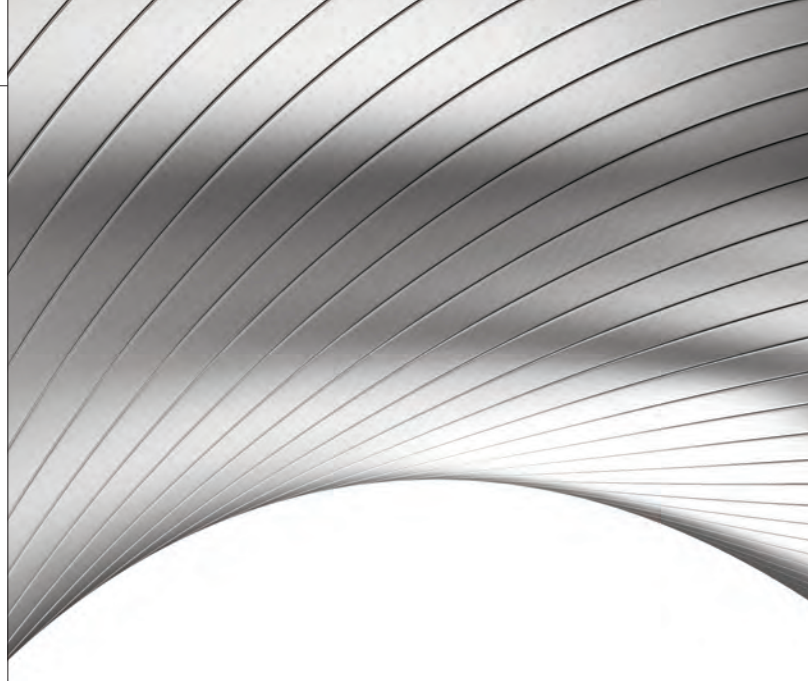
TECHNICAL FEATURE

NEW MATERIAL SUBSTRATES: ARE YOU READY?



The recent Ford F-150 program has taught us that not everyone is equipped, trained or even prepared for what is to come. Those repair shops that have been involved in the real Certified Collision Repair Facility programs (CCRFs) that require specific training and equipment (and have been involved in steel and aluminum repairs for years) have not had many issues with the newer models and designs. But this is an extremely small number of CCRFs in the USA, estimated (after the overlap of a CCRF on multiple OEM programs) at approximately 500-550 facilities. Those numbers get even scarier when we look just at those technicians who are structurally certified for aluminum welding, which would be approximately just under 1,500 total. There are approximately 37,000 registered shops in the USA, of which most are not equipped or trained to repair modern vehicles. Some of these shops have no business even touching some automobiles.

In March's Collision Hub Repair University live show, Collision Hub's Kristen Felder and I discussed GM vehicles and repair procedures with Jason Bartanen of I-CAR. Jason and I chose the Cruze quarter panel replacement as an example. Well, the new Cruze replacement procedures require silicon bronze, rivets and STRSW and no MAG welding. The procedure is very similar to Mercedes-Benz C-Class and E-Class vehicles. Some OEMs are designing their newer models as mixed-material or hybrid-construction vehicles, utilizing aluminum and steel panels joined together (like the 2016 Cadillac CT6 and 2016-and-up Audi Q7 and TT). These hybrid construction-type vehicles generally will require bolt or rivet bonding on aluminum-to-steel mating flanges and STRSW on steel-to-steel mating flanges. Another hybrid or mixed-material design incorporates aluminum, steel and carbon fiber as part of the structure. Plastic composites, fiber reinforced plastics (FRP), sheet molded compounds (SMC), reinforced reaction injection molding (RRIM) and reaction injection molding (RIM) – although still utilized for components on vehicles – will soon be replaced with nanoplastics, carbon-fiber reinforced polymer (CFRP) and carbon nanofiber.

Repairs to these newer plastics will be very similar to the repairs for plastic that we have been utilizing for the past 15 years, but with only a few changes (such as adhesive type and heat curing). Conversely, if the damage extends to the edge of the component, then it will require replacement in many cases. BMW was the first company to introduce a mass-produced, triple-material or multi-mixed-material hybrid construction vehicle with the all-new 7 Series (G12) in Model Year 2016. The G12 body is an AHSS, aluminum and CFRP-mixed construction, and BMW claims the new 5 Series, X5 and X6 models will all be built similarly when the platforms get an upgrade over the next few years. Once again, it is imperative that the repair facility employees (estimators, managers, technicians and even painters) review and understand the OEM repair procedures and protocols and adhere to them. Many OEMs will require their branded adhesive material, while others will allow choices from multiple adhesive brands.

In the future, expect more advanced steels – thinner, lighter and stronger than what is available now. Expect more aluminum outer panel components (both bolt-on and affixed), carbon fiber components and multi-mixed material hybrid construction vehicles. All repair facilities will need to invest in equipment and training, and we predict more OEMs will restrict replacement components to those shops who are certified by the OEM, which brings us to the all-new Audi A8 for Model Year 2018. This vehicle will mix four substrates to make up the all-new Audi Space Frame (ASF), multiple different strengths of advanced steels, aluminum, CFRP and magnesium.

This ASF multi-mixed material will make the vehicle lighter (fuel economy) and safer and add more torsional rigidity to the overall driving feel of the vehicle. The BMW G12 is one innovation in advanced design, and now Audi has upped the design technology with what we feel is more of a straightforward design that could eventually be seen in more economical vehicles.

The CFRP utilized in the A8 is an ultra-high-strength, torsionally rigid rear seat panel (behind the rear seats and package tray) and is the largest single component in the occupant cell of the new Audi A8. Audi says this panel contributes 33 percent to the torsional rigidity of the total vehicle. To optimally absorb longitudinal and transverse loads as well as shearing force, the panel is constructed from between six and 19 fiber layers that are placed one on top of the other, ensuring a load-optimized layout. These individual fiber layers consist of tapes 50 millimeters wide and can be placed individually in a finished layered package. The innovative direct-fiber layering process specially

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developed for this purpose makes it possible to entirely dispense with the normally needed intermediary step of manufacturing entire sheets. Using another newly developed process, the layered package is wetted with epoxide resin and sets within minutes. There will likely be no repair to this panel, and any damage will require replacement.

A high-strength combination of hot-formed steel (martinsite) components make up the occupant cell, which comprises the lower section of the front bulkhead (fire wall/dash panel), the side sills, the B-pillars and the front section (A-pillar/Windshield Post) of the roof line (upper inner roof rail reinforcement). Some of these sheet metal blanks are produced in varying thicknesses, using tailoring technologies (tailor-rolled), while other blanks undergo partial heat treatment. Tailor-rolled and heat treatment processes allow for a profile that reduces weight and increases the strength, especially in areas of the vehicle that are particularly critical for safety.

Audi says aluminum components make up 58 percent of the new A8 Audi Space Frame (ASF) and body. Aluminum is the largest portion in the mix of materials. As with the previous ASF design, cast nodes, extruded profiles and sheets are utilized in the new one, but the new heat-treated and ultra-high-strength cast alloys attain a tensile strength of significantly higher value than seen previously. The final addition to the intelligent mix of materials is the magnesium strut brace. Aluminum bolts attach the strut brace to the upper strut tower domes and front upper bulkhead, which adds to the body's high torsional rigidity. In the event of a frontal collision event, the applied impact forces generated are distributed to three impact buffers in the front end, which assist in the directing of the collision pulse. Additionally, the use of magnesium for this brace contributes a 28 percent weight savings over the previous design.

There are 14 different joining processes, and some new advancements in joining are seen for the first time on a production vehicle, including roller hemming at the front and rear door cutouts (openings on the uni-side or door rings). This mechanical, "cold" technology is used to join the aluminum side wall frame (uni-side panel – "cosmetic") to the hot-formed, ultra-strong steel sheets at the B-pillar, roof line and sills (inner reinforcements – "structural"). Audi says that in this process, engineers were able to make improvements at the door cutouts (compared to the predecessor model) that in turn make getting in and out of the car even more comfortable (and widens the driver's field of vision around the A-pillar, an area that is key to safe driving). For "hot" or "warm" joining processes, Audi really is in a class by itself by its development of remote laser welding for use with aluminum. Exact positioning of the laser beam during welding reduces the risk of hot cracking during the production process. The new process makes it possible to precisely control the penetration depth of the laser by means of the heat input, and computer-controlled sensors can immediately determine the gap width between parts being joined. Adjustments to the amperage can be made instantaneously.

As we have mentioned in previous articles, in 1994 the Audi A8 was considered the first mass-produced aluminum-intensive vehicle. It was also the first time the world saw the ASF, which established presence in the automotive world. Since 1994, Audi has built more than 1 million production cars with the ASF design, and Audi has been continually building upon its know-how in the use of materials and joining techniques.

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BMW first brought us the first mixed-material construction design with the 2004-2010 5 Series/E60 and 6 Series/E63, followed by Audi with the 2006-2014 TT/8J and 2015-Present TT/8S, then Porsche with the 2010-2016 Panamera/970. Most recently, we've seen the Mercedes-Benz 2014-Present S-Class/W222, BMW 2016 7 Series/G12, Cadillac 2016 CT6, Audi 2016-Present Q7/4M and now the all-new Audi A8 (and the D5 and 5H, if that's what they will ultimately be called) steps up the advancement in vehicle design. But where does this leave most collision repairers? Unfortunately, out of business for the facility owners who refuse to invest in training, and out of work for technicians who refuse to train and get educated. Additionally, the mindset must change; the old motto of "real body men fix it, those not skilled change parts" is not relevant or true.

As an industry, we must better ourselves by staying updated on training and education on the procedures and protocols that the OEM has laid out for us. This is why there are parts restrictions on most of these advanced designed vehicles. It is truly time to wake up and step up – or time to walk away.

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Executive Director's Thoughts

With the highest density of repairers in the country, only a handful of repairers in our entire region are qualified to fix the F-150 aluminum, and they're doubly scarce when it comes to the OEM certifications like Tesla, Porsche, Audi, VW, Nissan, etc. Larry and Jeff leave the door open (to walk out), but it is truly scary when we are talking about families getting in cars not fixed with proper equipment or repair processes. -Jordan Hendler