Why 4-Star?

Concept II Slats:

In 1995/96 4-Star Trailers designed and was awarded the patent on a revolutionary slat designed to shed water and reduce the amount of visible welds and heat distortion.

Prior to Concept II, aluminum slats were extruded in corrugated shapes with one side of the corrugation welded to the side posts of a trailer. All manufacturers using extruded aluminum slats utilized this style of slat to construct the outer walls of their trailers. The welds on these slats are grossly visible in the form of melt-through and heat distortion. Corrugated slats are difficult to make water tight and trailers built from them suffer from water leaks unless meticulous attention is given to sealing each slat at its ends and at each joint where they stack one atop another. At each end of a corrugated slat is a series of voids where the corrugations alternate. These voids are difficult to seal and provide a conduit for water to flow into the trailer. Corrugated slats require regular maintenance to insure that the sealants used to caulk them isn't cracked or separated. This is why many manufacturers, who still use corrugated slat designs, end their slats at the dressing room as a cost saving measure.

The 2006 model year 4-Star trailer introduces the 4th generation Concept II slat. The unique design of the 4-Star Concept II slat eliminates weld melt-through and 90% of visible heat distortion. Concept II slats solve the problem of leakage in the stacking of slats by using a water resistant interlocking joint that also significantly increases the strength of the slat compared to corrugated slat designs. It also minimizes and reduces the number of voids between the slat and the trailer side posts thereby contributing to an even more water resistant slat than was previously obtainable. Concept II slats are installed along the full length of our trailers contributing to 4-Star Trailers' legendary beauty, strength, and durability.

Doors:

In 2001 4-Star Trailers began bonding door skins using the same structural adhesive used in over 10 million cars and trucks built by DaimlerChrysler, General Motors, Ford, Volvo, Nissan, Mazda and Mitsubishi over the last 15 years. We chose adhesives formulated by the Lord corporation after reviewing the motives of these large automotive corporations for choosing them for bonding roof and door panels. Attributes such as impact resistance, vibration and noise dampening as well as superior strength were among those sited. Attributes we realized are important to trailer owners and their cargo.

We performed dozens of tests over a period of 2 years to develop fixtures and to test the strength of our bonded designs. You might imagine that a company that has been welding all aluminum trailers for nearly 20 years would be skeptical about 'gluing' something together. You'd be right. It took a lot of testing before we were convinced.

One of the reasons that we kept performing the tests over and over was because of how much stronger a bonded door seemed to be than one which is welded. They were 4 times stiffer with double the impact resistance of our welded door. We just couldn't believe it! We have a lot of

pride in what we build. We believed, as did many of our competitors, that our doors were the class of the industry - after all, the frames were welded, the skins were taped onto them using 3M VHB double sided acrylic adhesive tape and then riveted to the frames for good measure. So, when we were shown an adhesive said to be more effective than all of that, we were skeptical.

We took examples of each door type and froze them, baked them, dropped them, pulled them and hammered them. In every test the bonded doors outperformed the welded, taped, and riveted door.

The bonded doors turned out to be too good. Compared to a welded door, the bonded door is much stiffer. It does not flex as easily. This is a good thing when the security of your cargo is dependent upon the strength of your door. It's a bad thing when the frame around the door opening is the slightest bit out of square or out of plumb. (Plumb means to be flat, straight, or to have all 4 corners of the opening lying on the same plane.)

There are several causes for a door opening in the side of a trailer to become out of plumb. One of them is heat distortion caused by welding. Welding generates a lot of heat. The side posts of a trailer act like bacon in a frying pan when heat is applied to one side. They tend to bend or curl around the weld. There are several techniques that are employed to minimize heat distortion in welded assemblies, but it cannot be completely eliminated.

If the door is plumb, which all bonded doors are, and the opening into which it is hung is out of plumb, then leakage can occur. A welded door can be warped to match the plumb of an opening. A bonded door cannot be warped out of plumb due to it's superior stiffness. This inability to 'bend' a door to seal it into the opening and the difficulties experienced in attempting to provide an accurate opening led us to rethink the methods used to hang a door.

Our new process for attaching doors to the trailer involves pre assembling the door to a door jamb 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 allowing the rubber seal to have equal compression with no gaps contributing to much better water resistance than our previous designs. Even though the door seals to the jamb, a trailer is a dynamic assembly subject to flexing as it is towed. Making a truly water tight door would require using economically unfeasible mechanisms such as those used to seal bulkhead doors on ships. Therefore, our door jambs are designed to channel any water that does happen to make its way past the seal away from the interior of the trailer and back out to where damage to the trailer's interior is avoided.

We also designed the hinges to be an integral part of the door and jamb. The new hinge assembly utilizes a tab on the hinge butt which is mechanically locked and bonded using Lord engineered adhesive into a groove in the door and the door jamb. This mechanical interlock combines the strength of the hinge butt with the strength of the door and jamb to achieve exceptional strength without the bulkiness of previous designs.

The hinges on nearly all horse trailers are of the strap type. Strap type hinges are mounted like a strap across the face of the door and onto the trailer. This puts the direction of forces against the door perpendicular to the hinges. In technical terms, the hinge leaf is subjected to shear forces. The leafs of strap style hinges must be very large and thick to withstand the forces applied to

them. Large hinges, however, can pose a danger to horses as they protrude a significant distance out from the side of the trailer. Strap style hinges are used because they are readily available and are relatively easy to install.

Our hinges are oriented so that they are parallel with the direction of force. In technical terms, the hinge leaf is subjected to tensile forces. The differences between an object said to be in shear vs. in tensile can be compared with attempting to break a popsicle stick in two. If one were to grasp one end of the stick in each hand and bend it until it breaks - it is broken by shear forces. Grasping one end in each hand and pulling in opposite directions until it breaks is using tensile forces. If you examine the hinges on the doors of your home you'll see that each of them is oriented so that any force applied to the door applies tensile force to the hinge leaf - not shear. We feel that this design lends itself very effectively to horse trailers, particularly the sides where horses may be tethered.

Top and Bottom Rails:

4-Star Trailers is recognized for building one of the most, if not THE most, durable trailer in the industry. A major factor contributing to the overall strength of a trailer is its top and bottom rails. Our rails were designed borrowing design features from semi trailers with GVWR's of 60,000 lbs. Every 4-Star trailer uses the same top and bottom rail regardless of trailer length. The only differences are the inclusion of running boards for trailers 8'-0" or less in width. The bottom and top rails used on a 16' long bumper pull trailer are same as those designed for use on 53'-0" long trailers. We use them across all models so that each 4-Star Trailer shares common looks with its siblings.

Our top rail is a hollow, full length, heavy wall, extruded tempered aluminum structural strength beam. The hollow tube design of our top rail is the only one of its kind that we know of in the industry. In addition to the strength inherent in its hollow tube design, the large 6 inch radius on the outer wall resists twisting and warping under stress. The hollow shape also creates the perfect conduit for protecting the electrical wires running through it. The hollow shape makes it more difficult for us to run our light and accessory wires, but we feel that the additional strength conferred to the trailer make it worth the extra effort.

Our bottom rail is one of only a few in the market to extrude the running board and bottom rail together as a single piece. Others continue to weld running boards to their bottom rails. Our integrated design adds stiffness to this important structural member while minimizing the number of welds visible on the bottom rail.

Gooseneck Drop:

The plate that forms the drop wall connecting the gooseneck floor with the trailer floor is a critical component which ties the box of the trailer to the gooseneck and coupler assembly. The drop plate also supports the trailer's landing leg as well as providing a convenient place for locating battery boxes, propane bottles, spare tire, etc. Most manufacturers use 1/8" thick aluminum sheet to construct their drop plate. We build ours using a 3/16" thick marine grade 5052 aluminum alloy plate.

Tough enough to stop a 45 caliber bullet, our drop plate starts out as the largest plate available from our sheet metals supplier in this thickness. We cut the drop shape, including the gussets and top and bottom angles, in one large piece using a very accurate N/C (numerically controlled) plasma cutter. The drop plate is then formed into shape using an N/C brake press which is able to perform large bending operations with extremely tight tolerances and repeatability. The result is a one piece drop, stronger than, and free from the problems intrinsic to ones constructed by welding multiple pieces together. Multi-piece drops are harder to keep square as the pieces are brought together for welding. They can also experience leaks in the welds where the gussets attach to the drop plate and trailer side.

Side Wall Construction:

Our side posts are hollow rectangular tubes, extruded in three sizes, 1" x 2 $^{1}/_{2}$", 1" x 4" and 1" x 8" with $^{1}/_{8}$" minimum wall thicknesses. Even though it is more expensive to extrude a hollow tube, as opposed to an open shape like a C-channel, we feel that the extra strength imparted to the side wall makes it worth the investment. To minimize sharp edges, the side of the post facing the inside of the trailer is rounded with $^{1}/_{2}$" radius corners. Three sides of the post have heavier ($^{9}/_{64}$") walls to provide resistance to heat distortion when the slats are welded to it. Each size is suited to the purpose for which it was designed. Door frames, ramp openings, windows, etc., each requires a post designed for that function.

Due to the highly customized nature of our business model, our customers often ask us to do things that change the structural dynamics of the side wall of the trailer. Using sophisticated CAD structural analysis tools, we developed effective methods to insure that special requirements do not cause problems. As an example, when circumstances require it, we use a specially engineered aluminum reinforcement developed by 4-Star and validated by one of the nations leading aerospace consultants. The reinforcement is judiciously located and attached to our bottom rail in high stress areas to effectively neutralize concentrations of stress by dissipating it throughout its length.

All our Deluxe model horse trailers are double walled and insulated in the horse compartment. The kick walls are lined with.090 aluminum and the head wall with.063 aluminum. Rubber is bonded to both the head and kick wall. We are the only manufacturer we know of offering a lifetime warranty on our wall rubber.

Other structural considerations:

The top corners of a trailer at the front and rear are important to consider when contemplating which designs have high durability. The corners at the rear of the trailer are critical to the torsional stability of the trailer. If the rear corners are not sufficiently rigid the rear frame of the trailer can

sway back and forth in a motion known to the industry as ‘racking’. When not controlled, racking can lead to metal fatigue and failure. The result of excessive racking is cracking in the corners of the rear frame and abnormal wear to the rear door hardware. 4-Star incorporates several design features to control racking. The rear header is contoured to exactly match the profile of the top rail. The header fits snugly into the radius of the top rail, similar to a jig saw puzzle piece, limiting its range of motion. The rear corner post is notched so that the joint formed where it meets the rear header lies on two different planes at right angles to one another. Notching it this way redirects the lines of force away from the joint minimizing the likelihood of the joint cracking. The three elements forming the rear corners (top rail, header, corner post) are buttressed with two large gussets, one from top rail to rear header and one from rear header to rear corner post.

Racking starts down at floor level. A little flex down here can translate into a lot of movement up top. We reinforce our corner posts with large tail light gussets. On trailers with widths that do not allow for tail light gussets we extend the corner posts down through the floor so that the rear threshold and bottom rail are lapped over it to provide increased rigidity. The size of the rear corner posts and rear header beams have a tremendous influence on the potential of the rear frame to rack. Generally, the wider the members, the more resistance to racking. Our rear headers and corner posts are 6 inches wide in the rear and 4 inches wide on the sides.

Many manufacturers use a simple miter or butt joint to form their corners. Be sure to examine our corners and compare them to other manufacturers designs. We think you’ll agree with us that ours is the superior design.