

Remote SCI/NASS Combination Side Air Bag Investigation
Dynamic Science, Inc. (DSI), Case Number 2008-73-055J
2007 Honda Civic
Indiana
April 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.

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16. Abstract <p>This remote investigation focused on the side curtain and seat mounted side air deployments in a 2007 Honda Civic and the injuries sustained by the occupants. This two-vehicle crash occurred within a four-leg intersection. The Honda was occupied by a restrained 19-year-old male driver and a restrained 17-year-old front right seat passenger. The Honda was struck on the left side by a 1994 Chevrolet C1500 pickup that was being driven by a 49-year-old male. The left side curtain air bag and seat mounted side air bag in the Honda deployed during the impact with the Chevrolet. Both vehicles were redirected in a northeastern direction. The Honda came to rest off-road near the northeast corner of the intersection after striking two trees. The Chevrolet came to rest partially off-road, next to the Honda. The driver of the Honda sustained a head injury with loss of consciousness that was attributed to contact with the front right occupant. He also sustained a contusion to the left side of his head, an abrasion to the left side of his forehead, and an abrasion to the eyelid/orbit. The front right passenger sustained left side brain injuries and a left scalp contusion that were attributed to contact with the driver.</p>				
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TABLE OF CONTENTS

Background	1
Summary	1
Crash Site	1
Pre Crash	2
Crash	2
Post Crash	2
Vehicle Data - 2007 Honda Civic	2
Vehicle Damage	3
Exterior Damage	3
Interior Damage	4
Supplemental Restraint Systems	5
Occupant Demographics	6
Occupant Kinematics	6
Occupant Injuries	7
Attachment 1. Scene Diagram	8

BACKGROUND

This remote investigation focused on the side curtain and seat mounted side air deployments in a 2007 Honda Civic and the injuries sustained by the vehicle occupants (**Figure 1**). This two-vehicle crash occurred within a four-leg intersection. The Honda was occupied by a restrained 19-year-old male driver and a restrained 17-year-old front right seat passenger. The Honda was impacted on the left side by a 1994 Chevrolet C1500 pickup that was being driven by a 49-year-old male. The left side curtain air bag and seat mounted side air bag in the Honda deployed during the crash. Both vehicles were redirected in a northeastern direction. The Honda came to rest off-road near the northeast corner of the intersection. The Chevrolet came to rest partially off-road, next to the Honda. The driver of the Honda sustained a head injury with loss of consciousness that was attributed to contact with the front right occupant. He also sustained a contusion to the left side of his head, an abrasion to the left side of his forehead, and an abrasion to the eyelid/orbit. The front right passenger sustained left side brain injuries and a left scalp contusion that were attributed to contact with the driver.



Figure 1. Subject vehicle, 2007 Honda Civic

This Remote SCI/NASS Combination Side Air Bag Investigation was initiated in response to a report by the local National Automotive Sampling System (NASS) team. DSI was notified and assigned the case on July 25, 2008.

SUMMARY

Crash Site

This two-vehicle crash occurred at a four-leg intersection of two straight rural roadways in April 2008. At the time of the crash, there were no adverse weather conditions and the asphalt roadway surfaces were level and dry. The north/south roadway was configured with single lanes in each direction that were separated by a dashed yellow painted centerline (**Figure 2**). The roadway was controlled by stop signs in each direction. The posted speed limit was 48 km/h (30 mph). The east/west roadway was configured with single lanes in each direction that were separated by solid yellow painted centerlines (**Figure 3**). The speed limit was 64 km/h (40 mph).



Figure 2. Approach north, 2007 Honda Civic

Pre Crash

The 2007 Honda Civic was traveling northbound through the four-leg intersection. The driver brought the Honda to a controlled stop at the intersection, and then proceeded into the intersection. There were no indications that she ever saw the other vehicle. The 1994 Chevrolet C1500 pickup was traveling eastbound. The truck's pre-crash speed is unknown. As the Honda entered the intersection, the driver of the Chevrolet steered to left but could not avoid the impact.



Figure 3. 1994 Chevrolet pickup approach, west

Crash

The front of the Chevrolet pickup struck the left side driver's area of the Honda Civic. The impact severity was moderate, and resulted in the deployment of the left seat mounted side air bag and the left side curtain air bag in the Civic. The missing vehicle algorithm of the WinSmash program computed a total delta V of 29 km/h (18.0 mph), based on the Civic's left side crush profile. The longitudinal and lateral components were -19 km/h (11.8 mph) and 22 km/h (13.7 mph), respectively. The Civic was redirected diagonally across the intersection and struck a tree with its right side and then struck a second tree with its front plane. The right side impact resulted in the deployment of the right side air bag and side curtain air bag. The barrier algorithm of the WinSmash program computed a total delta V of 8 km/h (4.9 mph), based on the Civic's right side crush profile. The longitudinal and lateral components were -5 km/h (3.1 in) and -6 km (3.7 mph), respectively.

Post Crash

The Honda came to rest off-road near the northeast corner of the intersection. The Chevrolet came to rest partially off-road, next to the Honda. The driver of the Honda sustained a head injury with loss of consciousness that was attributed to contact with the front right occupant. He also sustained abrasions to the left temple, left forehead, and left upper eyelid. He was transported to a local trauma center where he arrived with a Glasgow Coma Score (GCS) of 15. He was hospitalized for one day. The front right passenger sustained left side brain injuries and a left scalp contusion that were attributed to contact with the driver. She also sustained a contusion to the left abdomen. She was transported to a local trauma center where she arrived with a GCS of 15. She was hospitalized for five days. Both occupants were trapped in the vehicle due to jammed doors.

Vehicle Data - 2007 Honda Civic

The Honda Civic was identified by the Vehicle Identification Number (VIN): 2HGFA55X7xxxxxx. The vehicle's odometer could not be read because there was no power to the vehicle. The Honda was a 4-door sedan that was equipped with a 2.0 liter, 4-cylinder engine, an automatic transmission, front wheel drive, 4-wheel ABS, front disc/rear drum brakes, and a tilt/telescopic steering wheel.

The Honda was configured with Michelin MXM4 P215/45R17 tires. The vehicle manufacturer's recommended cold tire pressure was not known, the tire manufacturer's stated maximum pressure was 303 kPa (44 psi).

The specific tire information was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	193 kPa (28 psi)	6 mm (8/32 in)	No	None
LR	186 kPa (27 psi)	6 mm (8/32 in)	No	None
RR	193 kPa (28 psi)	6 mm (8/32 in)	No	None
RF	193 kPa (28 psi)	6 mm (8/32 in)	No	None

The seating in the Honda Civic was configured with front bucket seats were adjustable head restraints and a rear bench seat. The driver's seat was located between the middle and rear most track positions. The seat back was slightly reclined. The front right seat was located between the middle and rear most track positions. The seat back was slightly reclined.

Vehicle Damage

Exterior Damage - 2007 Honda Civic

The 2007 Honda Civic sustained moderate left side plane damage from the impact with the Chevrolet pickup (**Figure 4**). The direct damage began 15 cm (5.9 in) forward of the left front axle and extended 200 cm (78.7 in) rearward along the left side plane. The direct and induced damage began 28 cm (11.0 in) forward of the left front axle and extended rearward 218 cm (85.8 in). Both left side door were jammed shut and left side glazing disintegrated. The left side mirror was missing. Six crush measurements were documented at the mid door level as follows: C1 = 3 cm (1.2 in), C2 = 22 cm (8.7 in), C3 = 24 cm (9.4 in), C4 = 21 cm (8.3 in), C5 = 6 cm (2.4 in), C6 = 3 cm (1.2 in). The Collision Deformation Classification (CDC) for the impact with the truck was 10LYAW3.



Figure 4. Left side damage

The Honda sustained moderate right side plane damage, primarily at the right rear door area, from the impact with the tree (**Figure 5**). The direct damage began 67 cm (26.3 in) forward of the right rear axle. The direct and induced damage began 34 cm forward of the right rear axle. Both right side doors were jammed shut and the right front door glazing was disintegrated.

Six crush measurements were documented at the mid door level as follows: C1 = 2 cm (0.8 in), C2 = 4 cm (1.6 in), C3 = 6 cm (2.3 in), C4 = 8 cm (3.1 in), C5 = 7 cm (2.8 in), C6 = 1 cm (0.4 in). The CDC for the impact with tree was 02RPEN2.

The Honda also sustained moderate damage to the front end from the impact with the tree. The hood was displaced rearward and to the left. The grille was deformed downward. The CDC for the impact with the tree was 02FYEN1.



Figure 5. Front and right side damage

Interior Damage

The 2007 Honda Civic sustained moderate interior damage as a result of passenger compartment intrusion. There was lateral intrusion into the driver's seated area from the B-pillar, the rear lower quadrant of the door, and the forward lower quadrant of the door.

The specific passenger compartment intrusions were documented as follows:

Row	Position	Intruded Component	Magnitude of Intrusion	Direction
Front seat	Left	B-pillar	≥ 8 to < 15 cm (≥ 3.1 to < 5.9 in)	Lateral
Front seat	Left	Door/Rear lower quadrant	≥ 15 to < 30 cm (≥ 5.9 in to < 11.8 in)	Lateral
Second seat	Left	Door/Forward lower quadrant	≥ 8 to < 15 cm (≥ 3.1 to < 5.9 in)	Vertical

Manual Restraints - 2007 Honda Civic

The 2007 Honda Civic was configured with manual 3-point lap and shoulder belts for each seating position. Both front seat safety belts were equipped with retractor and buckle pretensioners and adjustable D-rings. It was not known if the pretensioners actuated. The driver's shoulder adjustment was in the mid position. The driver's safety belt was configured with a sliding latch plate and an Emergency Locking Retractor (ELR). The remaining safety belts were configured with sliding latch plates and switchable ELR/Automatic Locking Retractors (ALR).

Supplemental Restraint Systems - 2007 Honda Civic

The Honda Civic was equipped with advanced occupant protection systems including multi-stage Certified Advanced 208-Compliant driver and front right passenger air bags. The multi-stage air bags were certified by the manufacturer to meet the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The frontal air bags did not deploy. The Civic was also equipped with 1st and 2nd row side curtain air bags and front seat mounted side air bags. The side impact air bag sensors were located on the driver and passenger side lower B- and C-pillars. The side air bags are designed to deploy separately, depending on which side was impacted. The front passenger seat was equipped with an Occupant Position Detection System (OPDS) that was designed to prevent the side air bag from deploying if a child or small-statured adult was in the path of deployment.

The left side curtain air bag and left seat mounted side air bag deployed during the impact with the Chevrolet pickup (**Figure 6**). The curtain air bag deployed from the roof cladding. The right side curtain and right seat mounted side air bag deployed during the impact with the tree (**Figure 7**). The curtain air bag deployed from the roof cladding. There were no reports of any damage or contact to the air bags.



Figure 6. Driver's side curtain air bag and seat mounted side air bag



Figure 7. Right side curtain air bag

OCCUPANT DEMOGRAPHICS - 2007 Honda Civic

	Driver	Front Right Passenger
Age/Sex:	19/Male	17/Female
Seated Position:	Front left	Front right
Seat Type:	Bucket	Bucket
Height:	173 cm (68 in)	160 cm (63 in)
Weight:	64 kg (141 lbs)	50 kg (110 lbs)
Alcohol/Drug Involvement:	None	N/A
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Right foot on accelerator, left on floor	Unknown
Restraint Usage:	Lap and shoulder belt used	Lap and shoulder belt used
Air bag:	Driver frontal air bag available, did not deploy. Side curtain air bag available, deployed. Seat mounted side air bag, deployed.	Front right passenger frontal air bag available, did not deploy. Side curtain air bag available, deployed. Seat mounted side air bag, deployed.

Occupant Kinematics - 2007 Honda Civic**Driver Kinematics**

The 19-year-old male driver of the Honda Civic was seated forward facing in an unknown posture and was restrained by the 3-point manual lap and shoulder belt. The bucket seat was adjusted to between the middle and rear most track position. The seat back was slightly reclined. The driver was beginning to accelerate into the intersection so his right foot was likely on the gas pedal prior to impact. At impact with the pickup, the driver initiated a left lateral and slightly forward trajectory in response to the vehicle's 10 o'clock direction of force. The driver contacted the side curtain air bag with the left side of his head, causing abrasions to the left temple, left forehead and left upper eyelid. His left lower leg contacted the left door panel/forward lower quadrant.

The Civic was redirected in a northeast direction. The driver remained in place, restrained by the safety belt. At the first tree impact, the driver was displaced laterally to the right. At some point, the right side of the driver's head contacted the front right occupant's head, causing the driver's concussive brain injury.

Front Right Occupant Kinematics

The 17-year-old female front right occupant of the Civic was seated forward facing in an unknown posture and was restrained by the 3-point manual lap and shoulder belt. The bucket seat was adjusted to between the middle and rear most track position. The seat back was slightly reclined. At impact with the pickup, the front right occupant initiated a left lateral and slightly forward trajectory. The occupant contacted the center console with her left abdomen and sustained a contusion. The Civic was redirected in a northeast direction. At the impact with the first tree, the front right occupant was displaced laterally to the right and probably contacted the deployed curtain air bag. At some point, possibly during a rebound from the first impact, the left side of this occupant's head came into contact with the driver's head, causing the left side scalp contusion and the left side brain injury.

OCCUPANT INJURIES - 2007 Honda Civic

Driver: Injuries obtained from emergency room records.

<u>Injury</u>	<u>AIS Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Concussion with loss of consciousness less than 1 hour	160202.2,0	Other occupant	Possible
Left temporal scalp abrasion	190202.1,2	Air bag	Certain
Left forehead/brow abrasion	290202.1,7	Air bag	Certain
Left upper eyelid abrasion	297202.1,2	Air bag	Certain
Left lower leg abrasion	890202.1,2	Left door/rear lower quadrant	Certain

Front right occupant: Injuries obtained from emergency room records.

<u>Injury</u>	<u>AIS Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Left temporal and parietal cerebrum hematoma, small	140652.4,2	Other occupant	Probable
Left parietal cerebrum contusion, single, small	140606.3,2	Other occupant	Possible
Left abdomen contusion	590402.1,2	Center console	Probable
Left scalp contusion/subgaleal hematoma	190402.1,2	Other occupant	Probable

Attachment 1. Scene Diagram

