

On-Site Side Air Bag Investigation
Dynamic Science, Inc. (DSI), Case Number DS08036
2007 Honda Civic LX
Washington
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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract This on-site Side Air Bag Investigation focused on the air bags that deployed in a 2007 Honda Civic LX sedan that was involved in a three-vehicle crash. The Honda was equipped with advanced, dual-stage frontal air bags, seat-mounted side air bags, and side curtain air bags. The driver's frontal air bag, seat-mounted side air bag, and side curtain air bag deployed in the crash. The crash occurred in August 2008 in the state of Washington. The crash site was a three-leg intersection of a north/south roadway and an east/west roadway. The first other vehicle was a 1991 Chevrolet S-10 Blazer. The second other vehicle was a 2002 Dodge Ram pickup. The Honda was being driven northbound in the outboard lane, which was a bus-only lane. The Chevrolet was being driven southbound in the inboard lane, which was a left turn only lane. The Dodge was stopped at the intersection in the inboard westbound lane, which was a left turn only lane. As the Honda entered the intersection, the Chevrolet initiated a left turn into the Honda's path, and the front end of the Chevrolet impacted the left side of the Honda. The Honda was redirected a short distance to its right and impacted the front of the Dodge. The driver of the Honda was reported by the police to have sustained a non-disabling, yet evident injury, and she complained of leg pain. The Honda was towed from the scene due to damage and was later declared a total loss by the insurance company.				
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BACKGROUND

This on-site Side Air Bag Investigation focused on the air bags that deployed in a 2007 Honda Civic LX sedan (**Figure 1**) that was involved in a three-vehicle crash. The Honda was equipped with advanced, dual-stage frontal air bags, seat-mounted side air bags, and side curtain air bags. The driver's frontal air bag, seat-mounted side air bag, and side curtain air bag deployed in the crash.

The crash occurred in August 2008 in the state of Washington. The crash site was a three-leg intersection of a north/south roadway and an east/west roadway.

The first other vehicle was a 1991 Chevrolet S-10 Blazer. The second other vehicle was a 2002 Dodge Ram pickup. The Honda was being driven northbound in the outboard lane, which was a bus-only lane. The Chevrolet was being driven southbound in the inboard lane, which was a left turn only lane. The Dodge was stopped at the intersection in the inboard westbound lane, which was a left turn only lane. As the Honda entered the intersection, the Chevrolet initiated a left turn into the Honda's path, and the front end of the Chevrolet impacted the left side of the Honda. The Honda was redirected a short distance to its right and impacted the front of the Dodge. The driver of the Honda was reported by police to have sustained a non-disabling, yet evident injury, and she complained of leg pain. The Honda was towed from the scene due to damage and was later declared a total loss by the insurance company.



Figure 1. Subject vehicle, 2007 Honda Civic LX

This on-site side air bag investigation was initiated by the National Highway Traffic Safety Administration (NHTSA) during a review of General Estimates System (GES) police reports. On September 26, 2008, DSI was forwarded the police report with instructions to obtain cooperation. The notification requested verification that a side air bag deployed into an occupant position. A review of auction facility photographs revealed a deployed left side curtain air bag within the subject vehicle, and the police report verified the driver was present in the vehicle at the time of the crash. DSI obtained permission to inspect the subject vehicle on October 17, 2008, and the case was assigned on October 22, 2008. The vehicle was inspected at an auto auction facility on October 24, 2008. The 2006 Honda Civic had an Event Data Recorder (EDR); however, it was not supported by the investigator's hardware, and permission to harvest the EDR module was denied by the insurance company due to the dismantling required to access the module. Therefore, EDR data was not obtained from this vehicle.

SUMMARY

Crash Site

The crash occurred within the three-leg intersection of a north/south roadway and an east/west roadway (**Figure 2**). The north/south roadway was divided by a raised median. There were three

northbound lanes and two southbound lanes. The median had raised concrete curbs, a grass center, and measured 3.1 m (10.0 ft) in width. The northbound outboard lane was restricted to travel for buses only. White painted “Bus Only” signs were spaced intermittently along the lane. The bus-only lane was bordered by a solid white stripe on the left side and a solid white fog line on the right side. The other two northbound lanes were divided by a dashed white stripe. The roadway was straight and the profile of the northbound lanes had a positive slope. At 30.5 m (100 ft) south of the point of impact, the grade was a positive 3.1 percent. At the point of impact the grade was a positive 2.1 percent. Outboard of the bus lane was 1 m (3.0 ft) bike lane, a raised curb, a narrow strip of ground, a paved sidewalk, and a steel guardrail.



Figure 2. Northbound approach of subject vehicle to area of impact

There were three-phase traffic signals for all lanes. North of the intersection, the southbound roadway comprised two through lanes and a left turn only lane. The roadway was straight and had a slight negative grade. At 30.5 m (100 ft) north of the point of impact, the slope was a negative 2.8 percent. At the point of impact the grade was a negative 2.1 percent. The left turn only lane was separated from the northbound lanes by a double yellow stripe. There were three-phase traffic signals for all lanes.

The east/west roadway consisted of one eastbound lane and two westbound lanes. The inboard westbound lane was a left turn only lane; the outboard westbound lane was a right turn only lane. The roadway was bordered with raised concrete curbs, and shrubs and trees grew in close proximity to the roadway. There were three-phase traffic signals for all three lanes. For traffic using the westbound/turn lanes, a white painted stop line was located 4.3 m (14.0 ft) east of the east curb line of the intersection. The grade of the westbound lanes at the painted stop line was a negative 0.7 percent.

All roadways had a posted speed limit of 56 km/h (35 mph).

Pre-Crash

This crash occurred during daylight at 1808 hours in August 2008. It was raining and the roadway was wet. The Honda was being driven by a 29-year-old female and was traveling northbound in the outboard lane, which was a restricted bus-only lane. According to her attorney, the driver was pregnant (trimester unknown) at the time of the crash. The police report stated that northbound traffic was stopped due to heavy traffic. The traffic signal for northbound traffic was in the green phase. Other than vehicular traffic, there were no visual obstructions in the pre-crash environment for northbound drivers.

The Chevrolet was being driven by a 28-year-old male and was traveling southbound in the inboard lane, which was a left turn only lane. The Chevrolet entered the intersection, and the driver initiated

a left turn with the intention of traveling westbound. The traffic signal for the left turn lane was in the flashing yellow phase. Other than vehicular traffic, there were no visual obstructions in the pre-crash environment for vehicles turning left at the intersection.

The Dodge was being driven by a 56-year-old male and was stopped in the inboard westbound lane, which was a left turn only lane. The traffic signal for the left turn lane was in the red phase.

Crash

The front end of the Chevrolet impacted the left side of the Honda. The Honda's damaged profile indicated a Principal Direction of Force (PDOF) of 320 degrees. At impact, the Honda driver's frontal air bag, seat-mounted side air bag, and left side curtain air bag deployed, and the left safety belt pretensioner actuated. The Honda was displaced laterally to its right a short distance and its right rear impacted the front end of the Dodge. After the second impact, the Honda was redirected a short distance to the northwest corner of the intersection. The distance traveled by the Honda between the first and second impact was estimated to be 9 m (30 ft). The distance traveled by the Honda from the second impact to final rest was estimated to be 3 m (10 ft).

For the impact to the Honda's left side, the Missing Vehicle algorithm of the WinSMASH program computed a Total Delta-V of 24 km/h (14.9 mph); the longitudinal and lateral components were -18 km/h (- 10.6 mph) and 15 km/h (9.3 mph), respectively. The results appear reasonable given the crush damage and post-impact trajectory. For the second impact to the Honda's right rear, the Missing Vehicle algorithm of the WinSMASH program computed a Total Delta-V of 10 km/h (6.2 mph); the longitudinal and lateral components were -8 km/h (- 4.8 mph) and -6 km/h (-4.0 mph), respectively.

Post-Crash

The driver of the Honda was transported to local hospital for treatment. The Honda was towed from the scene due to damage and was later declared a total loss by the insurance company. The driver of the Chevrolet did not report any injuries. The Chevrolet sustained disabling damage and was towed from the scene. The driver of the Dodge did not report any injuries. The Dodge was driven from the scene by the driver.

Vehicle Data - 2007 Honda Civic

The 2007 Honda Civic LX was a four-door sedan and was identified by the Vehicle Identification Number (VIN): 1HGFA16547Lxxxxxx. The vehicle's date of manufacture was December 2006. The vehicle's electronic odometer displayed a reading 30,299 miles (48,760 km). The Honda was equipped with a 1.8-liter, 4-cylinder engine, automatic transmission, front wheel drive, power steering and daytime running lights. It was equipped with a 4-wheel standard anti-lock braking system (ABS), 4-wheel disc brakes, and ventilated discs on the front. Standard equipment included stability and traction control features.

The vehicle manufacturer's recommended tire size was P205/55R16 and the recommended cold tire pressure was 221 kPa (32 psi). The vehicle was equipped with Goodyear Eagle RS-A tires, size P205/55R16, which had a tire manufacturer's recommended maximum tire pressure of 303 kPa (44

psi). The specific tire information was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Tire flat	5 mm (6/32 in)	No	Tire de-beaded, sidewall cut, abraded
LR	179 kPa (26 psi)	5 mm (6/32 in)	No	None
RR	179 kPa (26 psi)	6 mm (7/32 in)	No	None
RF	172 kPa (25 psi)	5 mm (6/32 in)	No	None

The Honda's interior was equipped with seating for five occupants. The front row seating was configured with fabric-covered bucket seats and adjustable head restraints. The second row seating was configured with a fabric-covered bench seat and adjustable head restraints for the three seating positions.

Vehicle Damage - 2007 Honda Civic

Exterior Damage

The Honda sustained moderate left side damage as a result of the impact with the Chevrolet (Event 1). The front bumper fascia was cracked and the left bumper corner was missing from the vehicle. The left front fender and door were crushed. The left front axle was bent and the tire was canted outboard approximately 10 degrees. The left side view mirror was fractured and missing, and there was direct contact to the lower A-pillar. The hood was slightly deformed and shifted to the right. The left headlamp assembly was fractured and part of it was missing. The direct damage to the left side began at the front left bumper corner, extended 225 cm (88.6 in) down the left side, and ended at the left B-pillar (**Figure 3**). Six crush measurements were taken at the mid-door level as follows: C1 = 0 cm, C2 = 6 cm (2.4 in), C3 = 7 cm (2.8 in), C4 = 7 cm (2.8 in), C5 = 14 cm (5.5 in), C6 = 11 cm (4.3 in). The maximum crush measured 14 cm (5.5 in) and was located at C5. The Collision Deformation Classification (CDC) for the first impact was 11LYAW2.

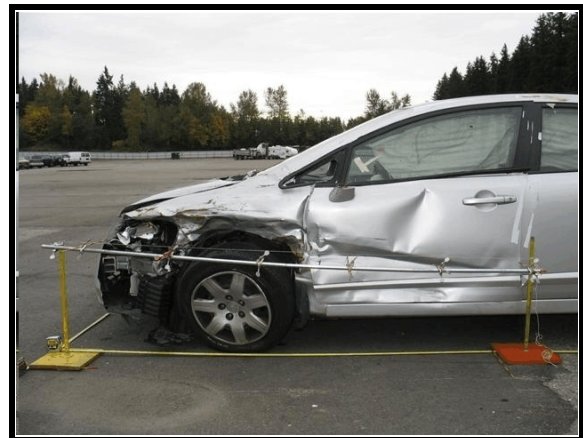


Figure 3. Left side damage



Figure 4. Right side damage

The Honda sustained minor right side damage as a result of the impact with the Dodge (Event 2). The rear quarter panel was deformed laterally and the right rear tail light was fractured. The direct damage to the right side began at the back right bumper corner and extended 97 cm (38.2 in) up the right side (**Figure 4**). Six crush measurements were taken at the mid-door level as follows: C1 = 10 cm (3.9 in), C2 = 11 cm (4.3 in), C3 = 12 cm (4.7 in), C4 = 8 cm (3.2 in), C5 = 3 cm (1.2 in), C6 = 0 cm. The maximum crush measured 14 cm (5.5 in) and was located at C3. The CDC for the second impact was 01RBEW2.

Interior Damage

The Honda sustained minor interior damage as a result of impact damage and occupant contacts during the crash. The windshield sustained a single stress crack which extended laterally from the right edge to the center. The triangular wing window forward of the left front door was disintegrated. The left front window frame was deformed outboard of the vehicle and revealed a 4 cm (1.6 in) gap between the frame and the door.

The control panel located on the forward aspect of the driver's door armrest was displaced approximately 1 cm (0.4 in), probably as a result of occupant contact. A small dark transfer was observed on the hardware's inboard aspect that measured 1 x 1 cm (0.4 x 0.4 in).



Figure 5. View showing driver compartment and left side interior

The B-pillars were configured with upper and lower interior covers. The covers on the left B-pillar came loose during the crash (**Figure 5**). The resulting gap measured 3 cm (1.2 in) and revealed the safety belt retractor mechanism and the stored length of belt within the pillar. Their displacement did not affect the deployment of the side curtain air bag, the seat mounted air bag, or the safety belt pretensioner. No suspected occupant contacts were observed on the covers, and the driver was shielded from these components by the deployed side curtain and seat mounted air bags. Other than the displacement of the covers, there was no damage observed.

The Honda was equipped with a tilt and telescoping steering wheel that was adjusted in the center to full-down position. The telescoping position was unknown. There was no deformation to the steering wheel due to occupant loading or contacts. The air bag module cover was displaced 2 cm (0.8 in) from the steering column at its upper aspect. The module cover was probably displaced during the air bag deployment. Other than the displacement of the component, there was no other damage observed.

There were no passenger compartment intrusions.

Manual Restraint Systems

The Honda was equipped with 3-point manual lap and shoulder belts for the five seating positions.

The front row safety belts were equipped with adjustable D-rings and pretensioners located within the buckles and retractors. The second row safety belts were configured with integrated belt retractors. All of the belts were configured with sliding latch plates, which displayed light scratching indicating historical usage. The driver's belt was equipped with an Emergency Locking Retractor (ELR). The remaining belts were equipped with switchable ELR/Automatic Locking Retractors (ALR).

The front row left safety belt was used to restrain the driver. The D-ring was adjusted to the full-down position. The retractor was locked in the used position due to the actuated retractor pretensioner. There was slack in the belt when it was in the buckled position. The belt webbing and buckle did not exhibit evidence of occupant loading forces.

Supplemental Restraint Systems

The Honda was equipped with advanced dual-stage Certified Advanced 208-Compliant (CAC) driver and front passenger frontal air bags. The air bags were certified by the manufacturer to be compliant with the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

The vehicle's supplemental restraint system consisted of a control module, driver and passenger frontal air bags, left and right side curtain air bags, left and right seat-mounted side air bags, front and side impact sensors, and safety belt pretensioners located at the retractors and buckles.



Figure 6. View showing deployed air bags

The driver's frontal air bag deployed from the steering wheel hub through one upper and two lower cover flaps (**Figure 6**). The flaps opened at their tear points and there was no damage to the flaps or to the bag. The module cover was displaced forward of its original position relative to the steering column by 2 cm (0.8 in). The frontal air bag was circular in shape and the face measured 56 cm (22 in) in diameter. There was a circular stitching pattern in the bag's front center which measured 16 cm (6.3 in) in diameter. The bag had one internal tether and two circular vent ports on the bag's upper back that were located at the 11 and 1 o'clock positions.

Two faint fabric transfers were located on the frontal air bag's face. The transfers were located in the upper left and upper right quadrants and each measured approximately 5 x 5 cm (2 x 2 in).

The driver's seat-mounted side air bag deployed from the module in the left side of the seat back. The bag was generally oval in shape, but was wider at the top than at the bottom. The bag measured 38 cm (15 in) at the upper aspect, 24 cm (9.5 in) at the lower aspect, and 50 cm (19.7 in) from top to bottom. One circular vent port was located at the bag's forward aspect. There were no tethers in the bag. No evidence of occupant contact was observed on the bag's inboard or outboard panels.

The molded plastic cover of the seat back was displaced from its original position and yielded a gap of 5 cm (2.0 in) from the seat back's fabric cover. No additional damage to the seat back existed, and the gap between the components was determined to be a normal result of the air bag deployment.

The left side curtain air bag deployed through roof cladding from a module located in the roof side rail. The air bag was generally rectangular in shape and measured 37 cm (14.6 in) in height and 180 cm (70.9 in) in length. The forward aspect of the bag was attached to the left A-pillar by a single external tether; the rearward aspect of the bag was attached to the left C-pillar. The longitudinal area of coverage began near the midpoint of the left A-pillar and extended to the midpoint of the C-pillar. The bag's vertical area of coverage began at the roof rail and extended to approximately 10 cm (3.9 in) below the bottom of the side glass. A second layer of fabric was sewn to the air bag's upper rear quadrant on the inboard side. The piece measured 15 cm (5.9 in) height and 75 cm (29.5 in) length. There were five holes in the bag, which measured 2 cm (0.8 in) in diameter and were surrounded with two rows of stitching.

The bag exhibited green and yellow markings that were applied during the manufacturing of the bag; the left side curtain air bag was otherwise unremarkable. The vehicle's roof cladding was torn lateral to the left B-pillar as a result of the deployment of the side curtain. The tear began at the outboard edge of the cladding and extended 16 cm (6.3 in) inboard.

Vehicle Data - 1991 Chevrolet S-10 Blazer

The 1991 Chevrolet S-10 Blazer 2-door sport utility vehicle was identified by the VIN: 1GN1T13ZXM2XXXXXX. The Chevrolet was equipped with a 4.3-liter, 6-cylinder engine, 4-wheel drive, and front disc/rear drum power brakes. The Chevrolet was traveling southbound and made a left-hand turn to travel south. The vehicle sustained frontal damage from the impact with the Honda and was towed from the scene. The vehicle was not inspected. The Missing Vehicle algorithm of the WinSMASH program computed a Total Delta-V of 17 km/h (14.9 mph); the longitudinal and lateral components were -16 km/h (-9.9 mph) and -6 km/h (-3.6 mph), respectively. The 28-year-old male driver did not report any injuries.

Vehicle Data - 2002 Dodge Ram 2500 pickup

The 2002 Dodge Ram 2500 Quad 4-door pickup was identified by the VIN: 3B7KF23662MXXXXXX. The Dodge was equipped with a 5.9-liter, 6-cylinder diesel engine, 4-wheel drive, and 4-wheel disc brakes with ABS. The Dodge was stopped at the intersection facing west. The vehicle sustained frontal damage from the impact with right side of the Honda and was driven from the scene. The vehicle was not inspected. The Missing Vehicle algorithm of the WinSMASH program computed a Total Delta-V of 4 km/h (2.5 mph); the longitudinal and lateral components were -3 km/h (-2.2 mph) and 2 km/h (1.2 mph), respectively. The 56-year-old male driver did not report any injuries.

OCCUPANT DEMOGRAPHICS

	Driver
Age/Sex:	29/Female
Seated Position:	Front left
Seat Type:	Bucket
Seat track position:	Mid-track
Height:	Unknown
Weight:	Unknown
Alcohol/Drug Involvement:	None
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt
Air bag:	Steering wheel mounted air bag, seat-mounted side air bag, side curtain air bag, deployed; deployed

OCCUPANT INJURIES

The driver complained of pain to one of her legs. The police reported that she sustained a non-disabling, yet evident injury.

OCCUPANT KINEMATICS

Driver Kinematics

The pregnant 29-year-old female driver was seated in an unknown posture and was restrained by the 3-point manual lap and shoulder belt. She was actively steering the vehicle and her right foot was on the accelerator. The vehicle entered the intersection on a green signal. The front end of the 1991 Chevrolet Blazer impacted the left side of the Honda. At impact, the driver's frontal air bag, seat-mounted side air bag, and left side curtain air bag deployed, and the safety belt retractor pretensioner actuated. The driver was displaced slightly forward and left in response to the 11 o'clock direction of force. She loaded the safety belt and possibly contacted the frontal air bag. The Honda initiated a slight clockwise rotation and was displaced to the right. The driver was displaced to the left, and her arm or torso probably contacted the left armrest and door hardware. The control panel located on the armrest was displaced and exhibited a dark transfer.

The vehicle traveled a short distance and impacted 2002 Dodge Ram that was stopped at the intersection. The left rear of the Honda impacted the front end of the Dodge, in what was a low Delta-V event. The driver stayed in place in her seat due to the safety belt pretensioner actuation. The Honda continued forward a short distance and came to rest at the northeast corner of the intersection.

The driver exited the vehicle in an unknown manner and was ground transported to a local hospital. Her specific injuries are not known.

Attachment 1. Scene Diagram

