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### ON-SITE CERTIFIED ADVANCED 208- COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN-03-038  
LOCATION - TEXAS  
VEHICLE - 2003 CHEVROLET K1500 SILVERADO Z71  
CRASH DATE - July 2003

Submitted:

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National Highway Traffic Safety Administration  
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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 of an air bag deployment crash that involved a 2003 Chevrolet K1500 Silverado Z71 (case vehicle) and a 1999 Honda Civic LX (other vehicle). This crash is of special interest because the case vehicle was equipped with multiple <u>A</u> dvanced <u>O</u> ccupant <u>P</u> rotection <u>S</u> ystem (AOPS) features, including certified advanced 208-compliant air bags, as well as an <u>E</u> vent <u>D</u> ata <u>R</u> ecorder (EDR) and the case vehicle's driver (29-year-old, male) did not sustain any injuries as a result of the crash. The trafficway on which the case vehicle had been traveling was a three-lane, undivided, city street, traversing in a north-south direction, and the case vehicle was stopped, heading southward, at a controlled four-leg intersection. On the northern leg of the intersection, the north-south roadway had one through lane in both the north and southbound directions, and there was one opposing left-hand turn lane on both the north and south legs of the four-leg intersection. The trafficway on which the Honda was traveling was a seven-lane, divided, city roadway, traversing in an east-west direction, and the Honda was approaching the same four-leg intersection. Both the east and west roadways had three through lanes, and there was one opposing left-hand turn lane on both the east and west legs of the four-leg intersection. From the southbound through lane the case vehicle accelerated into the intersection. The Honda was traveling west in the outside through lane. The crash occurred in the outside through lane of the westbound roadway, within the four-leg intersection of the two trafficways. The front left of the case vehicle impacted the right front of the Honda. Although the case vehicle was equipped with driver and front right passenger supplemental restraints (air bags), neither air bag deployed. The case vehicle's driver was seated with his seat track located between its middle and rearmost positions, and the tilt steering wheel was located in its down-most position. He was not using his available, active, three-point, integral lap-and-shoulder, safety belt system and, based upon his interview, he did not sustain any injuries as a result of this crash.					
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This report on-site investigation was brought to NHTSA's attention on August 14, 2003 by GES sampling activities. This crash involved a 2003 Chevrolet K1500 Silverado Z71 (case vehicle) and a 1999 Honda Civic LX (other vehicle). The crash occurred in July 2003, at 7:45 p.m. in Texas and was investigated by the applicable city police department. This crash is of special interest because the case vehicle was equipped with multiple Advanced Occupant Protection System (AOPS) features, including certified advanced 208-compliant air bags, as well as an Event Data Recorder (EDR) and the case vehicle's driver [29-year-old, White (non-Hispanic) male] did not sustain any injuries as a result of the crash. This contractor inspected the scene and vehicles on August 18, 2003 and downloaded the data from the onboard **EDR**. This contractor interviewed the driver for the case vehicle on August 26, 2003. This report is based on the Police Crash Report, an interview with the case vehicle's driver, scene and vehicle inspections, occupant kinematic principles, and this contractor's evaluation of the evidence.

## SUMMARY

***Crash Environment:*** The trafficway on which the case vehicle had been traveling was a three-lane, undivided, city street, traversing in a north-south direction, and the case vehicle was stopped, heading southward, at a controlled four-leg intersection. On the northern leg of the intersection, the north-south roadway had one through lane in both the north and southbound directions, and there was one opposing left-hand turn lane on both the north and south legs of the four-leg intersection. The trafficway on which the Honda was traveling was a seven-lane, divided, city roadway, traversing in an east-west direction, and the Honda was approaching the same four-leg intersection. Both the east and west roadways had three through lanes, and there was one opposing left-hand turn lane on both the east and west legs of the four-leg intersection. At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry. Traffic density was not determined, and the site of the crash was a combination of urban residential and commercial; see **CRASH DIAGRAM** at end.

***Pre-Crash:*** The case vehicle had been stopped, heading southward, at a traffic signal in the southbound through lane and accelerated into the intersection, intending to proceed straight ahead. The Honda was traveling west in the outside through lane and was approaching the four-leg intersection, intending to proceed straight ahead. The case vehicle's driver made no avoidance maneuvers prior to the crash. The crash occurred in the outside through lane of the westbound roadway, within the four-leg intersection of the two trafficways.

***Crash:*** The front left of the case vehicle impacted the right front of the Honda. Although the case vehicle was equipped with driver and front right passenger supplemental restraints (air bags), the driver's air bag did not deploy. Furthermore, the case vehicle was equipped with a switchable (i.e., a cutoff switch) front right passenger supplemental restraint (air bag) that was set to the "auto" position. This air bag also did not deploy during the crash sequence.

***Post-Crash:*** Post-impact, the case vehicle moved slightly forward and rotated approximately 15 degrees clockwise before coming to rest just inside the southern portion of the intersection, heading in a south-southwesterly direction. The Honda continued westward and was redirected

approximately 15 degrees to the south before coming to rest, obliquely oriented, in the center westbound through lane of the western leg of the intersection, heading in a west-southwesterly direction.

**Case Vehicle:** The 2003 Chevrolet K1500 Silverado Z71 was a four wheel drive (4x4), four-door, extended cab pick-up truck (VIN: 2GCEK19T731-----) and was CERTIFIED ADVANCED 208-COMPLIANT. The case vehicle was equipped with four wheel, anti-lock brakes, dual stage air bag inflators, and a seat belt sensing system. In addition, the case vehicle was equipped with an air bag ON/OFF switch and an Event Data Recorder (EDR).

**Vehicle Exterior:** The case vehicle’s contact with the Honda involved primarily its front left. Direct damage began at the front left bumper corner and extended approximately 60 centimeters (23.6 inches) inward along the front bumper. Crush measurements as well as maximum crush could not be determined. Because the vehicle was partially repaired at the time of inspection, it is unknown if the case vehicle’s wheel base was altered as a result of the crash. The case vehicle’s front bumper, bumper fascia, jounce bumper, portions of the left headlight and turn signal assemblies, and the left fog lamp were directly damaged and crushed rearward. There was induced damage to the remainder of the left headlight assembly, and remote buckling (i.e., an increased separation) was also found between the right portion of the case vehicle’s extended cab behind the right rear door and in front of the regular truck bed. No obvious induced damage or remote buckling was noted to the remainder of the case vehicle’s exterior.

The case vehicle manufacturer’s recommended tire size was: P245/75R16, but tire size P265/75R16 was optional; the case vehicle was equipped with tire size: P265/75R16. The case vehicle’s tire data are shown in the table below. In addition, the none of the case vehicle’s tires were damaged, deflated, or physically restricted.

Tire	Measured Pressure		Recommend Pressure		Tread Depth		Damage	Restricted	Deflated
	kPa	psi	kPa	psi	milli-meters	32 <sup>nd</sup> of an inch			
LF	228	33	241	35	9	11	None	No	No
RF	172	25	241	35	8	10	None	No	No
LR	276	40	241	35	5	6	None	No	No
RR	228	33	241	35	5	6	None	No	No

**Exterior Damage:** Based on the vehicle inspection and the available photographs (i.e., the case vehicle was partially repaired at time of inspection, but pre-repair photos were acquired from the repair facility), the CDC for the case vehicle was estimated as: **10-FYEW-1 (290 degrees)**. The WinSMASH reconstruction program, CDC-only algorithm–based on the measured crush profile for the Honda and the photo-estimated CDC for the case vehicle, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 8.0

km.p.h. (5.0 m.p.h.), -2.7 km.p.h. (-1.7 m.p.h.), and +7.5 km.p.h. (+4.7 m.p.h.). The case vehicle was towed due to damage.

**Vehicle Interior:** Inspection of the case vehicle's interior revealed no evidence of occupant contact on the interior surfaces of the case vehicle. Furthermore, there was no evidence of intrusion to the case vehicle's interior, no evidence of compression to the energy absorbing shear capsules in the steering column, and no deformation to the steering wheel rim.

**Supplemental Restraints:** The case vehicle's driver air bag was located in the steering wheel hub, and the front right passenger's air bag was located in the middle of the instrument panel. Although the case vehicle was equipped with dual inflation driver and front right passenger air bags, no air bags deployed as a result of this crash. The front right passenger air bag was controlled by an On/Off switch, which was positioned in the On (i.e., "AUTO"matic) position at the time of the crash.

**Crash Data Recording:** The data downloaded from the case vehicle's **EDR** showed the vehicle's SIR warning lamp status, driver's seat belt buckle status, ignition cycles at non-deployment, and the vehicle's speed and brake switch status for the five recorded sample periods preceding the **ALGORITHM ENABLE**. In addition, the vehicle's longitudinal velocity change (i.e., Delta V) is reported. Downloaded data of interest indicated the following. The case vehicle had accelerated from a stop to a speed of approximately 10 km.p.h. (6 m.p.h.), the driver's seat belt status showed it was not buckled, the air bags did not deploy, and the Delta V reached a value of 2.6 km.p.h. (1.6 m.p.h.) at the 120 millisecond mark of recorded data. This contractor believes that the recorded Delta V seems reasonable considering the amount of deformation to the case vehicle's front.

**Other Vehicle:** The 1999 Honda Civic LX was a front wheel drive, four-door sedan (VIN: 1HGEJ667XXL-----). Anti-lock brakes were not available for this Honda. The Honda was equipped with a driver and front right passenger supplemental restraint systems (air bags) that did not deploy as a result the crash.

**Vehicle Exterior:** The Honda's contact with the case vehicle primarily involved its right front. Direct damage began 208 centimeters (81.9 inches) forward of the right rear axle and extended, a measured distance of 120 centimeters (47.2 inches), along the right front door and fender. The Field L began 200 centimeters forward of the right rear axle and extended 128 centimeters (50.4 inches) to the right front bumper corner. Residual maximum crush was measured as 9 centimeters (3.5 inches) at C<sub>2</sub>. The wheelbase on the case vehicle's left side was extended at most 1 centimeter (0.4 inches) while the right side was shortened 10 centimeters (3.9 inches). The Honda's right fender, right front door, and right front wheel assembly were directly damaged and crushed inward. The Honda's hood and right headlight and turn signal assemblies sustained induced damage. The Honda's right front tire was damaged, deflated, and physically restricted.

**Exterior Damage:** Based on the vehicle inspection, the CDC for the Honda was determined to be: **01-RFEW-1 (20 degrees)**. The WinSMASH reconstruction program, CDC-only algorithm-based on the measured crush profile for the Honda and the photo-estimated CDC for

the case vehicle, was used on the Honda's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 16.0 km.p.h. (9.9 m.p.h.), -15.0 km.p.h. (-9.3 m.p.h.), and -5.5 km.p.h. (-3.4 m.p.h.). The Honda was towed due to damage.

**Case Vehicle's Driver:** Immediately prior to the crash the case vehicle's driver [29-year-old, White (non-Hispanic) male; 183 centimeters and 82 kilograms (72 inches, 180 pounds)] was seated in a slightly reclined posture with his back against the seat back, his left foot on the floor, his right foot on the accelerator, and at least one of his hands on the steering wheel. According to his interview, the driver did not remember how many hands he had on the wheel or the location of his hands. His seat track was located between its middle and rearmost positions, the seat back was slightly reclined, and the tilt steering wheel was located in its down-most position.

The case vehicle's driver indicated in his interview that he was restrained by his available, active, three-point, integral lap-and-shoulder, safety belt system; the belt system was not equipped with a pretensioner. Based on this contractor's vehicle inspection and confirmed by the EDR data, the driver was not restrained. There was no mention by the driver of belt pattern bruising and/or abrasions to his body, and the inspection of the driver's seat belt webbing, shoulder belt guide, and latch plate revealed no evidence of loading.

The case vehicle's driver made no known pre-crash avoidance maneuvers. As a result and independent of the nonuse of his available safety belts, his pre-impact body position did not change just prior to impact. The case vehicle's impact with the Honda enabled the case vehicle's driver to continue slightly forward and leftward toward the case vehicle's 290 degree Direction of Principal Force as the case vehicle decelerated. As a result of this minor [2-13 km.p.h. (1-8 m.p.h.)] impact and the subsequent 15 degrees of clockwise rotation that the case vehicle experienced, the driver possibly came into contact with the interior surface of the driver's door. However, no residual contact evidence was observed. The driver most likely rebounded to his right as the case vehicle came to rest. The exact position of the driver at final rest is unknown, but he was most likely near his original pre-crash driving position. The driver exited the case vehicle without assistance.

The driver was not transported by ambulance to the hospital and did not seek any medical treatment. The driver did not sustain any injuries as a result of this crash.

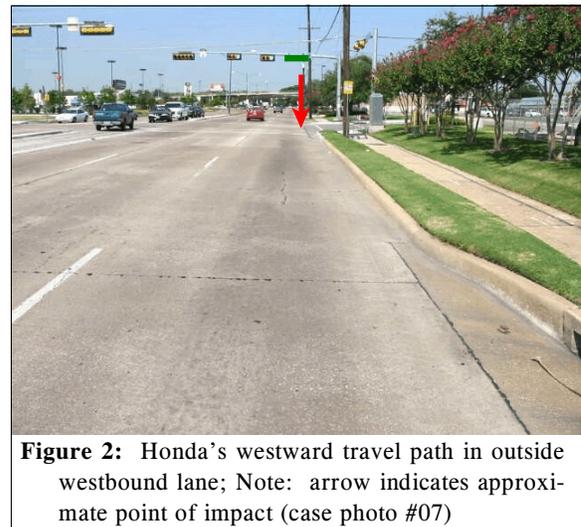
**Honda's Occupants:** According to the Police Crash Report, the Honda's driver [39-year-old, White (unknown if Hispanic) male] was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The driver was not transported by ambulance to the hospital, and he did not sustain any injuries as a result of this crash.



**Figure 1:** Case vehicle's southward travel path in southbound through lane; case vehicle accelerated forward into intersection from a stop; Note arrow indicates approximate impact location with Honda (case photo #01)

**Crash Environment:** The trafficway on which the case vehicle had been traveling was a three-lane, undivided, city street, traversing in a north-south direction, and the case vehicle was stopped, heading southward, at a controlled four-leg intersection (**Figure 1** above). On the northern leg of the intersection, the north-south roadway had one through lane in both the north and southbound directions, and there was one opposing left-hand turn lane on both the north and south legs of the four-leg intersection. The trafficway on which the Honda was traveling was a seven-lane, divided, city roadway, traversing in an east-west direction, and the Honda was approaching the same four-leg intersection (**Figure 2**). Both the east and west roadways had three through lanes, and there was one opposing left-hand turn lane on both the east and west legs of the four-leg intersection.

The case vehicle's city roadway was straight and level at the area of impact (i.e., actual slope was 1.6%, negative to the south—a downgrade in the case vehicle's direction of travel at the mouth of the intersection—**Figure 1** above). The pavement was concrete, and the width of the outside southbound through lane was 3.3 meters (10.8 feet). The north-south roadway's shoulders were not improved (i.e., grass), and roadway was bordered by barrier curbs. Pavement markings on the northern leg consisted of a double solid yellow centerline for both north and southbound traffic. Furthermore, a single solid white lane line and raised pavement markers separated the southbound left-hand turn lane from the combination through/right-hand turn lane. In addition, no edge lines were present on the northern leg. The estimated coefficient of friction was 0.80. Traffic controls for southward travel consisted of two on-colors, pre-timed, horizontal mounted traffic control signals that were located on the southwest quadrant of the four-leg intersection. The statutory speed limit was 48 km.p.h. (30 m.p.h.). No regulatory speed limit sign was posted near the crash site.

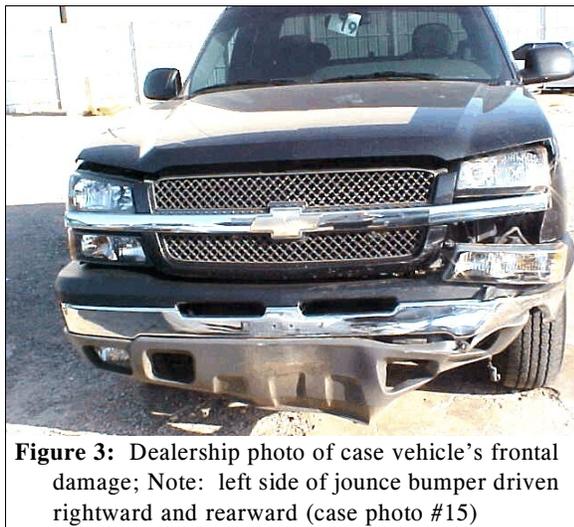


**Figure 2:** Honda's westward travel path in outside westbound lane; Note: arrow indicates approximate point of impact (case photo #07)

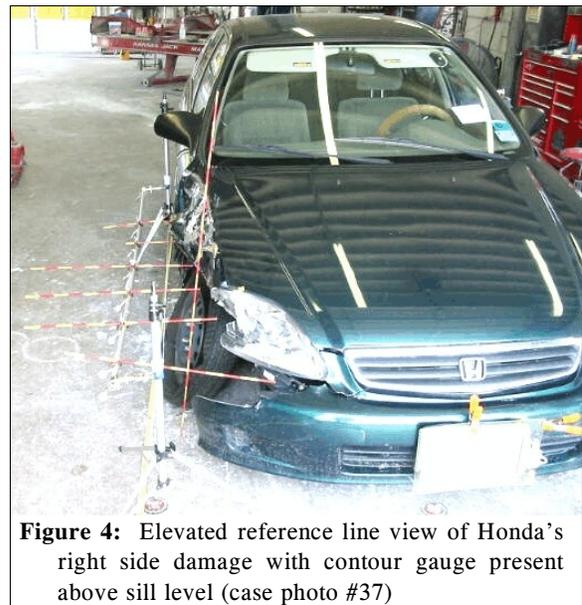
The other vehicle's city roadway was straight and level at the area of impact (**Figure 2**). The pavement was concrete, and the width of the outside westbound through lane was 3.5 meters (11.5 feet). The east-west trafficway's shoulders were not improved (i.e., grass), and the westbound roadway was bordered by barrier curbs with the curb on the north associated with a 1.5 meter (4.9 foot) raised paved median. No centerline was present for the westbound roadway. Pavement markings consisted of dashed white lines that separated the through lanes. Furthermore, the left-hand turn lane was separated from the through lanes by solid white lane line. In addition, no edge lines were present. The estimated coefficient of friction was 0.75. Traffic controls consisted of three on-colors, pre-timed, horizontal mounted traffic control signals that were located on the northwest quadrant of the four-leg intersection. The statutory speed limit was 72 km.p.h. (45 m.p.h.). No regulatory speed limit sign was posted near the crash site.

At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry. Traffic density was not determined, and the site of the crash was a combination of urban residential and commercial; see **CRASH DIAGRAM** at end.

**Pre-Crash:** The case vehicle had been stopped, heading southward, at a traffic signal in the southbound through lane and accelerated into the intersection, intending to proceed straight ahead (**Figure 1** above). The Honda was traveling west in the outside through lane and was approaching the four-leg intersection, intending to proceed straight ahead (**Figure 2** above). The case vehicle's driver made no avoidance maneuvers prior to the crash. The crash occurred in the outside through lane of the westbound roadway, within the four-leg intersection of the two trafficways.



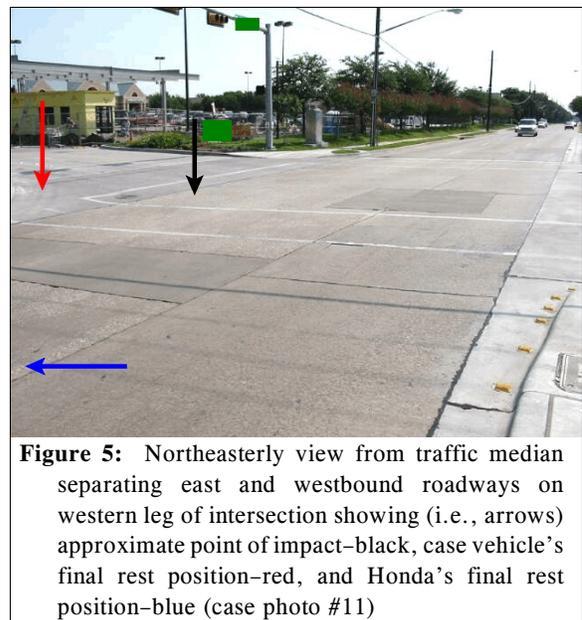
**Figure 3:** Dealership photo of case vehicle's frontal damage; Note: left side of jounce bumper driven rightward and rearward (case photo #15)



**Figure 4:** Elevated reference line view of Honda's right side damage with contour gauge present above sill level (case photo #37)

**Crash:** The front left (**Figure 3**) of the case vehicle impacted the right front (**Figure 4**) of the Honda. Although the case vehicle was equipped with driver and front right passenger supplemental restraints (air bags), the driver's air bag did not deploy. Furthermore, the case vehicle was equipped with a switchable (i.e., a cutoff switch) front right passenger supplemental restraint (air bag) that was set to the "auto" position. This air bag also did not deploy during the crash sequence.

**Post-Crash:** Post-impact, the case vehicle moved slightly forward and rotated approximately 15 degrees clockwise before coming to rest just inside the southern portion of the intersection, heading in a south-southwesterly direction. The Honda continued westward and was redirected approximately 15 degrees to the south before



**Figure 5:** Northeastery view from traffic median separating east and westbound roadways on western leg of intersection showing (i.e., arrows) approximate point of impact—black, case vehicle's final rest position—red, and Honda's final rest position—blue (case photo #11)

coming to rest, obliquely oriented, in the center westbound through lane of the western leg of the intersection, heading in a west-southwesterly direction (**Figure 5** above).

### CASE VEHICLE

The 2003 Chevrolet K1500 Silverado Z71 was a four wheel drive (4x4), six-passenger, four-door, extended cab pick-up truck (VIN: 2GCEK19T731-----) equipped with a 5.3L, V-8 engine and a four-speed automatic transmission. Braking was achieved by a power-assisted, front and rear disc, four-wheel, anti-lock system. The case vehicle's wheelbase was 364 centimeters (143.5 inches), and the odometer reading at inspection was 35,140 kilometers (21,835 miles).

The case vehicle was CERTIFIED ADVANCED 208-COMPLIANT and was equipped with dual stage driver and front right passenger air bag inflators, and a driver seat belt sensing system. Furthermore, the case vehicle was equipped with an air bag ON/OFF switch. Finally, the case vehicle was also equipped with an Event Data Recorder (EDR).

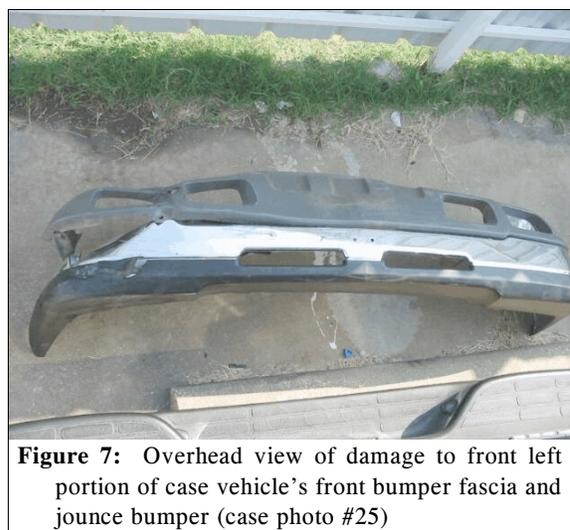
Inspection of the vehicle's interior revealed an adjustable front 40/20/40 split bench seat with adjustable head restraints for the front outboard seating positions only; a non-adjustable, folding, back bench seat also with adjustable head restraints for the back outboard seating positions; continuous loop, three-point, lap-and-shoulder, safety belt systems at the front (i.e., integral) and back outboard positions; and a two-point, lap belt system at the front and back center positions. The front seat belt systems were integral and thus were not equipped with manually operated, upper anchorage adjusters. The vehicle was equipped with knee bolsters for both the driver and front right seating positions, neither of which showed evidence of occupant contact or deformation. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a frontal air bag for the driver and front right passenger seating positions. Neither frontal air bag deployed as a result of the case vehicle's oblique frontal impact with the Honda.

### CASE VEHICLE DAMAGE

**Exterior Damage:** The case vehicle's contact with the Honda involved primarily its front left. Direct damage began at the front left bumper corner and extended approximately 60 centimeters (23.6



**Figure 6:** Dealership close-up photo of damage to case vehicle's front left bumper and left headlight and turn signal assemblies (case photo #18)



**Figure 7:** Overhead view of damage to front left portion of case vehicle's front bumper fascia and jounce bumper (case photo #25)

inches) inward along the front bumper (**Figures 6 and 7** above). Crush measurements as well as maximum crush could not be determined. Because the vehicle was partially repaired at the time of inspection, it is unknown if the case vehicle’s wheel base was altered as a result of the crash. The case vehicle’s front bumper, bumper fascia, jounce bumper, portions of the left headlight and turn signal assemblies, and the left fog lamp were directly damaged and crushed rearward. There was induced damage to the remainder of the left headlight assembly, and remote buckling (i.e., an increased separation) was also found between the right portion of the case vehicle’s extended cab behind the right rear door and in front of the regular truck bed (**Figure 8**). No obvious induced damage or remote buckling was noted to the remainder of the case vehicle’s exterior.



**Figure 8:** Dealership photo of remote buckling to case vehicle’s right truck bed (case photo #24)

The case vehicle manufacturer’s recommended tire size was: P245/75R16, but tire size P265/75R16 was optional; the case vehicle was equipped with tire size: P265/75R16. The case vehicle’s tire data are shown in the table below. In addition, the none of the case vehicle’s tires were damaged, deflated, or physically restricted.

Tire	Measured Pressure		Recommend Pressure		Tread Depth		Damage	Restricted	Deflated
	kPa	psi	kPa	psi	milli-meters	32 <sup>nd</sup> of an inch			
LF	228	33	241	35	9	11	None	No	No
RF	172	25	241	35	8	10	None	No	No
LR	276	40	241	35	5	6	None	No	No
RR	228	33	241	35	5	6	None	No	No

**Vehicle Interior:** Inspection of the case vehicle’s interior revealed no evidence of occupant contact on the interior surfaces of the case vehicle (**Figures 9 and 10** below). Furthermore, there was no evidence of intrusion to the case vehicle’s interior, no evidence of compression to the energy absorbing shear capsules in the steering column, and no deformation to the steering wheel rim.

**Damage Classification:** Based on the vehicle inspection and the available photographs (i.e., the case vehicle was partially repaired at time of inspection, but pre-repair photos were acquired from the repair facility), the CDC for the case vehicle was estimated as: **10-FYEW-1 (290 degrees)**. The WinSMASH reconstruction program, CDC-only algorithm-based on the measured crush profile for the Honda and the photo-estimated CDC for the case vehicle, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are,

respectively: 8.0 km.p.h. (5.0 m.p.h.), -2.7 km.p.h. (-1.7 m.p.h.), and +7.5 km.p.h. (+4.7 m.p.h.). The case vehicle was towed due to damage.



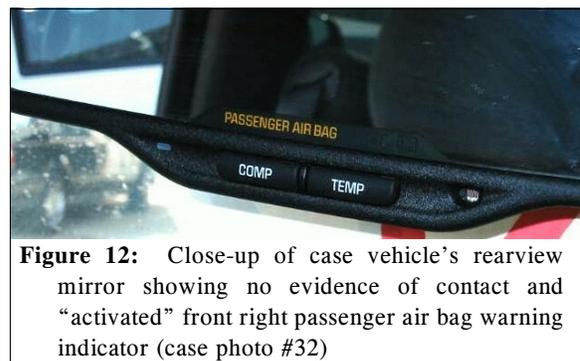
**Figure 9:** Case vehicle's driver seating area showing non-deployed driver air bag and foot well and no apparent evidence of occupant contact to left instrument panel, driver's knee bolster, and left "A"-pillar, windshield glazing, or sun visor (case photo #27)



**Figure 10:** Case vehicle's driver seating area and center instrument panel showing non-deployed driver air bag and no apparent evidence of occupant contact to steering wheel, center instrument panel, or greenhouse areas (case photo #29)



**Figure 11:** Close-up of case vehicle's center instrument panel showing front right air bag control switch in "auto" position (case photo #30)



**Figure 12:** Close-up of case vehicle's rearview mirror showing no evidence of contact and "activated" front right passenger air bag warning indicator (case photo #32)

### AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a Supplemental Restraint System (SRS) that contained dual stage frontal air bags at the driver and front right passenger positions. Neither frontal air bag deployed as a result of the oblique frontal impact with the Honda. The case vehicle's driver air bag was located in the steering wheel hub, and the front right passenger's air bag was located in the middle of the instrument panel. The front right passenger air bag was controlled by an On/Off switch, which was positioned in the On (i.e., "AUTO"matic) position at the time of the crash (Figures 11 and 12).

The data downloaded from the case vehicle's **EDR** showed the vehicle's SIR warning lamp status, driver's seat belt buckle status, ignition cycles at non-deployment, and the vehicle's speed and brake switch status for the five recorded sample periods preceding the **ALGORITHM ENABLE**. In addition, the vehicle's longitudinal velocity change (i.e., Delta V) is reported. Downloaded data of interest indicated the following. The case vehicle had accelerated from a stop to a speed of approximately 10 km.p.h. (6 m.p.h.), the driver's seat belt status showed it was not buckled, the air bags did not deploy, and the Delta V reached a value of 2.6 km.p.h. (1.6 m.p.h.) at the 120 millisecond mark of recorded data; see **EVENT DATA RECORDER DATA (Figures 15 through 17)** below. This contractor believes that the recorded Delta V seems reasonable considering the amount of deformation to the case vehicle's front.

#### **CASE VEHICLE DRIVER KINEMATICS**

*Case Vehicle's Driver:* Immediately prior to the crash the case vehicle's driver [29-year-old, White (non-Hispanic) male; 183 centimeters and 82 kilograms (72 inches, 180 pounds)] was seated in a slightly reclined posture with his back against the seat back, his left foot on the floor, his right foot on the accelerator, and at least one of his hands on the steering wheel. According to his interview, the driver did not remember how many hands he had on the wheel or the location of his hands. His seat track was located between its middle and rearmost positions, the seat back was slightly reclined, and the tilt steering wheel was located in its down-most position.

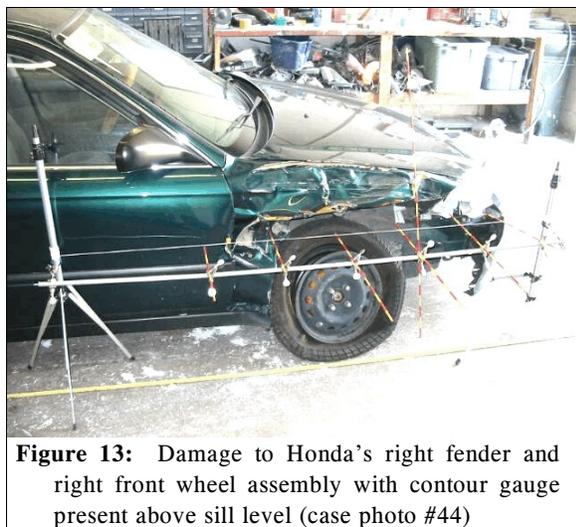
The case vehicle's driver indicated in his interview that he was restrained by his available, active, three-point, integral lap-and-shoulder, safety belt system; the belt system was not equipped with a pretensioner. Based on this contractor's vehicle inspection and confirmed by the EDR data, the driver was not restrained. There was no mention by the driver of belt pattern bruising and/or abrasions to his body, and the inspection of the driver's seat belt webbing, shoulder belt guide, and latch plate revealed no evidence of loading.

The case vehicle's driver made no known pre-crash avoidance maneuvers. As a result and independent of the nonuse of his available safety belts, his pre-impact body position did not change just prior to impact. The case vehicle's impact with the Honda enabled the case vehicle's driver to continue slightly forward and leftward toward the case vehicle's **290** degree Direction of Principal Force as the case vehicle decelerated. As a result of this minor [2-13 km.p.h. (1-8 m.p.h.)] impact and the subsequent 15 degrees of clockwise rotation that the case vehicle experienced, the driver possibly came into contact with the interior surface of the driver's door. However, no residual contact evidence was observed. The driver most likely rebounded to his right as the case vehicle came to rest. The exact position of the driver at final rest is unknown, but he was most likely near his original pre-crash driving position. The driver exited the case vehicle without assistance.

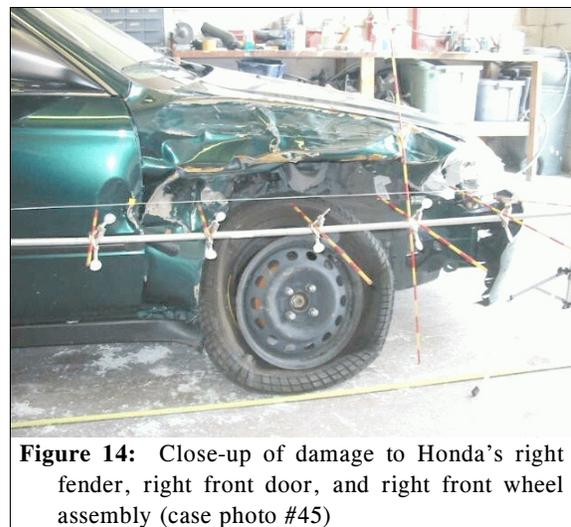
#### **CASE VEHICLE DRIVER INJURIES**

The driver was not transported by ambulance to the hospital and did not seek any medical treatment. The driver did not sustain any injuries as a result of this crash.

The 1999 Honda Civic LX was a front wheel drive, five-passenger, four-door sedan (VIN: 1HGEJ667XXL-----) equipped with a 1.6L, I-4 engine and a four-speed automatic transmission. Braking was achieved by a power-assisted, front and rear disc system; anti-lock brakes were not available on this model. The Honda’s wheelbase was 262 centimeters (103.2 inches), and the odometer reading is unknown because the Honda’s interior was not inspected. The Honda was equipped with ADVANCED OCCUPANT PROTECTION SYSTEM features including redesigned air bags.



**Figure 13:** Damage to Honda’s right fender and right front wheel assembly with contour gauge present above sill level (case photo #44)



**Figure 14:** Close-up of damage to Honda’s right fender, right front door, and right front wheel assembly (case photo #45)

**Exterior Damage:** The Honda’s contact with the case vehicle primarily involved its right front (Figures 13 and 14). Direct damage began 208 centimeters (81.9 inches) forward of the right rear axle and extended, a measured distance of 120 centimeters (47.2 inches), along the right front door and fender. The Field L began 200 centimeters forward of the right rear axle and extended 128 centimeters (50.4 inches) to the right front bumper corner. Residual maximum crush was measured as 9 centimeters (3.5 inches) at C<sub>2</sub>. The table below shows the case vehicle’s 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	120	9	128	0	9	6	4	1	3	140	135
in		47.2	3.5	50.4	0.0	3.5	2.4	1.6	0.4	1.2	55.1	53.2

The wheelbase on the case vehicle’s left side was extended at most 1 centimeter (0.4 inches) while the right side was shortened 10 centimeters (3.9 inches). The Honda’s right fender, right front door, and right front wheel assembly were directly damaged and crushed inward. The Honda’s hood and right headlight and turn signal assemblies sustained induced damage.

The Honda’s recommended tire size was: P185/65R14, and the Honda’s tires were the recommended size. The Honda’s tire data are shown in the table below. In addition, the Honda’s right front tire was damaged, deflated, and physically restricted.

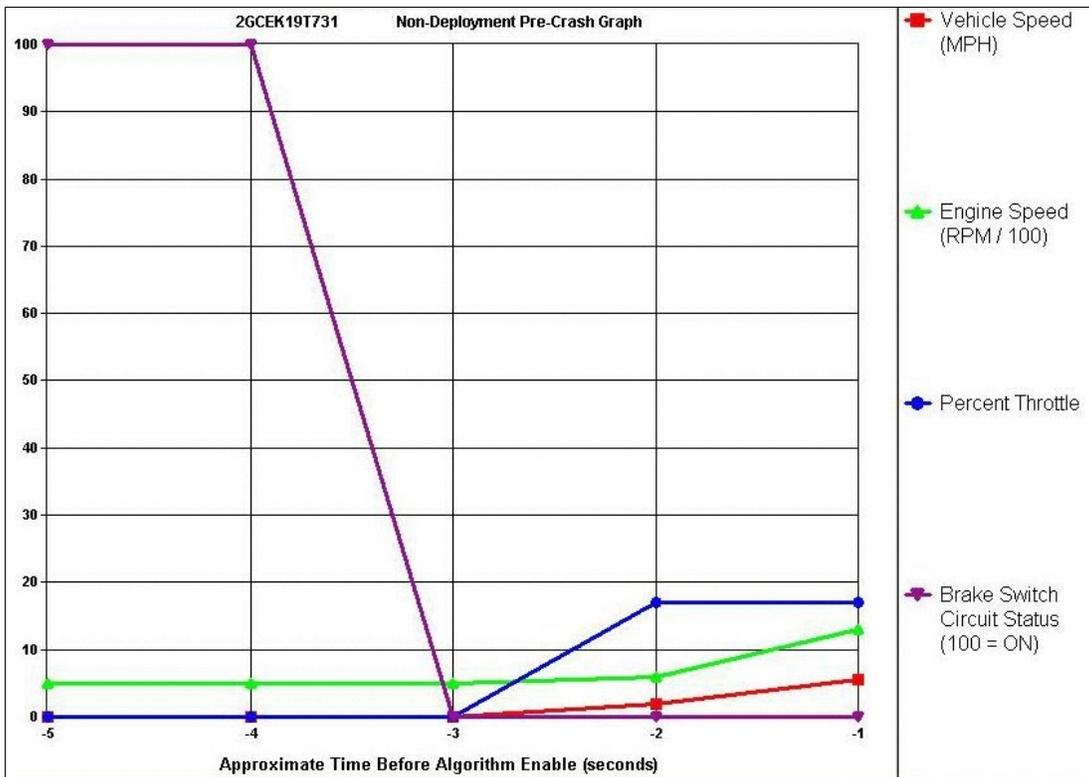
<i>Tire</i>	<i>Measured Pressure</i>		<i>Recommend Pressure</i>		<i>Tread Depth</i>		<i>Damage</i>	<i>Restricted</i>	<i>Deflated</i>
	kPa	psi	kPa	psi	milli-meters	32 <sup>nd</sup> of an inch			
LF	165	24	207	30	7	9	None	No	No
RF	0	0	207	30	8	10	Side wall puncture	Yes	Yes
LR	172	25	200	29	8	10	None	No	No
RR	179	26	200	29	7	9	None	No	No

**Damage Classification:** Based on the vehicle inspection, the CDC for the Honda was determined to be: **01-RFEW-1 (20 degrees)**. The WinSMASH reconstruction program, CDC-only algorithm–based on the measured crush profile for the Honda and the photo-estimated CDC for the case vehicle, was used on the Honda's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 16.0 km.p.h. (9.9 m.p.h.), -15.0 km.p.h. (-9.3 m.p.h.), and -5.5 km.p.h. (-3.4 m.p.h.). The Honda was towed due to damage.

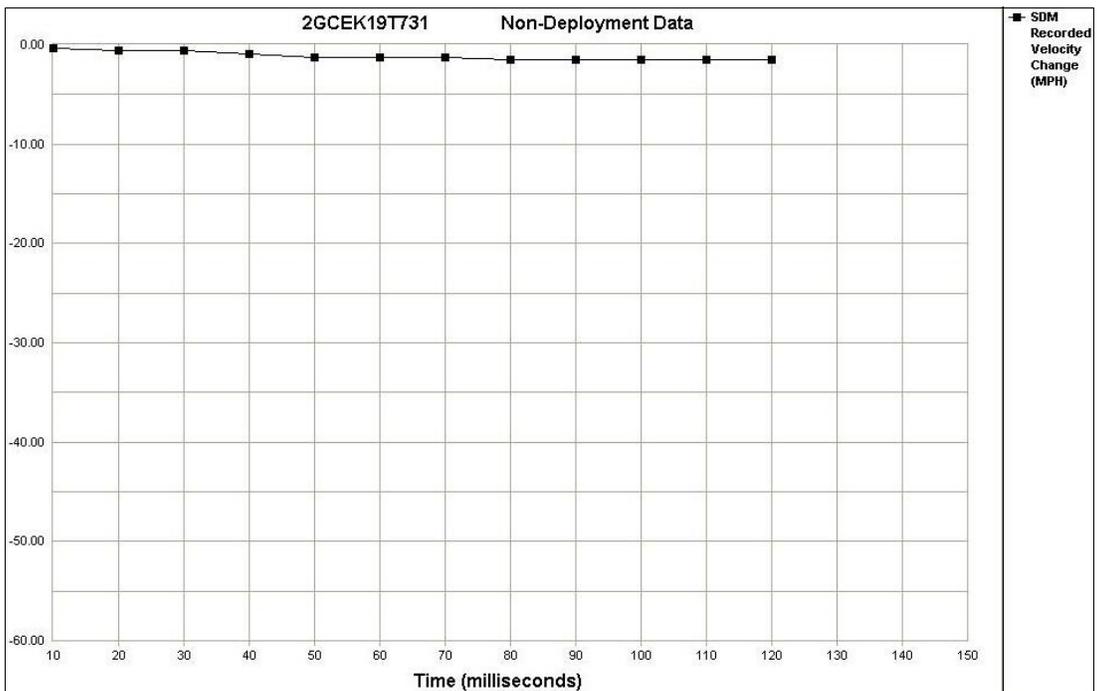
**Honda’s Occupants:** According to the Police Crash Report, the Honda's driver [39-year-old, White (unknown if Hispanic) male] was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The driver was not transported by ambulance to the hospital, and he did not sustain any injuries as a result of this crash.

2GCEK19T731		System Status At Non-Deployment														
SIR Warning Lamp Status	OFF															
Driver's Belt Switch Circuit Status	UNBUCKLED															
Ignition Cycles At Non-Deployment	1672															
Ignition Cycles At Investigation	1705															
Maximum SDM Recorded Velocity Change (MPH)	-1.69															
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	110															
Event Recording Complete	Yes															
Multiple Events Associated With This Record	No															
One Or More Associated Events Not Recorded	No															
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Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	
Recorded Velocity Change (MPH)	-0.31	-0.62	-0.62	-0.93	-1.24	-1.24	-1.24	-1.55	-1.55	-1.55	-1.55	-1.55	N/A	N/A	N/A	
<div style="border: 1px solid black; height: 100px; width: 100%;"></div>																
PRE-CRASH DATA																
Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status												
-5	0	512	0	ON												
-4	0	512	0	ON												
-3	0	512	0	OFF												
-2	2	576	17	OFF												
-1	6	1280	17	OFF												

**Figure 15:** Case vehicle's non-deployment data including: pre-crash speed, brake switch status, restraint system status, and the case vehicle's change in velocity (Delta V) over the first 120 milliseconds post algorithm enablement



**Figure 16:** Case vehicle's pre-crash speed and brake switch circuit status showing that the vehicle had accelerated to approximately 10 km.p.h. (6 m.p.h.) and that the brake switch had been deactivated approximately 3 seconds prior to algorithm enable.



**Figure 17:** The case vehicle sustained a velocity change of approximately 2.6 km.p.h. (1.6 m.p.h.) during the first 120 milliseconds after the crash was detected

