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## ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION INVESTIGATION

CASE NUMBER - IN08032

LOCATION - TEXAS

VEHICLE - 2007 HONDA CIVIC LX

CRASH DATE - June 2008

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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.

**Technical Report Documentation Page**

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16. <i>Abstract</i> This report covers an on-site investigation that involved a 2007 Honda Civic LX and a 2007 Buick Lucerne, which were involved in an intersection collision. The focus of this on-site investigation was on the Honda's side impact air bag system and the sources of injury for the vehicle's restrained 44-year-old female driver. The Honda was traveling north approaching the intersection of an access roadway to a commercial establishment. The Buick's driver had been traveling south and was in the process of executing a left turn into the commercial establishment. As the Buick's driver executed the left turn, the vehicle's front plane impacted the Honda's front plane. The impact triggered a deployment of the Honda's driver's frontal air bag. The impact caused the Honda to rotate clockwise and the Buick to rotate counterclockwise. The right rear corner of the Buick impacted the Honda's left side plane, which triggered the deployment of the Honda's left side curtain air bag and front left seat back-mounted side impact air bag. The Honda's driver was transported by ambulance to a hospital. She sustained minor injuries and was treated and released from the emergency room.					
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The focus of this on-site investigation was the 2007 Honda Civic's side impact air bag system and the sources of injury for the vehicle's restrained 44-year-old female driver. This crash was brought to the National Highway Traffic Safety Administration's attention on August 8, 2008 by the sampling activities of the National Automotive Sampling System. The crash involved a 2007 Honda Civic LX (**Figure 1**) and a 2007 Buick Lucerne CXL. The crash occurred in June, 2008, at 16:10 hours, in Texas and was investigated by the applicable city police department. This contractor inspected the Honda and the crash scene on August 18 and 20, 2008. The Buick had been repaired and was not inspected. The Honda's driver could not be located for an interview. This report is based on the police crash report, scene and vehicle inspections, occupant kinematic principles, and this contractor's evaluation of the evidence.



**Figure 1:** The damaged 2007 Honda Civic LX

## CRASH CIRCUMSTANCES

**Crash Environment:** The trafficway on which both vehicles were traveling was a 10-lane, divided, city street, traversing in a north-south direction. Each vehicle's roadway had four through lanes and an opposing left turn lane allowing access through the raised concrete median. Each travel lane was nominally 3.5 m (11.5 ft) in width and the pavement markings consisted of broken white lane lines and yellow median edge lines. The posted speed limit was 72 km/h (45 mph). At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry, level concrete. The traffic density is unknown and the site of the crash was urban commercial. See the Crash Diagram on page 9 of this report.

**Pre-Crash:** The Honda's restrained 44-year-old female driver was traveling north in the outside center lane (**Figure 2**) and she intended to continue northbound. The Buick's 77-year-old restrained female driver had been traveling south and was in the process of executing a left turn from the left turn lane (**Figure 2**). She intended to cross the northbound travel lanes and enter the access roadway to a commercial establishment located on the east side of the roadway. It is not known if the Honda's driver took any actions to avoid the crash.



**Figure 2:** Approach of Honda northbound in the outside center travel lane and Buick turning left from left turn lane

**Crash:** As the Buick's driver proceeded through the left turn, the vehicle's front left impacted the Honda's front left bumper corner (**Figures 3 and 4**, event 1). The Honda's direction of force was within the 11 o'clock sector and the impact force was sufficient to deploy the driver's frontal air bag. The impact caused the Honda to rotate clockwise and the Buick to rotate counterclockwise, and the right rear corner of the Buick impacted the Honda's left lower B-pillar (**Figure 5**, event 2). The Honda's direction of force was within the 9 o'clock sector and the impact force was sufficient to trigger the deployment of the Honda's left side curtain air bag and the front left seat back-mounted side impact air bag. Both vehicles came to final rest on the north leg of the intersection heading north.



**Post-Crash:** The police were notified of the crash and arrived on the scene in seven minutes. Emergency rescue and medical services also responded to the crash scene. The Honda's driver was transported by ambulance to a hospital. The driver of the Buick was not injured and not transported to a hospital. Both vehicles were towed from the scene due to damage.

#### CASE VEHICLE

The 2007 Honda Civic LX was a front wheel drive, 4-door sedan (VIN: 1HGFA165X7L-----) equipped with a 1.8L, 4-cylinder engine, automatic transmission, and 4-wheel anti-lock disc brakes. The front row was equipped with bucket seats, adjustable

active, head restraints, lap-and-shoulder belts, a tilt and telescoping steering column, dual stage driver and front right passenger frontal air bags, seat back-mounted side impact air bags, and side curtain air bags, which provided coverage for the front and second row outboard seating positions. The second row was equipped with a split bench seat with folding back (60/40), adjustable head restraints, lap-and-shoulder seat belts, and Lower Anchors and Tethers for Children (LATCH).

### CASE VEHICLE DAMAGE

**Exterior Damage:** The Honda's initial impact with the Buick involved the front plane. The front left portion of the bumper, grille, left fender, and left headlamp/turn light assembly were directly contacted and the bumper fascia was torn off the vehicle. The direct damage also extended 135 cm (53.1 in) down the left fender and onto the front portion of the left front door. The direct damage to the front plane began at the front left bumper corner and extended 26 cm (10.2 in) across the bumper fascia. The crush measurements were taken on the front bumper bar and the residual maximum crush was 6 cm (2.4 in) occurring at C<sub>1</sub>. The table below shows the vehicle's front crush profile.

Units	Event	Direct Damage		Field L	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>	C <sub>6</sub>	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	26	6	118	6	3	2	0	0	0	-60	0
in		10.2	2.4	46.5	2.4	1.2	0.8	0.0	0.0	0.0	-23.6	0.0

The second impact involved the Honda's left side plane. The left front door, left rear door, B-pillar, and sill sustained direct contact. The direct damage began 131 centimeters (51.6 inches) forward of the left rear axle and extended forward 98 centimeters (38.6 inches). The maximum residual crush was 5 centimeters (2 inches) occurring at C<sub>4</sub>. The Honda's left and right side wheelbase were unchanged and the induced damage involved the hood and the left front and rear doors. The table below shows the vehicle's left side crush profile.

Units	Event	Direct Damage		Field L	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>	C <sub>6</sub>	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	2	34	5	98	0	0	3	5	3	1	-21	-49
in		13.4	2.0	38.6	0.0	0.0	1.2	2.0	1.2	0.4	-8.3	-19.3

**Damage Classification:** The Honda's Collision Deformation Classifications were **11-FLEE-6** (340 degrees) for the front impact (event 1, **Figure 6**) with the Buick, and **09-LPEN-1** (280 degrees) for the left side impact (**Figure 7**) with the Buick's right rear corner (event 2). The Missing Vehicle algorithm of the WinSMASH program calculated the Honda's total Delta V for the front impact as 12 km/h (7.5 mph). The longitudinal and lateral velocity changes were -11

km/h (-7 mph) and 4 km/h (3 mph), respectively. The Missing Vehicle algorithm calculated the Honda's total Delta V for the left side impact as 10 km/h (6 mph). The longitudinal and lateral velocity changes were -2 km/h (-1 mph) and 10 km/h (6 mph), respectively. Both sets of results were based only on the Honda's crush profiles because the Buick had been repaired. The results should be considered a borderline reconstruction of the Honda's Delta Vs.



**Figure 6:** Front and left fender damage from the impact with the front of the Buick



**Figure 7:** Damage on the left side plane from the impact with the Buick's right rear corner

The vehicle manufacturer's recommended tire size was P205/55R16. The Honda was equipped with tires of the recommended size. The vehicle's tire data are shown in the table below.

Tire	Measured Pressure		Vehicle Manufacturer's Recommended Cold Tire Pressure		Tread Depth		Damage	Restricted	Deflated
	kPa	psi	kPa	psi	milli-meters	32 <sup>nd</sup> of an inch			
LF	207	30	221	32	4	5	Sidewall abraded	No	No
LR	207	30	221	32	6	7	None	No	No
RR	207	30	221	32	5	6	None	No	No
RF	207	30	221	32	4	5	None	No	No

**Vehicle Interior:** The inspection of the Honda's interior revealed no occupant contact evidence and no evidence of steering rim deformation or compression of the energy absorbing steering column. All the doors remained closed and operational. All of the vehicle's window glazing was either fixed or closed and none of the side window or backlight glazing was damaged. The windshield glazing was cracked due to impact forces. The vehicle sustained no passenger compartment intrusion.



The Honda was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system that consisted of dual stage driver and front right passenger air bags, front seat position sensors, seat belt usage sensors, retractor and seat belt buckle mounted pretensioners and a front right passenger weight sensor. The manufacturer has certified that the vehicle is compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

The Honda's side impact air bag system consisted of front seat back-mounted side impact air bags and roof side rail-mounted side curtain air bags. The vehicle's side impact sensors were located on each side of the vehicle within the lower B and C-pillars. The inflation cylinders were located within the lower C-pillars.

The driver's frontal air bag was located within the steering wheel hub and the module cover was a three flap configuration (**Figure 8**) constructed of pliable vinyl. The top flap was 14 cm (5.5 in) in length and 6 cm (2.4 in) in height at the Honda emblem. Each bottom flap was triangular-shaped and was 7 cm (2.8 in) in width and height as measured along the top and center tear seams. An inspection of the air bag module cover flaps revealed that they opened at the designated tear points. The deployed air bag (**Figure 9**) was round with a diameter of 60 cm (23.6 in) and was designed with two tethers and two vent ports. The vent ports were located at the 3 and 9 clock positions. Inspection of the air bag revealed no damage and no discernable evidence of occupant contact.

The front right passenger frontal air bag was located within the top of the instrument panel. The deployment of this air bag was suppressed because the front right passenger seat was unoccupied.



**Figure 8:** The driver's frontal air bag module cover flaps



**Figure 9:** Driver's frontal air bag



**Figure 10:** Front portion of left side curtain air bag had been cut away by emergency personnel

The left side curtain air bag was located along the left roof side rail (**Figures 10 and 11**) inside the headliner and extended from the A-pillar to the C-pillar. The deployed side curtain air bag was 175 cm (68.9 in) in length and 34 cm (13.4 in) in height. It was attached at the A-pillar by a 6 cm (2.4 in) cloth tether. There was no visible tether at the C-pillar. The fold creases on the air bag indicated that it had been folded accordion fashion within the headliner. The front portion of the air bag had been cut away (**Figure 10**), probably by rescue personnel during removal of the driver from the vehicle. Only the portion of the air bag from the B-pillar rearward was present within the vehicle.

The driver's seat back-mounted side impact air bag was located in the outboard side of the seat back (**Figure 12**) and deployed through a tear-seam. The deployed air bag (**Figure 13**) was oblong and designed with one vent port located on the outboard side. The air bag had a single oval tether where both sides of the air bag were sewn together. The sewn area was 15 cm (5.9 in) in width and was located 24 cm (9.4 in) from the top and 21 cm (8.3 in) from the leading edge of the air bag. The deployed air bag was 54 cm (21.3 in) in height and 30 cm (11.8 in) in width. Inspection of the deployed air bag revealed no discernable evidence of occupant contact and no damage. There was a light abrasion on the left B-pillar (**Figure 12**) from contact with the outboard surface of the deploying air bag.



**Figure 11:** Back portion of left side curtain air bag



**Figure 13:** Driver's deployed seat back-mounted side impact air bag



**Figure 12:** Locations of driver's seat back-mounted side impact air bag; yellow tape highlights light abrasions on B-pillar from the deployment

The Honda was equipped with lap-and-shoulder belts for all the seating positions. The driver's seat belt consisted of continuous loop belt webbing, an Emergency Locking Retractor (ELR), sliding latch plate, and an adjustable upper anchor that was in the full up position. The front right seat belt was equipped with a switchable ELR/Automatic Locking Retractor (ALR), sliding latch plate, and adjustable upper anchor that was located in the full down position. The front row seat belts were equipped with retractor-mounted and buckle-mounted pretensioners. The second row seat belts consisted of continuous loop belt webbing, switchable ELR/ALRs, sliding latch plates and fixed upper anchors.

The inspection of the driver's seat belt system revealed that both pretensioners had actuated. The length of the buckle stalk was reduced by 2 cm (0.8 in) and the retractor was jammed and would not retract the seat belt. The seat belt webbing also had a slight stretched appearance. The evidence indicated that the driver was restrained by the lap-and-shoulder belt. The remaining seat positions were unoccupied.

#### CASE VEHICLE DRIVER KINEMATICS

The Honda's driver [44-year-old, female; unknown height and weight] was seated in an unknown posture. At the time of the vehicle inspection, the driver's seat track was adjusted between the middle and full rear position and the seat back was slightly reclined (**Figure 14**). The adjustable head restraint was located in the full down position, and the distance from the top of the seat back to the top of the head restraint was 19 cm (7.5 in). The tilt steering column was located in the full down position and the telescoping adjustment was located between the full back and middle position.



**Figure 14:** Driver seat position

The Honda's front impact with the Buick locked the driver's seat belt retractor and actuated the pretensioners consistent with the deployment of the driver's frontal air bag. The impact displaced the driver forward and left opposite the 11 o'clock direction of force and she loaded the lap-and-shoulder belt, which caused a contusion on her chest and thoracic and lumbar strains. The driver also sustained an abrasion and contusion on the right forearm, which was probably due to contact with the deploying frontal air bag. The Honda's left side impact with the Buick redirected the driver to the left opposite the 9 o'clock direction of force. While there was no discernable evidence of occupant contact on the seat back-mounted side impact air bag, occupant kinematic principles indicate that the driver's left upper arm and hip loaded this air bag and she sustained an abrasion on the left upper arm. Occupant kinematic principles also indicate that the driver probably loaded her head on the deployed left side curtain air bag during the left side impact. The medical records revealed no head injuries.

The Honda's driver sustained minor injuries and was transported by ambulance to a hospital. She was treated in the emergency room and released. The table below shows the driver's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Contusion chest, not further specified; faint seat belt bruising noted	minor 490402.1,4	Torso portion of safety belt system	Certain	Emergency room records
2	Strain, thoracic, not further specified; tenderness left mid back	minor 640478.1,7	Lap portion of safety belt system {Indirect injury}	Probable	Emergency room records
3	Strain, lumbar, not further specified	minor 640678.1,8	Lap portion of safety belt system	Probable	Emergency room records
4	Abrasion left upper arm, not further specified	minor 790202.1,2	Air bag, driver's side impact	Probable	Emergency room records
5	Abrasion right forearm with swelling and tenderness	minor 790202.1,1	Air bag, driver's	Probable	Emergency room records
6	Contusion {ecchymosis} right forearm and right wrist with swelling and tenderness	minor 790402.1,1	Air bag, driver's	Probable	Emergency room records

#### OTHER VEHICLE

The 2007 Buick Lucerne CXL was a front wheel drive, 4-door, sedan (VIN: 1G4HD57297U-----) equipped with a 3.8L, V6 engine, automatic transmission, four wheel anti-lock disc brakes, traction control, a tire pressure monitoring system, and dual stage driver and front right passenger frontal air bags. The supplemental restraint system in the Buick is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

**Damage Classification:** The Buick had been repaired and was not inspected. There were no photographs of the vehicle available and a CDC could not be estimated.

The Missing Vehicle algorithm of the WinSMASH program calculated the Buick's total Delta V for the front impact as 8.0 km/h (5.0 mph). The longitudinal and lateral velocity changes were -7 km/h (-4 mph) and -4.0 km/h (-3 mph), respectively. The Missing Vehicle algorithm calculated the Buick's total Delta V for the right rear corner impact as 7.0 km/h (4 mph). The longitudinal and lateral velocity changes were 4 km/h (2 mph) and -6 km/h (-4 mph), respectively. Both sets of results were based only on the Honda's crush profile because the Buick had been repaired and should be considered as a borderline reconstruction of the Buick's Delta Vs.

***Buick's Occupants:*** The police crash report indicated that the Buick's driver [77-year-old, female] was restrained by the lap-and-shoulder belt and the driver air bag did not deploy. The driver sustained no injuries and was not transported from the scene to a medical facility.

