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Estimating the aluminum repair

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This is aluminum uni-rail from a 2010 BMW. It is constructed of sheet aluminum with a cast front mount bracket welded to it. You can see multiple deformities on the component and in the "kinked" area where the metal has folded over itself you see stress cracking. The opposite side of the kinked area you can see a bend to the component. None of this damage is repairable.

We have all heard all the talk about the new aluminum because of the 2015 Ford F-150. But to tell you the truth, aluminum is not new. What is new is that it will be the first time a mass-produced vehicle from an American company will be constructed from aluminum. It is funny how history repeats itself. Back in 1979, the collision repair industry was in an uproar over the monocoque design coming to an American mass-produced vehicle, the 1980 Chevrolet Citation. Although the monocoque design was going to be new to the 90 percent of American collision repair facilities, it was not new to the US. As far back as 1917, Nash Motors and 1922 Lancia Lambda vehicles utilized the monocoque design. Through the 1930s, other companies like Cord started to use this design. In the 1950s, Mercedes-Benz introduced the W120 body, called the 180, their first monocoque that was mass produced in Germany. In the 1960s Ford produced the Lincoln Continental (at the time the largest and heaviest monocoque), and during the Japanese invasion (late 1960s and 1970s) the monocoque design employed to the masses outside the US. So by 1980 it was not new, but it was new in the US. This is the main reason I-CAR was formed — to teach the masses about this design and how to repair it. Now we return to the present and the same thing is happening again.

The first aluminum sports car was unveiled at the Berlin Motor Show in 1899. As far as a mass-produced, non-sports car, aluminum-intensive vehicle, the 1994 Audi A8 with the Audi Space Frame (ASF) is considered the first. Followed by the Acura NSX, Jaguar XJ and XK, Audi R8 and TT. Last year Land Rover jumped into aluminum-intensive design. GM has claimed that the 2018 Chevrolet Silverado and GMC Sierra will be aluminum intensive bodies with HSS steel full frames. I was lucky to be involved with the Audi Aluminum program from its infancy and have been through all the trials and tribulations surrounding aluminum repair.

Aluminum can be very difficult, if not down right impossible, to work with, and it is not because it is hard to repair. It is difficult because of

This is an extruded aluminum bumper reinforcement. In the severely kinked area you can see multiple indications of stress cracks and even fracturing of the material. Even at the bent area there are visible fractures.

human nature toward change. Aluminum is very different from steel, and we must change the way we think when repairing it. And as we all know, a large percentage of humans do not like change. Aluminum vs. steel repair can be compared to the lacquer vs. urethane and urethane vs. waterborne refinishing processes. Many facilities remember difficulties with the change to urethane, and those who don't know all too well the issues of changing to waterborne. Aluminum is not hard or difficult, just very different.

Damage analysis

First and foremost, the kink vs. bend rule does not apply to aluminum, just as it does not apply to advanced high strength steels (AHSS), such as Martensitic steels and Boron alloyed steels. If an aluminum structural component is kinked or bent, it will be replaced in most cases. For outer panels, most of the deformities will not be repairable when compared to steel.

There are three types of aluminum component designs you will see:

Sheet aluminum, which is formed just like sheet steel, where sheets of the aluminum material are stamped in to shapes such as apron panels, pillars, rockers and outer panels. They can be used for cosmetic and structural body components. Some of these components maybe repaired, such as outer panels and certain select structural components. Damage indicators are, but not limited to, deformities, visual fractures (cracks) and tearing. They can be riveted, rivet-bonded, bonded and rope hemmed flanged, flow-drilled, clinched or MIG welded.

Aluminum extrusions are similar in design to the hydro-formed steel components we see on late-model steel vehicles. Extrusions are only used for structural components — to form inner reinforcements on pillars, inner roof rails, uni-rails (frame rails), frame rails (Corvette ZR1/Z06), suspension cradles and structural crossmembers. Generally they are not repairable. Again, damage indicators are, but not limited to, deformities, visual fractures (cracks) and tearing. Aluminum extrusions can be riveted, rivet-bonded, bonded, flow-drilled or MIG welded.

Aluminum casts have multi-thickness variations and generally rough surfaces. Cast components can only be used to make structural components — structural pillars, structural crossmembers, reinforcements, cradle support ends and strut towers and are never repairable and must be changed. Damage indicators will generally be very obvious and would include visual fractures (cracks) and tearing, but surprisingly, cast is ductile and will bend a great deal prior to fracturing. The amount of ductility a cast component has is dependent on the alloying agents and type of casting process utilized. Cast aluminum will almost always be MIG welded, but you will see other components attached with flow-drill screws.

Anchoring considerations for aluminum-intensive vehicles

An excerpt from I-CAR's Aluminum Panels & Structures Damage Analysis Course (DAM05)

Following the damage analysis and blueprinting process, aluminum vehicles will need to be mounted on a measuring and straightening system for repair. Even if straightening for repair will not be done, this best practice will allow for proper replacement part installation.

Anchoring aluminum vehicles can pose a few challenges, which are unique to aluminum. Some aluminum-intensive vehicles do not have pinch weld flanges that can be used to attach anchoring. Those that do have pinchwelds may have rivets along the pinchweld, making the attachment of conventional pinchweld clamps challenging. Fortunately, there are specialized pinchweld clamps available that are designed to encapsulate the rivets and provide the necessary holding.

To prevent possible

Damaged aluminum intensive vehicles will require pre-measuring, just like steel vehicles. The importance of pre-measuring is to determine if there is collateral misalignment, which in the case of aluminum is generally unrepairable. Ford does allow some realignment for collateral damage. Conversely, most of the other OEMs say no realignment to damaged aluminum structure. So how do we inspect a collision damaged aluminum intensive vehicle? It is not really different from inspecting a steel vehicle, but there are some special operations. The first and most important step is to check with the dealer or OEM to find out if the vehicle is restricted or not. If the vehicle is restricted, it means the OEM has restricted the sale of structural components to only certified collision repair facilities — you would then have to send the vehicle to one of these facilities. If the vehicle is not restricted, then follow these steps:

1. Wash the damaged vehicle to remove all grease, grime and dirt. This is not only the first step prior to the commencing of any repair procedures; it will also ensure that no contaminants enter your spray booth.

2. Examine the entire vehicle by walking around it. Always start in the opposite corner or side away from the point of impact. This will make you start in areas where damage would not be anticipated and work into those areas where damage is anticipated.

3. Look at all panel gaps for symmetry. If any misalignment is found, take notes and inspect further to discover the root cause of the misalignment. With aluminum, this misalignment can sometimes be difficult to discover without measuring and some disassembly.

4. Operate all closure panels for proper operation. If any component is found to be inoperative or operates unacceptably, take notes and inspect further to discover the root cause. Remember with aluminum components, such as door assemblies, the door shell may have been deformed and the pillar may have sustained damage too.

5. Enter the interior of the vehicle. Check steering wheel position and operation (including tilt and telescopic). Statically test all seatbelts ("thump test"), buckle and unbuckle them, check the operation of seats and inspect seat tracks. Take note of any issues.

6. Take quick measurements of the wheel positions. For the rear wheels, measure from the rear lower edge of the rocker

contamination and galvanic corrosion between the steel jaws of a pinchweld clamp and the aluminum pinchweld, aluminum plates could be placed between the steel clamp and the pinchweld.

Some aluminum vehicles have pinchwelds that are horizontal, instead of vertical. A vehicle with horizontal pinchwelds will require a special clamp that is positioned horizontally. Some horizontal pinchweld clamps are able to clamp horizontally and vertically.

Additionally, many aluminum-intensive vehicles utilize castings in the center section of the structure, where fixtures or anchors may be attached. Castings can be extremely vulnerable to damage by the forces of pulling, and must be monitored very closely. If, during repairs, a casting is damaged, it must be replaced; there are no repair options, other than replacement, for aluminum castings on today's aluminum-intensive vehicles.

Similar to steel vehicles, it is important to use multiple anchor points so that any pulling force is distributed over a larger area, reducing the stress at each anchoring point. All areas under stress

panel to the center of the wheel on the left and right side. For the front wheels, make sure the steering wheel is centered and the front wheels are straight, and then measure from the front lower edge of the rocker panel to the center of the wheel on the left and right side. If any misalignment is noticed, take notes. This is especially important with four-link suspension vehicles.

7. If no misalignment is discovered, skip to Step 11. If misalignment is discovered, go to the next step.

8. Place the vehicle on a two-post lift, remove any undershields and visually inspect the undercarriage. Obtain the vehicle measurements from the OEM and/or an information provider's repair data, and use a tape measure and/or tram gauge to verify the measurements of the vehicle. If any misalignment or deviation from the specifications is discovered, take notes and then prepare the vehicle for three-dimensional measurements on a two-post lift or realignment apparatus. If no misalignment is discovered (taking into account the severity of the sustained damage, the description of the collision event and the function of the damaged components), then the vehicle might be a candidate for a nonstructural repair, commonly referred to a fast-track repair (Skip to Step 11). If misalignment is discovered, go to the next step.

9. Disassemble the vehicle as necessary. Place the vehicle on a two-post lift or structural realignment apparatus (SRA) and measure the vehicle with an electronic three-dimensional measuring system.

10. Measure the vehicle completely to ascertain the root cause of the misalignment discovered during the quick-check process. Once the root cause of the misalignment is discovered, determine the proper repair processes, according to the OEM, to correct the misalignment. Generally with aluminum intensive vehicles, this will either be full component replacement or sectioning may be allowed.

11. Fully disassemble the vehicle as necessary, in preparation for parts ordering and repairs.

12. Protect and store all reusable components.

13. After the triage of the vehicle (diagnosing), have the damage assessor, parts manager, shop foreman and structural repair technician meet to discuss the repair plan and review the required OEM repair procedures, materials and components. After all parties understand the repair plan, notes should be written on the vehicle (with water-based markers) commonly known as "blueprinting."

from the pulling forces must be carefully monitored.

Following repairs, it is necessary to refinish the clamping area, if coatings have been removed, to prevent corrosion.

Each year, about 75 vehicles are debuted or redesigned, and with the accelerating focus on CAFE, many of these will be manufactured with unfamiliar materials and systems like aluminum. Knowledge is truly the foundation for complete, safe and quality repairs especially given the rapid advancements in vehicle technology and the use of different materials. For more information on aluminum repair, visit i-car.com.

I-CAR® is a not-for-profit education, knowledge and solutions organization designed to support the evolving needs of the collision repair inter-industry.

14. Now store the vehicle, as no repairs should be attempted until all replacement components and materials arrive. Ensure all openings are sealed and covered.

By following the above analysis steps, you ensure that you have:

1. Prevented overlooked, hidden damage and damaged components

2. Ensured all OEM protocols are adhered to and discussed

3. Determined if a vehicle is a total loss or not, up front

4. Lowered your overall cycle/touch times

5. Increased your technicians' efficiency/production output

6. Increased your net profit by eliminating the waste

Although the above triage and blueprinting procedures will assist your facility in diagnosing sustained damage, you will need some additional, and very important, information. The damage assessor(s), foreman and technicians will need a full understanding of the following for an aluminum intensive vehicle:

1. Vehicle design engineering

2. How a vehicle is constructed — sheet, extrusion and/or cast

3. How it is designed to react in a collision event

4. How collision energy travels through the vehicle

5. Which components are designed to deform or transfer energy

6. Mechanical and electrical component operation and diagnosis

7. Vehicle joining methods and materials (rivets, rivet-bonding, clinched, MIG welded)

8. Steering and suspension operation and diagnosing

9. OEM repair protocols and position statements and how to interpret the information

If we all thought this way, there would be fewer mistakes during diagnosis. Adopting these SOPs will make our assessments easier for steel vehicles, but is paramount for aluminum intensive vehicles. The most important thing in the diagnosis assessment is knowing what is actually damaged. The only way to know the amount of sustained damage is through a thorough triage and blueprinting process. We must rise to the level of professionalism required to repair today's advanced engineered vehicle designs and must possess advanced training though education and hands-on work experience. Repair facilities must purchase the proper equipment and computerized programs necessary to ensure the vehicle can be diagnosed and repaired correctly.

Judgment times

All of the certified aluminum programs require specific structural repair apparatuses. Celette is the most required, followed by Car-O-Liner and then Globaljig and CarBench, which round out the top four manufacturers. Chief is only on the Ford program and cannot be used on any other certified aluminum collision repair program. Currently there are no other structural repair equipment makers on the programs, although I know Spanesi is in testing now for a few OEM programs. Set up on this equipment can be four to eight hours for an aluminum intensive vehicle, depending on the extent of sustained damage. You may also see no realignment time at all (pulling), as most of the OEMs prohibit realignment. However, Ford allows some realignment for collateral damage. For outer panel damage, if repairable, times can be three to four times the amount of time for similar damage to a steel panel. Only through training and education will you be able to determine the amount of time required to repair aluminum. As with steel vehicles and the ROI for the training, education and purchases to repair steel vehicles, you will also need to adjust your labor rates for aluminum vehicles.

I hope this article, the first of a six part series, has helped you understand some of the differences with assessing damage to aluminum intensive vehicles. This is an overview, and we will delve deeper into each area in our following articles throughout the 2015 year. As always, if any questions arise, please feel free to contact me.

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