

Body Innovations On The 2004 Audi A8

Audi set aluminum design precedents with the introduction of the 1997 Audi A8. The A8 was the first aluminum-intensive production vehicle. The Audi Space Frame (ASF) design featured vacuum die cast joints connecting the structure at all four corners and crush tubes on the lower front rails that were repaired by bolting on short replacement extensions. The next generation aluminum A8, introduced in June 2003, is as innovative in body design as the previous generation A8 was to other vehicles of aluminum construction. There are double the number of castings, and added hydroformed roof rails and one-piece unside stampings.

ALUMINUM STRUCTURES

Before listing any more details on the A8 construction innovations, it is necessary to discuss the types of structural construction used on aluminum-intensive vehicles. Basically, there are three forms of construction:

- Sheet metal stampings
- Extrusions
- Castings

Structural sheet metal stampings are formed like the name sounds, by stamping rolled sheet aluminum with a huge die that immediately creates the shape and size of the final part. Stamped parts typically have raised, ribbed, or dimpled areas for added strength and structure. These may also serve as crush zone areas, similar to steel construction. Some stampings have tell-tale stretch marks on

the corners, indicating how the part was formed (see Figure 1).

Extrusions are made by forcing heated solid aluminum billets through a die. The metal is pushed through the die, and sometimes pulled when it exits the die if the extrusion must be especially straight. A simple example of extruding is pushing adhesive out of a tube or cartridge. A hollow extrusion can be made by using a mandrel inside the die. Extrusions have no apparent seams or pinched flanges.

Casting involves pouring molten aluminum into a mold or injecting molten aluminum into a mold under pressure. The aluminum is allowed to cool and harden, and then the cast part is removed from the mold. Vacuum-die castings are the most common. Vacuum-die castings introduce a vacuum into the die cavity before metal is injected in order to reduce or eliminate air and vapor entrapment.

A8 STRUCTURES

Whereas the previous generation Audi A8 had some castings, such as the strut towers, the 2004 model introduced entire pillar halves with cast construction. The inner A-pillars and reinforcements are two cast shells. The inner B-pillars are castings (see Figure 2). There is a casting in the floor tunnel. The lower cowl panel is also cast construction.

Extrusions are used for the roof beams and front longitudinal members (lower



Figure 1—Stretch marks on this aluminum sheet metal part indicate a stamping operation.



Figure 2—This inner B-pillar is a single casting.

rails). The fender mounting flanges (upper rails) are two-piece stampings, instead of the extruded construction on the previous model (see Figure 3). The extruded roof rails are hydroformed.

The 2004 A8 has a stamped floor pan, and the entire unisides are one-piece stampings. These uniside parts include the quarter panels (see Figure 4).

ADDED OCCUPANT PROTECTION

The extensive use of cast and extruded construction adds stiffness and improved occupant protection. The 2004 A8 also has added passive restraint systems. Knee airbags for both the driver and passenger were added. Active head restraints were also added to protect occupants during a rear-end collision.

A8 JOINING TECHNOLOGY

The previous generation A8 was notable for the extensive use of self-piercing rivets (SPRs), or punched rivets as Audi refers to them (see "Self-Piercing Rivet Self Awareness" in the November 24, 2003 Advantage Online). The A8 also used a minimum of squeeze-type resistance spot welds, a total of 500 on the entire vehicle, compared to 1,100 SPRs. The new A8 construction uses no spot welds whatsoever, and twice the number of SPRs.

There are also GMA (MIG) welded seams on both models. The new A8 also features laser-welded seams (see Figure 5), and introduced a combination GMA (MIG) and laser weld called a hybrid seam (see Figure 6). This process uses a laser to pre-heat the joint, followed immediately by a GMA (MIG) weld.

REPAIRING THE A8

Once Audi of America has approved a facility for aluminum structural repairs, Audi offers training for repairs to both the previous generation A8 and the new A8. The two-week training program, held at the I-CAR Tech Centre, includes Audi aluminum welding technology, TÜV Aluminum Welding Certification, structural repair guidelines, riveting and adhesive repairs, cosmetic panel repairs, and a discussion of mechanical and restraint systems on the A8.

I-CAR classes offer valuable information to prepare technicians for the vehicle-specific programs. Programs that discuss aluminum construction and repair include Structural Aluminum Design And Repair Processes (SPA01), Structural Aluminum Repair Processes (SPA02), and Replacing Aluminum Exterior Panels (PRA01). Watch for them in your area.

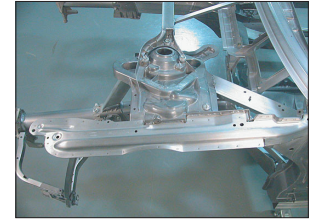


Figure 3—The upper rails are two-piece sheet metal stampings.



Figure 4—This one-piece stamping is the uniside on the A8.



Figure 5—The thin, straight weld joints on this A-pillar are robotic laser welds.

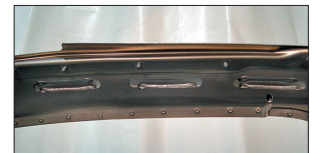


Figure 6—These hybrid laser/GMA (MIG) welds are in a typical location, on the edge of slots.