



## Specialty adhesives put the squeeze on welding



**F**or more than 20 years, 4-Star Trailers has welded the components of their aluminum trailers together, so they were initially skeptical about using an adhesive process. However, after learning that several major automotive manufacturers including DaimlerChrysler, General Motors, and Ford, have used structural adhesives on more than 10 million cars, 4-Star Trailers decided to evaluate the adhesives' merits.

### **Testing the technology**

“We chose adhesives formulated by LORD Corporation after reviewing the motives of these large automotive corporations for choosing them for bonding roof and door panels,” says Butch Patchell, manager of research and development. “Attributes such as impact resistance, vibration, and noise dampening as well as superior strength were among those cited, which is exactly what our customers want.”

For a two-year period, the company conducted extensive testing to develop fixtures and test the strength of their bonded designs. The door shop was the ideal place to try the adhesives.



***4-Star employees apply the adhesive to the trailer doors in preparation for the testing.***

Two doors were created for the testing process — a traditional welded door (with taped and riveted outer panels) and one constructed entirely using adhesives, both of which were hung to a heavy steel frame. A hole was drilled in the lower corner of the door to simulate where a horse may kick and the panel would experience the most stress. Then, the chain from a 3/4-ton winch was threaded through the hole.



On the welded door, at 40 lbs of force, the door pulled off the frame. At 950 lbs of force, the door pulled out 5.5 in. and broke apart.

In contrast, at 1,000 lbs of force from the winch, the bonded door had only pulled out 1/2 in. The team was so amazed with the results that they bought a 3-ton winch, hooked it up, and performed the test again. Only when 2,500 lbs of force was applied did the bonded door move 1 in.



***During 4-Star's testing, the adhesive withstood 1,600 lbs of force. Welds did not measure up.***

The same test was repeated again at a later date for the non-believers. This time, the welded door was irreparably damaged at approximately 960 lbs of pressure. Because the team never broke the adhesive door on the first test, they set out to find the breaking point by adding 800 lbs per stroke of the winch. Somewhere between 4,000 and 4,400 lbs, the door popped loose, but when they released the winch, it went back to its original position and laid flat with easily repairable damage.

Another test involved using adhesives on small feed doors and placing them in a freezer maintained at minus 20°F. The doors, which were shuttled from the freezer to the outdoor sun and back several times over the course of a week, experienced no change with the temperature difference. This test was important

as thermal expansion problems are common with welded components.

Yet another test involved the use of a high-powered vibrator hooked to the door. Although the welded door quickly failed, the adhesive door never fell apart though the hinges eventually wore out from the heavy vibration.

The results showed that the bonded doors outperformed welded, taped, and riveted doors in every test. Therefore, it was determined that the bonded doors were four times stiffer and possessed double the impact resistance of the welded doors. This stiffness prevented the door from flexing as easily and provides excellent security for cargo.

“The doors were frozen, baked, dropped, pulled, and hammered,” says Patchell. “We conducted these tests repeatedly because we could not believe how much stronger the bonded door was when compared to the welded door. Our welded doors were considered the best in the industry because the frames were welded and then the skins were taped onto them using double-side acrylic adhesive tape as well as riveted for good measure. This is why we were initially skeptical when we were shown an adhesive that was more effective than all those measures.”

Unlike welded doors, a bonded door cannot warp out-of-plumb because of its superior stiffness. As such, the company developed a new process for attaching doors to the trailer. The new approach involves pre-assembling the door to a doorjamb and then attaching the pre-hung door assembly to the trailer. This design maintains a uniform gap between the door and its sealing surface all around the door, which allows the rubber seal to have equal compression with no gaps. Further, the lack of gaps contributes to better water resistance than previous designs.

### **Proof is in the numbers**

Although strength and durability are key, 4-Star also sought a more efficient and cost-effective solution. This goal was achieved by integrating adhesives into their door assembly. Not only has the company been able to reduce labor by 50%, but the switch from rivets, adhesive tape, and welding also results in savings, enabling reinvestment in improved designs for their hinges and doorjamb. Because of this success, 4-Star is experimenting with bonding the floor panels. In addition, the adhesives are expected to be a quieter solution, which is important in reducing the stress horses experience during transport.

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**Lord Corp.**

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