abrn TECHNICAL

automechanika CHICAGO

COMMITMENT TO TRAINING

TRAINING IN FOCUS

NEW ADVANCED MATERIALS

THE BMW 7 SERIES AND CADILLAC CT6 PRESENT NEW DESIGNS AND REPAIR CHALLENGES

Cadillac CT6 A-pillar wheel well extrication

BY **LARRY MONTANEZ** | CONTRIBUTING TECHNICAL EDITOR

Let's take a look at two specific vehicles that will set the standard for the future of vehicle design in the next few years. We are all aware of the all-aluminum-bodied 2015 Ford F-150, which introduced aluminum to the masses. While the Ford was a shock to the collision repair industry as a whole, it was not the first. The Audi A8 in 1994 is considered the first mass-produced aluminum intensive vehicle, and the 1995 BMW 5 Series (E60) with its front monocoque aluminum structure and rear monocoque steel structure was the first hybrid-construction vehicle, followed by the 2007 Audi TT (8J) and 2010 Porsche Panamera (970) hybrid construction vehicles. The BMW E60, Audi 8J and the Porsche 970 set up the future of vehicle design we are seeing now on two mass-produced vehicles and eventually on even more vehicles.

As we all know, OEMs are being forced to meet very tough safety and fuel mileage standards, and they must design vehicles with lighter materials. The designs from BMW, Audi and Porsche set the stage for everyone else in the automotive business, and we

will see these advanced designs in the next few years.

2016 BMW 750i (G11) and 750iL (G12)

These vehicles are not cars as we know them. It is as if BMW took your home entertainment system, put it inside a space shuttle and threw it on wheels. Yes, you can drive it like any other vehicle, or, if you like, it can drive itself. It will automatically perfume the air you breathe and draw the sun shades if it is too bright inside the vehicle. Approach the vehicle and it'll roll out what BMW calls a "Light Carpet," an LED-projected runway welcoming you to your vehicle. It also reminds you of speed limits and road conditions. And when you reach your destination, it will park for you, or just act as spotter if you prefer to do it yourself. All these features are pretty cool, but they are nothing compared to the vehicle's advanced structural design. Few vehicle designs have ever had such a diverse, high-tech construction as the new 7 Series. The 2016 model represents the auto industry's most mainstream application yet of structural carbon fiber. BMW put the 7 Series on a diet and trimmed 88 pounds from the 7's unibody structure, which now weighs in at 4,883 pounds, almost 100 pounds lighter than the previous generation 750i. All of the major suspension components are adjustable by computer-controlled systems. Air springs tweak the ride height based on load, speed and driver vehicle setting. Adjustable dampers and anti-roll bars vary the ride between soft (luxury) and firm (sport). The newly available Active Comfort Drive with Road Preview adjusts chassis systems according to data drawn from the navigation system. Not even the rear-wheel toe angle is fixed, as BMW's rear steering is available for the first time with four-wheel drive. Wheel alignments on this vehicle will require BMW software, and damage analysis will require multiple measurements with electronic three-dimensional measuring equipment, and in some cases a pre-wheel alignment or wheel alignment check will be required.

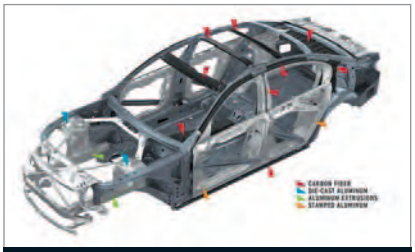
The BMW Display Key

The BMW 7 Series has a multi-material construction.

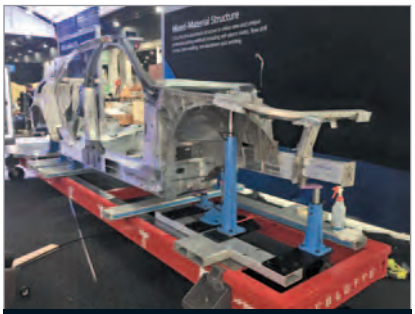
And shops will need to be careful with the optional Display Key ($250). The key incorporates a small screen on which the driver can check to see if the doors were left unlocked, the windows down or sunroof open, and it will even inform you how long until the next scheduled oil change.

OEMs must live in a material world to meet the high mpg fuel mileage requirements. They must choose advanced lightweight metals and composites capable of delivering light, stiff vehicle bodies, and at a reasonable cost of profit. We can all safely assume that BMW studied and dissected the aluminum-intensive precedents set by Audi, Jaguar, Mercedes-Benz and Porsche, and even the E60 design. BMW pushed the new structural concept it calls "Carbon Core" for the i3 and i8, and now it expanded that concept on its sixth-generation 7 Series sedan.

The 7 Series is BMW's new flagship's unibody, and it is composed mainly of resistance-welded high-strength steel stampings of various tensile strengths. Even though BMW says it is 88 pounds lighter, it is notably stiffer and has more torsional rigidity than its predecessor. Lessons learned from the i3 and i8 carbon fiber concept projects are behind the 15 carbon-fiber-reinforced moldings applied to high-stress areas. Tubular arches and reinforcements are utilized inside the A-Pillar and door-opening framework and under the upper outer roof rail panel/upper uniside panel. Additionally, BMW strategically placed aluminum structural components into the monocoque. These include extruded longitudinal chassis members, the die-cast strut towers, and the stampings for the hood and decklid panels, and doors assemblies. A magnesium space frame supports the instrument panel and steering column, and the front fenders are plastic composite. At press time, not a lot of repair information was available for publication, and we will revisit this topic. It is unknown if BMW will restrict structural components for sale.



The material make up of the BMW 7 Series


The Cadillac CT6 structure

2016 Cadillac CT6

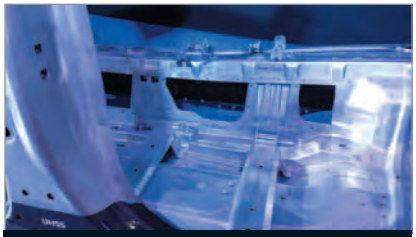
The CT6 is slotted above the ATS and CTS in the Cadillac lineup. Cadillac engineers concentrated their focus for the CT6 to avoid unnecessary weight. Its exterior dimensions and interior spaciousness put the CT6 roughly even with BMW's short-wheelbase 7 Series, but the CT6 claims the body in white is both lighter and stiffer than those of the smaller BMW 5 Series and Audi A6. Conversely, its main competition will be with full-size luxury flagship sedans such as the BMW 7 Series, Mercedes-Benz S Class, Audi AS/S8 and Lexus LS. Cadillac claims the CT6 will weigh in at just less than 3,700 pounds, roughly the same as the current CTS, despite the fact that the CT6 is 8.5 inches longer than the CTS.

Hybrid body design

The main weight-saving mission was bolstered by an extensive use of aluminum. Cadillac is using aluminum for all exterior body panels, as well as numerous structural castings. Like the Audi TT (8J), mixed-material engineering (hybrid construction) was utilized in the CT6's monocoque architecture. Advanced laser welding and aeronautic-type structural bonding adhesives were utilized for joining methods all in the name of reduced mass (weight). Reports say Cadillac has stated a weight savings of 218 pounds over an identical structure made mostly of steel.

The CT6 is the first production vehicle to utilize GM's new Omega platform. The suspension design is an aluminum-intensive multilink front suspension and a multilink rear, as well as GM's magnetorheological Magnetic Ride Control dampers and optional Active Chassis System, which includes rear steering. This will also require extensive analysis after a collision event, much like the procedures mentioned previously for the BMW.

The Cadillac CT6 mixed material structure uses advanced aluminum and steel to save 218 pounds.


The Cadillac CT6 structure

GM states that state-of-the-art monocoque architecture is the foundation for its benchmark-establishing agility and vault-like solidity and quietness — every panel of the structure is optimized with innovative joining techniques. These joining techniques provide the best balance of strength, lightness and refinement. Thirteen high-pressure aluminum die castings in the lower body construction reduce complexity and are significant contributors to the architecture's low mass. Additionally, there are reinforced areas of advanced high-strength steels (AHSS) affixed to the aluminum components. GM was able to accomplish this through advanced manufacturing techniques. GM's most advanced body manufacturing methods are used to fabricate the monocoque structure, including proprietary aluminum spot welding technology — a first in the industry — that is more efficient and helps reduce weight. Laser welding, flow drill screw fasten-

ers (FDS) and self-piercing rivets with adhesives are also utilized in many areas where steel and aluminum are joined. GM claims roughly 591 feet of advanced structural adhesives are used on the vehicle structure.

What we know as of now is that the fire wall, floor pans, floor cross members, inner passenger compartment panels, upper roof rail reinforcements and B-Pillar reinforcements and inner panels are all different strengths of steel. The remaining components are aluminum stampings, including all outer panels, and closure panels and cast components are used for the strut towers and upper rail components (aprons).

Training

GM states that about 25,000 units will be produced for the 2016 model year. The certified repair network will "probably more closely align" with luxury car programs like Audi and Mercedes, meaning parts will be restricted to only those shops that are certified by Cadillac and meet all the requirements. Additionally, repair facilities will be required to purchase specific tools and equipment and meet the training requirements. GM says that the specific training for the high-strength steel and aluminum vehicle will be "primarily web based" and offered through a GM partnership with I-CAR. These training offerings include 22046.20W1, "GM Body Structural Fastening Systems 1" and 22046.20W2, "GM Body Structural Fastening Systems 2," according to the Cadillac Aluminum Repair Network manual. Other I-CAR aluminum courses might also be necessary if staff hasn't yet taken them.

To be eligible for the program, the repair facility must be I-CAR Gold or VeriFacts VQ, have I-CAR technical training certificates, estimator training certificates and be current on aluminum structural certification with another OEM program, according to the shop participation agreement. Cadillac is not stating how many technicians must be trained in aluminum collision repair to be on the program. But the company has stated that each participating facility will be expected to have the necessary number and type of technicians properly trained for aluminum collision repairs. It is at Cadillac's sole discretion to determine the training requirements acceptable for program criteria.

As we have said, aluminum is here and so are advanced construction vehicles. Repair facilities will have to invest in equipment and training to stay current, and many of these vehicles may not be able to be repaired in your facility due to the parts restrictions.

LARRY MONTANEZ
CONTRIBUTING TECHNICAL EDITOR

Montanez is co-owner of P&L Consultant, which works with collision shops on estimating, production and proper repair procedures. He is also a certified technician for multiple OEM collision repair programs.

E-mail Larry at info@PnLEstimology.com