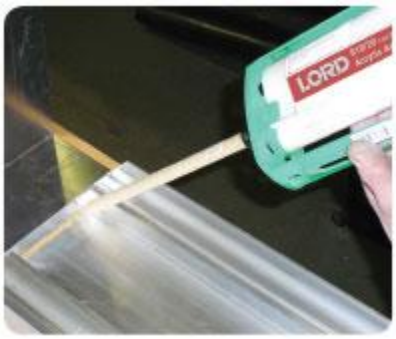
Avoiding panel read-through problems

Larry Johns | July 15, 2015

As automakers join multiple, different materials in vehicle structures, new adhesives can eliminate common cosmetic flaws.



Read-through baffles many vehicle OEMs and parts suppliers. Read-through occurs when you can actually see the adhesive used for assembling automotive parts through the substrate. Anything assembled with thin-gauge materials (composite or metal) can suffer from this surface distortion problem. Seeing the adhesive line is not acceptable to automotive OEMs looking to achieve a Class A finish.

Why does read-through occur? Often the substrate is blamed. To remedy read-through problems, OEMs will often revise their designs and switch back to substrates that did not have read-through issues. In doing so, OEMs and their suppliers lose the benefits of using lighter-weight substrates.

In reality, it is not always the substrate's fault. More likely, the adhesive used to assemble vehicle panels is too rigid, exotherms too much (releasing excess heat in the join process), and shrinks excessively during cure – all of which contribute to read-through.

The substrate conundrum

As the automotive industry strives to save on assembly costs and provide better fuel economy to consumers, it is switching to thinner-gauge, composite substrates as a replacement for steel components. A typical vehicle might have a mixture of various substrates in one unit.

Similarly, as the industry transitions from welding to structural adhesives – as well as experiment with various substrates ranging from steel and plastics to aluminum – it is crucial to employ adhesives that balance strength with read-through requirements. As requirements change for conditions such as weight, longevity, and quality – and varied substrate materials become more popular – manufacturers are relying more on adhesives for bonding.

As structural adhesives began to replace welding, the adhesives were nearly always engineered to be as strong as possible, typically having high exotherms, and tending to be very rigid. Since thin-gauge materials tend to be very flexible, if two thin-gauge substrates are joined with a stiff adhesive, a visible distortion of the metal surface will be created – read-through. Additionally, as most adhesives cure, they shrink, further distorting the surface of the substrate.

To avoid read-through and the complications with rigid structural adhesives, some users resort to a urethane or silicone adhesive. However, these formulations are fraught with their own problems. Silicones generally do not have the desired strength for structural applications, and urethanes cannot be used on bare metals without a lot of surface preparation.

Some OEMs have gone so far as to characterize volumes of substrate and adhesive combinations, only to be frustrated when polycarbonate from Supplier A distorts and polycarbonate from Supplier B does not.

ACRYLIC ADHESIVE APPLICATIONS

Car spoilers – An automotive OEM had a cost of quality clause in its contracts with suppliers – if a part does not have perfect appearance, the OEM would accept it but pay a reduced price.

One supplier, making air spoilers for the OEM, was continually forced to accept a lower profit margin due to high read-through.

After switching to the 810LRT adhesive, read-through problems ended, allowing for full payments for parts.

Carbon fiber hoods – A supplier was using a thin-gauge carbon fiber substrate and was having difficulties with adhesive read-through.

Using the 810 LRT adhesive on the high-end part eliminated the problem.

Advanced adhesives

As a solution to these problems, LORD Corp. has developed an acrylic adhesive, LORD 810 Low Read-Through (LRT) adhesive, that offers a fast cure time and no bond-line read-through on most substrates. The flexible acrylic adhesive formulation features low modulus, high elongation, low exotherm properties, and low shrinkage. It bonds thin-gauge metal-to-metal and metal-to-composites/plastics with little or no substrate preparation.

The 810 LRT adhesive also delivers superior peel strength on a variety of metal and plastic/composite substrates, and has excellent bake resistance on thin-gauge aluminum. Good peel strength is especially important on applications such automotive and heavy-duty truck panels, where wind resistance is crucial.

Adhesive read-through (right) occurs when the adhesive joint is visible through the thin gauges of material that have been combined. The panel on the right displays the effects of a stiff adhesive with significant exotherm and shrinkage during cure. LORD Corp.'s 810 LRT adhesive eliminates that problem (left) by using a more flexible bond that still offers strength and rigidity.

The acrylic adhesive offers the strength of a structural adhesive without the time-consuming surface preparation needed with silicone or urethane. Cure times can be customized to the user's application. The 810 LRT has a handling time of as little as 20 minutes and is 90% cured in 30 minutes at room temperature. Cure rates can be accelerated by applying modest heat, <150°F/66°C. The adhesive also offers environmental resistance to dilute acids, alkalis, solvents, greases, oils, and moisture; and resists UV-exposure and weathering.

Eliminating read-through takes commitment on the part of the adhesive supplier. LORD partners with many substrate manufacturers, vehicle OEMs, and their suppliers from the development of new solutions all the way through to final vehicle assembly. The development of LORD 810 for aesthetically sensitive applications complements more traditional, high-strength solutions, such as the LORD 400-series.

Adhesive dispensing systems are available for high- and low-volume uses. Automated dispensing systems are offered for high-production environments and assembly lines, and hand-held applicators can be used for smaller jobs.

With the 810 LRT adhesive there are no trade-offs. Low read-through adhesive can be used on any substrate or mixture of substrates required by the component design. In applications where aesthetics matter as much as strength, the 810 adhesive offers a good solution.

LORD 810 LRT

Work time – 8 minutes to 12 minutes
Time to handling strength – 20 min to 25 min
Mixed appearance – Gray paste
Tensile strength at break – 841psi (5.8MPa)
Elongation – 190%
Shore hardness – 40 (D)

Automotive OEMs invest a great deal of time and money to design cars that run efficiently and have a great appearance. Likewise, for the investment consumers make in a vehicle, they are looking for a Class A finish along with fuel economy.

As OEMs move away from traditional welding methods, adhesives are becoming more popular as a joining system. The use of thin-gauge substrates is also causing OEMs and suppliers to take a closer look at manufacturing-friendly adhesives that don't compromise aesthetics. Acrylic adhesives that offer low read-through, low shrinkage, low exotherming, and fast cure times – with the strength of structural adhesives – can deliver an aesthetically pleasing vehicle.

Changing from welding to adhesives

When considering the switch from welding procedures to bonding with structural adhesives, approach the transition holistically – look at all aspects that will affect production including environment, substrates, finishing, processing, and joint design. Sometimes adhesives are not the answer.

Here are a few tips:

Understand your substrate – Adhesives are ideal for bonding dissimilar materials such as steel-to-aluminum or aluminum-to-composites/plastics. Knowing the specifics of your substrate can ensure you select the best adhesive that meets your aesthetic, strength, and manufacturing goals.

Consider strength – Welding or drilling holes for mechanical fasteners leave residual stresses in materials. Assemble dissimilar materials and you have the added stress of coefficient of thermal expansion (CTE) mismatches. Using an engineered adhesive better distributes the load across the bond-line without introducing stresses in the underlying substrate, ensuring a stronger bond that doesn't sacrifice substrate integrity.

Review cycle times – Adhesives capable of bonding a variety of substrates exist with cure times from 3 minutes to greater than 90 minutes – giving many options to optimize a solution. Having a knowledgeable adhesive supplier that can work with you to audit your process and determine alternative solutions can be invaluable.

Calculate secondary benefits – Adhesives offer benefits besides bonding. Welds tend to corrode over time because welded joints leave room for moisture to seep in and cause rust. Adhesives provide resistance to corrosion and environmental conditions – assembling and sealing from outside ingress at the same time.

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