

CRASH DATA RESEARCH CENTER

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**CALSPAN ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION
SYSTEM CRASH INVESTIGATION**

SCI CASE NO. – CA09029

VEHICLE – 2009 HONDA CIVIC

LOCATION – NEW JERSEY

CRASH DATE – MAY 2009

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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 are 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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BACKGROUND

This on-site investigation focused on the side impact inflatable occupant protection system in a 2009 Honda Civic Si (**Figure 1**). The Honda was equipped with front seat back-mounted side impact air bags and Inflatable Curtain (IC) air bags for the outboard positions. Additionally, the vehicle was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system and buckle mounted safety belt pretensioners for the front belt systems. The manufacturer of this vehicle has certified that the Civic is compliant to



the Advanced Air Bag portion of Federal Motor Vehicle Safety Standard No. 208. The Honda was occupied by a restrained 20-year-old male driver and was involved in an intersection collision with a 2000 Dodge Durango. During the crash, the driver's buckle pretensioner actuated and the left frontal air bag, left seat back mounted side impact air bag, and the left curtain air bags deployed. The driver sustained minor injuries and was transported to a hospital where he was treated and released.

This crash was identified by the Crash Investigation Division of the National Highway Traffic Safety Administration through police reported crashes sampled by the National Automotive Sampling System (NASS). The crash information was forwarded to the Calspan Special Crash Investigations (SCI) team on May 7, 2009. The Calspan SCI team contacted the insurance company and located the Honda at a salvage facility. Cooperation was established with the insurance company and the salvage facility to inspect the vehicle. An on-site investigation of the crash was assigned to the Calspan SCI team on May 11, 2009 due to the agency's interest in vehicles equipped with side impact air bags. The Honda and the Dodge were inspected on May 13, 2009. The interview with the driver was conducted on May 13, 2009.

SUMMARY

Crash Site

This crash occurred during the nighttime hours of February 2009, at a T-intersection. The intersection was comprised of a business driveway and an east/west roadway. The 7.8 meter (25.5 feet) wide driveway was oriented in the north/southbound directions. The travel lanes were not physically separated and were controlled by a stop sign for the exiting southbound lane. The east/west roadway was configured with one travel lane in each direction that was separated by double-yellow centerlines. In the vicinity of the crash site, the double-yellow center lines widened to form a painted median. Both roadways were surfaced with level asphalt and were wet due to rain at the time of the crash. The posted speed limit for east/west roadway was 64 km/h (40 mph). The scene schematic is included as **Figure 10** of this report.

Vehicle Data

2009 Honda Civic Si

The 2009 Honda Civic Si was a two-door coupe that was identified by Vehicle Identification Number: (VIN) 2HGFG21559H (production number deleted). The Honda Civic was a uni-body design that was powered by a 2.0-liter transverse mounted four-cylinder engine linked to a six-speed manual transmission with front wheel drive. The braking system consisted of power-assisted front and rear disc brakes with an Antilock Braking System (ABS) and Electronic Brake Distribution (EBD). The standard features for the Civic Si also included an Electronic Stability Control (ESC) system. The tires on the vehicle were Continental Conti Touring Contact, size P215/45R17 mounted on multi-spoke OEM alloy wheels. The vehicle manufacturer recommended cold tire pressure was 228 kPa (32 PSI) for the front and rear. The temporary spare tire was on the left front position at the time of the SCI inspection; the OEM tire wheel could not be located for inspection. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Tire/Wheel Damage
Left Front	Spare tire 414 kPa (60 PSI)	4 mm (5/32")	None
Left Rear	269 kPa (39 PSI)	8 mm (10/32")	None
Right Front	262 kPa (38 PSI)	7 mm (9/32")	None
Right Rear	262 kPa (38 PSI)	8 mm (10/32")	None

The interior of the Honda was configured with cloth upholstered five-passenger seating. The front bucket seats were separated by a center console and equipped with active head restraints that were height adjustable. The front head restraints were adjusted to the full-down position at the time of the SCI inspection. The rear seating consisted of a bench seat with a forward folding back feature and height adjustable head restraints.

The Honda's safety systems consisted of front seat back-mounted side impact air bags, IC air bags for the outboard positions, a CAC frontal air bag system, and buckle mounted safety belt pretensioners for the front belt systems. In addition to these systems the vehicle was equipped with ABS, EBD, ESC, Honda's Advanced Compatibility

Engineering (ACE) body structure, active front head restraints, daytime running lights, and side impact door beams.

2000 Dodge Durango

The 2000 Dodge Durango was identified by the VIN: 1B4HS28N8YF (production number omitted) and was manufactured in 09/99. The Dodge was constructed as a body-on-frame sport utility vehicle. The power-train consisted of a 4.7-liter eight-cylinder engine linked to an automatic transmission with four-wheel drive. The tires on the vehicle were Uniroyal Liberator AX, size P235/75R15 mounted on multi-spoke OEM alloy wheels. The vehicle manufacturer recommended cold tire pressure was 241 kPa (35 PSI) for the front and 283 kPa (41 PSI) for the rear. The right rear tire pressure could not be obtained due to the lack of space between the Dodge and the adjacent vehicle. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Tire/Wheel Damage
Left Front	269 kPa (39 PSI)	6 mm (8/32")	None
Left Rear	303 kPa (44 PSI)	6 mm (7/32")	None
Right Front	317 kPa (46 PSI)	6 mm (7/32")	None
Right Rear	Unknown	3 mm (4/32")	None

Crash Sequence
Pre-Crash

The restrained 20-year-old male driver of the Honda was traveling south approaching the intersection where his intention was to turn left (**Figure 2**). The Dodge was driven by a 52-year-old male and was occupied by a 43-year-old female front right passenger. The driver of the Dodge Durango was operating the vehicle westbound approaching the intersection (**Figure 3**). During the SCI interview, the driver of the Honda stated that he had stopped at the intersection. He did not detect on-coming traffic and initiated the left turn.



Figure 2. Honda's southbound approach to the intersection.



Figure 3. Westbound travel direction of the Dodge.

Crash

The front of the Dodge impacted the left side of the Honda within the intersection.

Figure 4 is a view of the area of impact from the Dodge's westbound approach. The resultant directions of force for the Honda and the Dodge were within the 10 and 1 o'clock sectors, respectively. The Damage Algorithm of the WinSMASH program was used to compute the delta-V. The total velocity change for the Honda was 24 km/h (14.9 mph), with a longitudinal component of -15 km/h (-9.3 mph) and a lateral component of 18 km/h (11.2 mph). The total delta-V for the Dodge was 15 km/h (9.3 mph). The longitudinal and lateral components for the Dodge were -14 km/h (-8.7 mph) and -5 km/h (-3.1 mph), respectively.



Figure 4. Westbound view of the area of impact.

As a result of the crash, the buckle pretensioner actuated, and the frontal air bag, the left seat back mounted air bag, and the left curtain air bags deployed in the Honda. Both vehicles came to rest within the intersection. A bystander stated to the SCI investigator that the Honda was facing a northwest direction at final rest. At rest, the Dodge was facing a southeast direction. There was no physical evidence or police documentation to support the exact final rest positions of the vehicles.

Post-Crash

The restrained 20-year-old male driver of the Honda exited the vehicle unassisted through the right front door. He sustained minor severity injuries and was transported to a local hospital where he was treated and released. The driver and passenger of the Dodge were not injured or transported to a hospital. Both vehicles were towed from the crash site. The Honda was deemed a total loss by the insurance company and was transferred to a salvage yard where it was inspected for this SCI investigation. The Dodge was located at the owner's residence where it was inspected.

Vehicle Damage

Exterior – 2009 Honda Civic Si

The exterior of the Honda sustained moderate severity damage as a result of the intersection crash (**Figure 5**). The direct contact damage for the impact with the Dodge measured 129 cm (50.1 in) and began 48 cm (18.9 in) forward of the left rear axle. The maximum crush was 20 cm (7.9 in) and was located 141 cm (55.5 in) forward of the left rear axle. The height of the maximum crush was 67 cm (26.3 in).



Figure 5. Residual left side damage.

A crush profile was documented at the mid-door level and was as follows: C1 = 1 cm (0.4 in), C2 = 11 cm (4.3 in), C3 = 16 cm (6.3 in), C4 = 20 cm (7.9 in), C5 = 10 cm (3.9 in), C6 = 0 cm. In addition to the crush profile, a single measurement documenting the distance between the sill and the door was obtained. This measurement is identified as the Door Sill Differential (DSD) and was 13 cm (5 in). The Collision Deformation Classification (CDC) assigned for this crash was 10-LZEW-2.

Interior – 2009 Honda Civic Si

Inspection of the passenger compartment of the Honda revealed damage associated with occupant contacts and passenger compartment intrusions. An occupant contact point was noted to the rear lower quadrant of the left front door panel. This contact was evidenced by deformation to the door panel. A white colored scuff mark was noted to the right aspect of the steering column. The passenger compartment intrusions are listed in the following table:



Figure 6. Overall view of the left front area.

Location	Component	Magnitude	Direction
Left Front	Forward upper quadrant of the left front door	9 cm (3.5 in)	Lateral
Left Front	Left front seat back	7 cm (2.8 in)	Lateral
Left Front	B-pillar	10 cm (3.9 in)	Lateral
Left Front	Roof side rail	3 cm (1.2 in)	Lateral
Left Rear	Side panel rear of B-pillar (plastic panel)	27 cm (10.6 in)	Lateral
Left Rear	Sill	2 cm (0.8 in)	Lateral
Left Rear	Roof side rail	5 cm (1.9 in)	Lateral

The driver's bucket seat track was unbolted during the estimate process and the exact seat track location could not be determined. The driver stated to the SCI investigator that the seat was adjusted to a mid-track position with the seat back in an upright position. The rear seat cushion was also removed during the estimate process and was located in the rear of the vehicle uninstalled. **Figure 6** depicts the front left of the Honda Civic.

Exterior – 2000 Dodge Durango

The 2000 Dodge Durango sustained minor frontal damage as a result of the impact with the Honda (**Figure 7**). The direct contact damage was confined to the center and left aspects of the front plane and measured 78 cm (30 in) in width. The direct damage began 5 cm (1.9 in) left of the centerline and extended 83 cm (32.6 in) to left bumper corner. The maximum crush measured 12 cm (4.7 in) and was located at the front left bumper corner. Six equidistant crush measurements were documented along the bumper beam of the vehicle and were as follows: C1 = 12 cm (4.7 in), C2 = 8 cm (3.1 in), C3 = 7 cm (2.8 in), C4 = 3 cm (1.2 in), C5 = 0 cm, C6 = 0 cm. The CDC assigned for this impact was 01-FYEW-1.



Figure 7. Frontal damage to the 2000 Dodge Durango.

Manual Safety Belt Systems – 2009 Honda Civic Si

The Honda was equipped with manual 3-point lap and shoulder safety belts for the five designated seat positions. All belt systems utilized continuous loop webbing with sliding latch plates. The driver's belt was equipped with an Emergency Locking Retractor (ELR), fixed height D-ring, and a buckle pretensioner. The lower anchor of the driver's belt was unbolted during the estimate at a repair shop and was found in this condition at the time of the SCI inspection. The driver used the safety belt at the time of the crash which was supported by the subtle frictional abrasions to the latch plate, webbing, and the actuated buckle pretensioner. The loading abrasions on the webbing were located 157 cm (61.2 in) above the anchor. The actuation of the buckle pretensioner compressed the buckle stalk 2 cm (0.8 in).

The front right safety belt system utilized a switchable ELR and Automatic Locking Retractor (ALR) and a buckle pretensioner. The front right seat was not occupied; however, the pretensioner actuated compressing the buckle stalk 5 cm (1.9 in).

The three rear belt systems utilized switchable ELR/ALR. These positions were unoccupied at the time of the crash.

Side Impact Inflatable Occupant Protection System – 2009 Honda Civic Si

The Honda was equipped with front seat back-mounted side impact air bags and roof side rail mounted IC air bags. The left seat back-mounted air bag and the left curtain air bag deployed during the crash.

The left curtain air bag deployed as designed from the roof side rail. The air bag measured 140 cm (55.1 in) in length. In height, the air bag measured 38 cm (15 in) at the left rear position and extended 8 cm (3.1 in) below the beltline. The air bag was tethered by a 7 cm (2.8 in) tether at the A-pillar.

The air bag at the driver's position was cut post-crash. The cut section measured 70 cm (27.6 in) length and was removed from the vehicle (**Figure 8**). A section that measured 7 cm (2.8 in) in height remained attached to the roof rail at the area of the cut fabric. The presence of occupant contacts and damage could not be confirmed at the front position.



Figure 8. Curtain air bag cut from the left front position.



Figure 9. Front seat back mounted air bag.

The left seat back-mounted air bag was concealed within the outboard aspect of the seat back. The air bag deployed through a 44 cm (17.3 in) tear seam at the forward aspect of the seat back. The air bag measured 50 cm (19.7 in) in height and 35 cm (13.8 in) in width and was comprised of two panels sewn together at the forward edge. There was no damage or occupant contact points to the seat back-mounted side air bag. **Figure 9** depicts the inboard aspect of the right seat back-mounted side impact air bag,

Frontal Air Bag System – 2009 Honda Civic Si

The Honda was equipped with a CAC frontal air bag system that consisted of dual stage driver and passenger air bags, seat track positioning sensors, a front right occupant presence sensor, buckle pretensioners, and safety belt buckle switches. A CAC vehicle is certified by the manufacturer to be compliant to the Advanced Air Bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

As a result of the crash, the driver's frontal air bag deployed. The driver's frontal air bag was conventionally mounted within the center of the three-spoke steering wheel rim and was concealed by three cover flaps. The top cover flap measured 7 cm (2.8 in) in height and 13 cm (5.1 in) in width. The total width of the lower cover flaps measured 13 cm (5.1 in) with a height of 9 cm (3.5 in). The driver's air bag measured 45 cm (17.7 in) in diameter in its deflated state. The air bag contained two tethers at the 12 and 6 o'clock positions and was vented by two vent ports at the 11 and 1 o'clock positions. There was no damage or occupant contact points present on the air bag fabric. The air bag contained several areas of dirt and grease from post-crash handling.

The front right seat was not occupied at the time of the crash; therefore, as designed the CAC system suppressed the deployment of the air bag.

Driver Demographics – 2009 Honda Civic Si

Age/Sex: 20-year-old/Male
Height: 175 cm (69 in)
Weight: 64 kg (140 lb)
Seat Track Position: Mid-track position
Safety Belt Usage: Three-point manual lap and shoulder safety belt
Usage Source: SCI vehicle inspection
Egress from Vehicle: Exited unassisted through the right front door
Mode of Transport from Scene: Ambulance
Type of Medical Treatment: Treated and released

Driver Injuries

<i>Injury</i>	<i>Injury Severity (AIS 90/ Update 98)</i>	<i>Injury Source</i>
Forehead laceration	Minor (290602.1,7)	Unknown
Nose laceration 0.5 cm (bridge of nose)	Minor (290602.1,4)	Unknown
Chin laceration 0.5 cm (just below right lower lip)	Minor (290602.1,8)	Unknown
Facial abrasion (unknown aspect)	Minor (290202.1,9)	Unknown
Abdominal contusion	Minor (590402.1,2)	Lap belt

Source= Medical records and driver interview

Driver Kinematics

The 20-year-old male driver of the Honda was seated in a mid-track position with the seat back adjusted to an upright position. He was restrained by the manual lap and shoulder safety belt system. At impact, the buckle pretensioner actuated, the frontal air bag, the left seat back-mounted air bag, and the left IC air bags deployed. The driver initiated a left trajectory in response to the crash forces and loaded the deployed seat back-mounted side impact air bag, the curtain air bag, and the safety belt. The loading of the safety belt resulted in the abdominal contusion. The interior of the vehicle did not contain disintegrated glass or other objects; therefore, the injury source (s) for the facial abrasion and lacerations could not be determined.

Immediately following the crash, the driver exited the vehicle through the right front door. He was transported by ambulance to a local hospital where he was treated and released for the minor injuries.

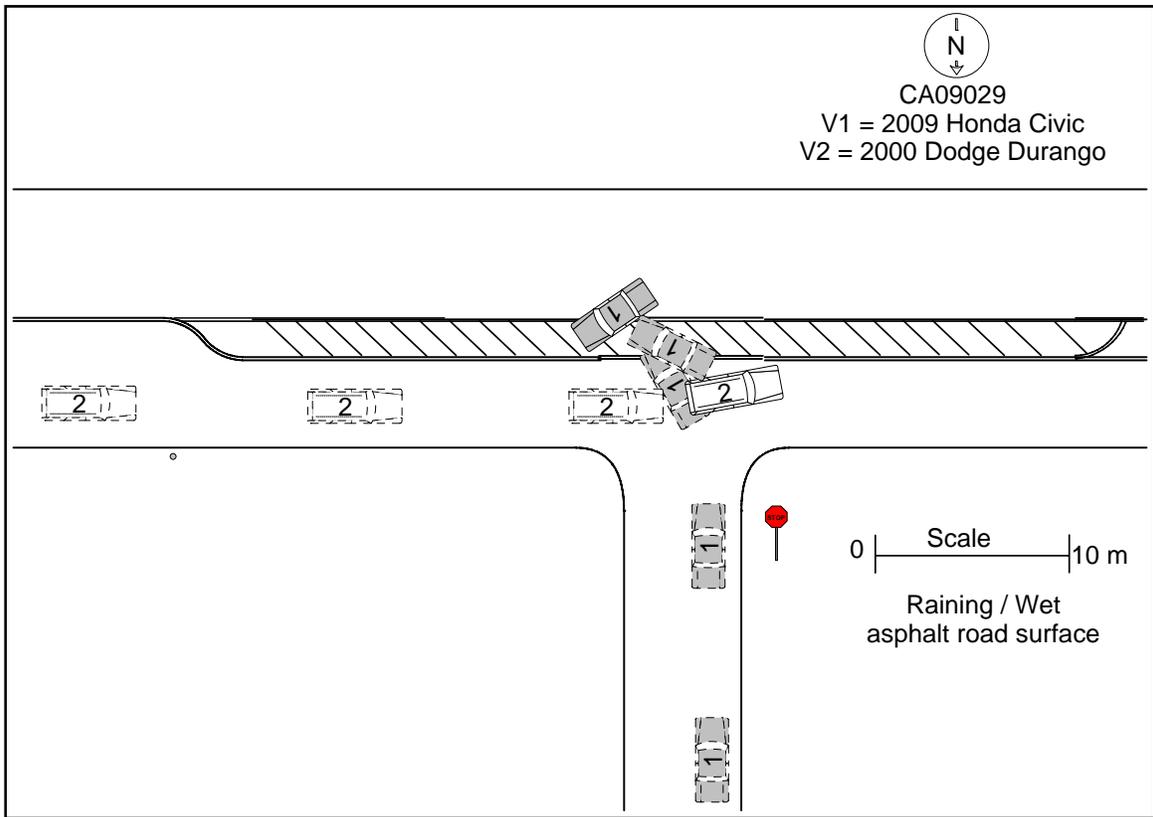


Figure 10: Scene Schematic