental conditions;

the ability to join dissimilar materials; enhanced sealant properties; and increased structural rigidity. Structural adhesives are defined as load-bearing adhesives – they can withstand a constant load on the bond without undergoing creep or losing adhesion. The most common structural adhesives are available in three chemistries: acrylic, epoxy and urethane. Service temperature, environmental exposure, and curing temperature and time will determine which adhesive is suitable for a particular application. Generally, acrylics are ideal for bonding unprepared metals, composites and thermoplastics. Epoxies and urethanes typically are used to bond prepared metals and composites. For higher service temperatures, acrylics and epoxies will provide the best performance.

Proven Applications

Adhesive bonding is an established joining method, proven in a variety of end-use markets, including automotive, exterior signage and transportation. In each of these industries, the benefits of structural adhesives have helped to reduce manufacturing costs, decrease production times and increase the structural rigidity of components. In the automotive industry, adhesives are used both during the initial assembly process as well as for aftermarket repair. Door panels bonded with structural adhesives have significantly more impact resistance than welded doors. Using structural adhesives has improved the corrosion resistance of automobiles by eliminating hundreds of welds. (Figure 1)

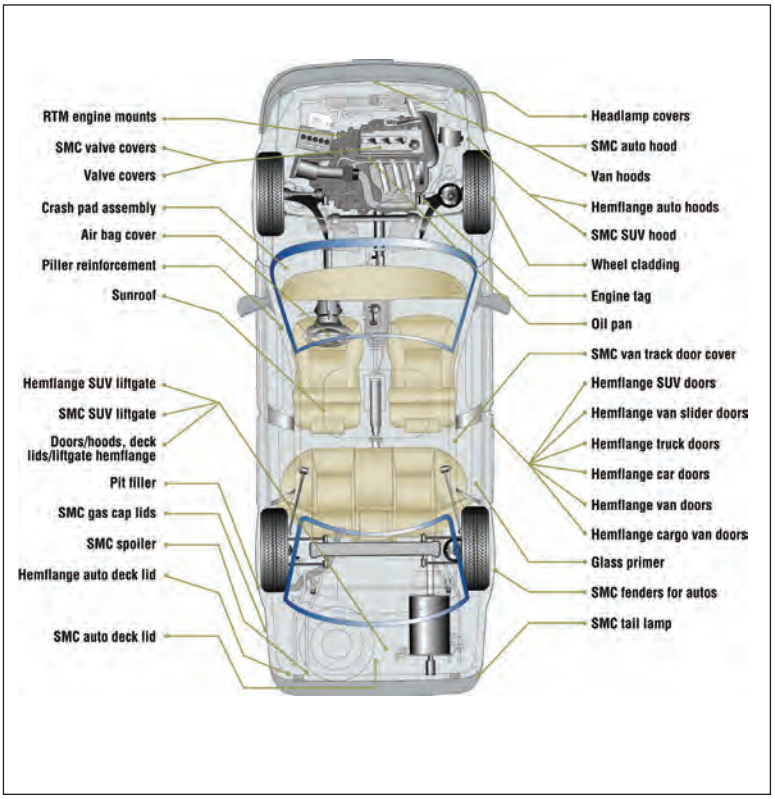


Figure 1: Adhesives provide superior structural integrity in applications for the automotive industry

Sign manufacturers have found that using structural adhesives offer a considerable time savings during the assembly process compared to traditional fastening methods and/or welding operations. In the sign industry, structural adhesives are used in the assembly of sign extrusions; to mount letters and raceway brackets; and to adhere sign-mounting attachments. (Figure 2)

For the transportation industry, structural adhesives have demonstrated excellent durability in harsh environments over an extended period to time. The adhesives are widely used where structural integrity is required on roof, sidewall, door, and floor assemblies on trailers, medium-duty trucks, specialty and recreational vehicles, and buses.

Reliable and Durable

As noted earlier, environmental resistance is especially important to solar installations. Structural adhesives have demonstrated outstanding environmental resistance in real-world applications. In a large heliostat installation, an acrylic adhesive was used to bond corner clips (to reinforce the panel's metal frame), channels for sealants, and module support doublers. After more than 25-years of operation, the adhesive has provided excellent durability with no failures. Similarly, adhesives have been successfully used for many years to construct aluminum satellite dishes, commercial signage and military transport vehicles, where excessive thermal and mechanical stresses create fatigue conditions.

Accelerated fatigue testing has proven that structural adhesives are successfully resistant to the thermal and mechanical stresses posed on these assemblies. In one example, an adhesively bonded specimen was tested for its ability to withstand various loads applied to the joint. The bonded specimen surpassed 10,000,000-cycles of repeated loadings of 900 psi.

Figure 2: Using a handheld cartridge, a worker easily applies adhesive during sign assembly

Figure 3: Two-part adhesives supplied in convenient side-by-side cartridges

Structural adhesives offer tremendous opportunities to the solar power industry

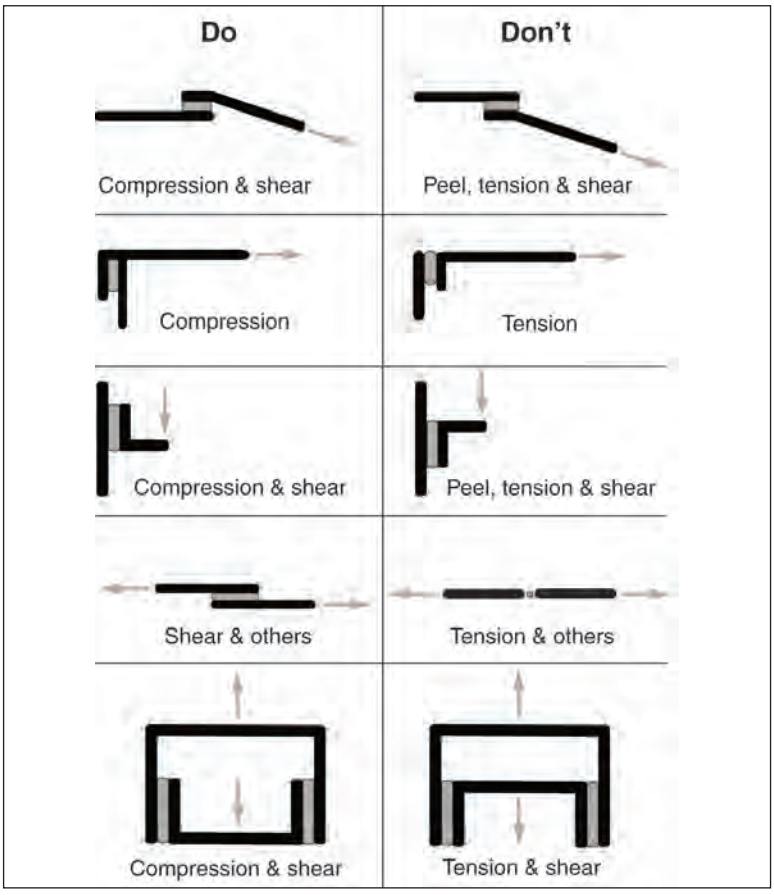
Adhesives not only reduce the weight of an overall installation, but they also reduce maintenance and warranty costs, compared to using traditional nuts and bolts. Over time, bolts and screws will loosen and work themselves loose due to wind-induced and/or structural vibration, requiring periodic maintenance. Once a panel is bonded, the bond requires no additional maintenance.

Structural adhesives have been used to replace mechanical fasteners in solar frame assemblies, frame-to-rack installations, and rack-to-tracking systems. These replacements have resulted in a simpler, more robust installation process that produces an array that can survive the 25-year lifespan promised by many solar equipment manufacturers.

Selection Criteria

When choosing a structural adhesive, it is important to consider cure times, and joint and process design. Paying attention to these parameters will ensure that the adhesive chosen will match the application. Two-component (resin and curative) adhesive systems provide the broadest range of cure times. With this system, the components are separated until just prior to use. For small volume applications, the components are supplied in a side-by-side cartridge configuration (Figure 3) and dispensed through a manual or pneumatic caulk gun. For higher volume use, adhesives are dispensed through meter-mix units. Cure times range from minutes to hours, allowing users to select an adhesive that is optimal for their process. Faster-curing adhesives can reach handling strengths within minutes of application to the substrate.

Figure 4: Recommended "Dos" and "Don'ts" for joint design



If heat is applied, quicker cure times can be achieved. Slower curing adhesives can take several hours to acquire handling strength. Though many designs for traditional joining methods might not appear to be good candidates for structural-adhesive bonding, in reality it is not difficult to convert to adhesive bonding. When designing a bonded joint, it is better to design for shear and compressive loading, while avoiding peel and high-tensile loading. (Figure 4)

Cure speed and fixturing should be taken into account when implementing adhesives into the manufacturing process. The cure speed of the adhesive must be balanced to allow for easy application of the adhesive and optimum throughput of bonded assemblies. Fixturing allows assemblies to remain in the correct alignment during the curing process. Sufficient pressure applied to the bond line ensures intimate contact between the substrate and the adhesive.

A Solar Solution

While the primary function of a structural adhesive is the joining of two or more components, other benefits are of particular importance to the solar panel manufacturers. Providing protection against the elements, equally distributing stresses, eliminating galvanic corrosion, and improving structural rigidity are examples of additional benefits that make structural adhesives a wise alternative to traditional fastening methods.

In addition, don't forget a major advantage - significantly reduces maintenance after the initial installation. Whether bonding frames to racking systems or racks to tracking systems, structural adhesives provide a simple alternative to the multiple mechanical fasteners used in joining metal components in solar installations.