

Poor Quality Collision Repairs Alters Timing of Air Bag Deployment

By Courtesy [I-CAR](http://www.i-car.com)

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Proper structural repair is even more critical with air bags than with seat belts. Why? Because the stiffness and crushability of the structure is what tells the air bag sensor when to deploy the air bag. If the sensor has been altered due to a repair, the air bag may not open at the right time. Since the time to deploy the air bag is so short, deployment must occur at the right time in order to cushion the occupant.

Crash Pulse

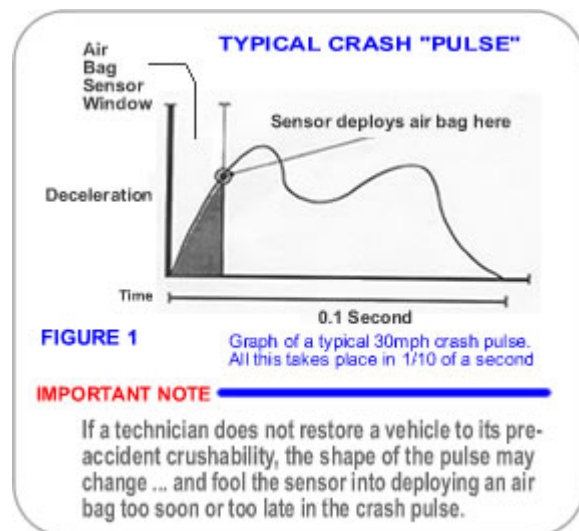
Car makers take great care to insure all the structural components work together. The correct flow of crash energy (*the "Crash Pulse"*) through the vehicle is imperative. Automakers "tune" the pulse to exactly the right combination of deceleration, time and crush distance for maximum occupant protection.

Figure 1 is a typical 30 mph barrier crash pulse. The pulse is produced by the deceleration over a period of time after the vehicle hits a solid object. The shape of this pulse is determined by the way each piece of a structure crushes during the accident. The pulse is unique to each make and model of car.

The entire crash pulse takes about 1/10th of a second. During this time, the occupants move forward. If there are no seatbelts or air bags, the occupants will hit the steering wheel, windshield or dashboard. This normally occurs just before the car completely stops. The occupants continue to travel at the speed they were originally going and only slow down when they hit something. This is what causes serious or fatal injuries to unrestrained occupants. It is often called "the second collision."

Seat Belts

The effect of the seat belt occurs late in the pulse. A seat belt helps slow the occupant down before hitting the interior of the car. The occupant may still hit the interior, but at a much slower speed – greatly reducing the possibility of injury. The car is nearly stopped before the seat belt starts to have an effect. Crushability and the shape of the pulse have some effect, but not as much as with an air bag.



Air Bag Timing

The air bag is inflated very early in the crash in order to cushion the occupant. As it deflates, it slows the occupant down over a relatively long period of time. Figure 2 shows this in action. This makes air bags effective in reducing injuries. It also makes the best use of the pulse or crushability of the structure.



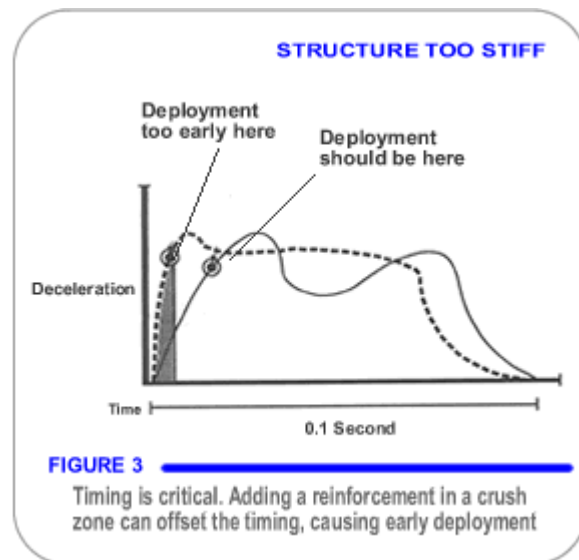
Air bag sensors measure deceleration. If there isn't enough deceleration, the sensor knows the accident is not severe enough and will not send a deploy signal. If the deceleration is sufficient enough, the sensor instantly deploys the air bag.

Timing is so important that each make and model car has a different shaped pulse. Each sensor is designed to match the crash pulse of the car. Other safety components and the air bag system are also carefully matched for the make and model.

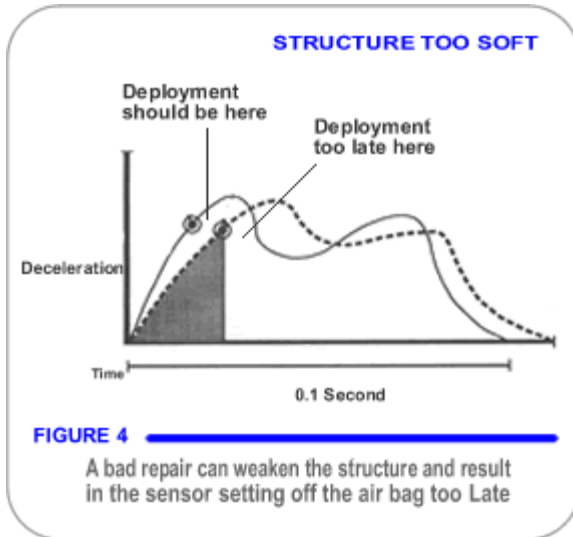
If the vehicle is damaged, it is important to restore the sensor and the structural safety elements to their original conditions. That is why car makers require technicians to:

- make sure sensors are inspected and replaced when necessary.
- use only part numbers specified for each car.
- make sure all sensors are properly installed.

Structural repair is risky for the timing sequence. If the technician does not restore the vehicle to pre-accident crushability, the shape of the pulse may change. This may fool the sensor into deploying the air bag too soon or too late in the crash pulse.



For example, a technician can make the structure too stiff by adding reinforcement in a crush zone. This can cause the deceleration to increase too early or too fast. The sensor may then deploy the air bag too soon (*see figure 3.*)



The opposite is also true. If a structure element is weakened the deceleration may become too slow or too late. The sensor may then deploy the air bag too late (see *figure 4.*)

Conclusion

Technicians should review everything they have learned about structural repair: straightening, welding, sectioning, when to replace, when to repair, etc. They should keep up with it and use it in their daily work, especially with air bag equipped cars. I-CAR publishes comprehensive information on these subjects in the Advantage. They

also cover it in detail in courses.