INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER

School of Public and Environmental Affairs
501 S. Madison Street–Suite 105
Bloomington, Indiana 47403-2452
(812) 855-3908 Fax: (812) 855-3537

ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION INVESTIGATION

CASE NUMBER - IN08043
LOCATION - TEXAS
VEHICLE - 2003 HONDA ACCORD EX
CRASH DATE - September 2008

Submitted:

December 1, 2009

Contract Number: DTNH22-07-C-00044

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

DISCLAIMERS

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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

1. *Report No.* IN08043	2. *Government Accession No.*	3. *Recipient's Catalog No.*
4. *Title and Subtitle* On-Site Side Impact Inflatable Occupant Protection Investigation Vehicle - 2003 Honda Accord EX Location - Texas		5. *Report Date:* December 1, 2009 6. *Performing Organization Code*
7. *Author(s)* Special Crash Investigations Team #2		8. *Performing Organization Report No.*
9. *Performing Organization Name and Address* Transportation Research Center Indiana University 501 S. Madison Street–Suite 105 Bloomington, Indiana 47403-2452		10. *Work Unit No. (TRAIS)* 11. *Contract or Grant No.* DTNH22-07-C-00044
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation (NVS-411) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003		13. *Type of Report and Period Covered* Technical Report Crash Date: September 2008 14. *Sponsoring Agency Code*

15. *Supplementary Notes*

On-site side impact air bag deployment investigation involving a 2003 Honda Accord EX, 2-door coupe, with manual safety belts and dual front, side, and curtain air bags, and a 2002 Chevrolet Trailblazer 4-door sport utility vehicle

16. *Abstract*

This report covers an on-site investigation of a side impact air bag deployment crash that involved a 2003 Honda Accord EX and a 2002 Chevrolet Trailblazer. The focus of this case is on the 2003 Honda's side air bags, which deployed on the driver's side as a result of this crash. This right-angle type collision occurred within a 4-leg intersection. The left front fender and door were impacted by the front of the Chevrolet. The Honda's driver (31-year-old, female) was seated and restrained by her lap-and-shoulder, safety belt system. The driver sustained, according to her medical records, only minor soft tissue injuries as a result of this crash.

17. *Key Words* Side Air Bag Deployment Motor Vehicle Traffic Crash Injury Severity		18. *Distribution Statement* General Public	
19 *Security Classif. (of this report)* Unclassified	20. *Security Classif. (of this page)* Unclassified	21. *No. of Pages* 10	22. *Price*

Form DOT 1700.7 (8-72) Reproduction of completed page authorized

TABLE OF CONTENTS

IN08043

This crash was brought to our attention by the National Highway Traffic Safety Administration (NHTSA) on October 28, 2008 through the sampling activities of the National Automotive Sampling System (NASS)–General Estimates System (GES). This investigation was assigned on November 12, 2008. This crash involved a 2003 Honda Accord EX and a 2002 Chevrolet Trailblazer. The crash occurred in September 2008, at 1208 hours, in Texas and was investigated by a city police department. The focus of this investigation is the Honda's side impact air bags, which deployed on the driver's side of the vehicle. This contractor inspected the scene and vehicle on November 19, 2008. Multiple attempts to interview the Honda's driver were unsuccessful. This summary is based on the police crash report, scene and vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the Honda was traveling was a 6-lane, undivided, one-way service road of an Interstate highway, traversing in a southeasterly direction, and the Honda was approaching a 4-leg intersection (**Figure 1**). On the northwest leg of the intersection, the southeastbound roadway had 3 through lanes, one channelized right turn lane, a left turn lane, and a channelized U-turn lane. The trafficway on which the Chevrolet was traveling was a 7-lane, divided, city street, traversing in a north-northeasterly and south-southwesterly direction, and the Chevrolet was approaching the same 4-leg intersection (**Figure 2**). On the northern leg of the intersection, both the roadways had 3 through lanes while the southern leg had one left-hand turn lane.

Figure 1: Honda's southeast travel path in inside through lane

Figure 2: Chevrolet's south-southwest travel path in center through lane

The interstate service road's trafficway was straight and level in the Honda's direction of travel near the area of impact (i.e., actual grade was 1.0%, positive to the southeast). The pavement was concrete, and the width of the trafficway was 24.9 meters (81.7 feet). The width of the Honda's inside through lane was 3.8 meters (12.5 feet). The roadway was bordered by curbs with associated concrete rain gutters. Pavement markings consisted of single solid white lane lines separating each of the through lanes and turn lanes from one another. Also present were turn lane-use arrows for both the left and right hand turn lanes (**Figure 1**). Traffic controls consisted of two on-colors, pre-timed, horizontal mounted traffic control signals located on the eastern quadrant of the southeast leg of the intersection. In addition, there was one vertically mounted traffic control signal on the same signal pole,

controlling the left-hand turn lane (**Figure 3**). Furthermore, there was a YIELD sign (Manual on Uniform Traffic Control Devices, R1-2) located in the channel for the right-hand turn lane and an advanced intersection lane control sign (MUTCD, R3-8 series) sign at the separation of the left-turn lane from the U-turn lane (**Figure 1**). The speed limit was 64 km/h (40 mph). No regulatory speed limit sign was posted near the crash site.

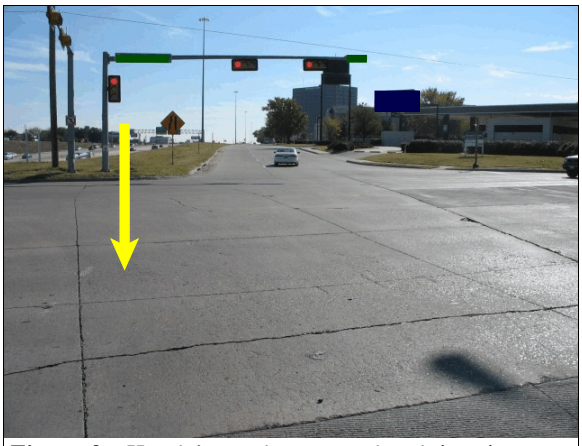


Figure 3: Honda's southeast travel path into impact with Chevrolet; arrow indicates approximate collision location

The Chevrolet's city roadway was straight and level near the area of impact. The pavement was also concrete, and the width of the trafficway was 25.2 meters (82.7 feet). The width of the Chevrolet's center through lane was 3.2 meters (10.5 feet). The southern roadway was bordered by curbs with the curb on the east associated with a 1.2 meter (3.9 foot) raised paved median. No edge lines were present, and the pavement markings consisted of dashed white lines separating the three through lanes and a solid white line separating the left-hand turn lane from the through lanes (**Figure 2**). Traffic controls consisted of three on-colors, pre-timed, horizontal mounted traffic control signals that were located on the western quadrant of the four-leg intersection. The speed limit was 56 km/h (35 mph). 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 urban commercial; see **CRASH DIAGRAM** on page 10.

Pre-Crash: The Honda was traveling southeast in the inside through lane and the driver intended to proceed straight through the intersection (**Figures 1** and **3**). The Chevrolet was traveling south-southwest in the center through lane and the driver intended to continue straight through the intersection (**Figures 2** and **4**). It is unknown if the Honda's driver made any avoidance maneuvers prior to the crash. The crash occurred in the 4-leg intersection of the 2 trafficways (**Figures 3**, **4**, and **5**).

Figure 4: North view of impact location (arrow) between Honda and Chevrolet

Crash: The left side of the Honda was impacted by the front of the Chevrolet, causing the Honda's left seat back-mounted side impact air bag and the side curtain air bag to deploy. The Honda's frontal air bags did not deploy during the crash sequence. As a result of the impact, the Honda was redirected in a southern direction and came to rest within the intersection, heading south-southeast. After maximum engagement, the Chevrolet rotated approximately 50 degrees counter-

clockwise and came to rest within the intersection, also heading in a south-southeasterly direction.

Post-Crash: Based upon the driver's medical records, the driver of the Honda remained inside her vehicle at final rest. She was conscious and was able to exit the vehicle without any assistance. The driver was ambulatory at the scene. The investigating police agency was notified of the crash within 4 minutes post-crash and arrived on-scene 12 minutes later. The driver was transported by ambulance to a medical facility. Following the police investigation, the Honda was towed due to damage. The Chevrolet was driven from the scene.

Figure 5: Northwest view of impact location (arrow) between Honda and Chevrolet

CASE VEHICLE

The 2003 Honda Accord EX was a front wheel drive, 5-passenger, 2-door coupe (VIN: 1HGCM82673A------) equipped with a 3.0-liter, V-6 engine and a 5-speed automatic transmission. This vehicle's date of manufacture could not be determined because the driver's door was jammed at the time of this contractor's inspection. The Honda was equipped with Advanced Occupant Protection System features (AOPS), including 4-wheel, anti-lock brakes, dual stage driver and front right passenger air bag inflators, front seat-mounted side impact air bags and right and left side impact inflatable curtain (IC) air bags protecting all outboard seating positions. There was an occupant weight sensor for the front right passenger seating position. This vehicle was equipped with height adjustable head restraints for the front and second row outboard positions, seat belt pretensioners, traction control, and Lower Anchors and Tethers for Children (LATCH) system features.

Inspection of the vehicle's interior revealed adjustable front bucket seats with folding backs and adjustable head restraints and a non-adjustable second row bench seat with folding backs and adjustable head restraints for the second row outboard seating positions. The Honda's wheelbase was 267 centimeters (cm) [105.1 inches (in)], and the odometer reading at inspection was unknown because the vehicle was equipped with an electronic odometer.

CASE VEHICLE DAMAGE

Exterior Damage: The Honda's contact with the Chevrolet involved the left side with the damage distributed on approximately the center portion (**Figures 6** and **7**). Direct damage began 63.0 cm (24.8 in) in front of the left rear axle (**Figure 8**) and extended 178 cm (70.1 in) forward along the left side. Residual maximum crush was measured as 15 cm (5.9 in) at C_4 (**Figure 9**). The table below shows the case vehicle's crush profile.

Units	Event	Direct Damage		Field L	C_1	C_2	C_3	C_4	C_5	C_6	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	178	15	178	0	3	9	15	10	3	19	19
in		70.1	5.9	70.1	0.0	1.2	3.5	5.9	3.9	1.2	7.5	7.5

Figure 6: Honda's left side crush from impact by Chevrolet; C_6 was located just behind left front wheel assembly

Figure 7: Elevated view from front of Honda's left side crush showing C_1 through C_5

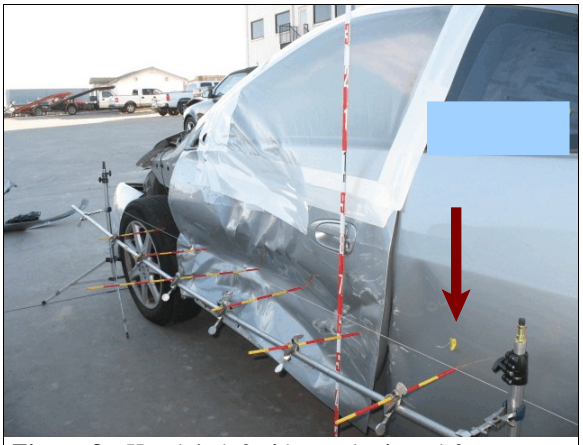


Figure 8: Honda's left side crush viewed from rear; arrow points to yellow dot representing C_1, indicating beginning of Field L

Figure 9: Elevated view of Honda's crush profile; C_6 was located just behind left front tire; maximum crash occurred at C_4

The wheelbase on the Honda's left side was extended 1 cm (0.4 in) while the right side was also extended 1 cm (0.4 in). The Honda's left fender, left door, left exterior rearview mirror, and left quarter panel were directly damaged and crushed inward. There was induced damage to the front bumper fascia (**Figures 6** and **10**), left head-

light and turn signal assemblies, and the left door's glazing. No obvious induced damage or remote buckling was noted to the remainder of the Honda's exterior.

Figure 10: Induced damage to Honda's front bumper fascia from left side impact by Chevrolet

The Honda manufacturer's recommended tire size was P205/60R16, and the vehicle was equipped with the proper sized tires. The Honda's tire data are shown in the table below.

Damage Classification: The Collision Deformation Classification for the Honda was: **10-LYEW-2** (**300** degrees). The WinSMASH reconstruction program, missing vehicle algorithm, was used on the Honda's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs were, respectively: 12.0 km/h (7.5 mph), -6.0 km/h (-3.7 mph), and 10.4 km/h (6.5 mph).

Tire	*Measured Pressure*		*Vehicle Manufacturer's Recommended Cold Tire Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	193	28	221	32	5	6	None	No	No
LR	207	30	207	30	4	5	None	No	No
RR	193	28	207	30	4	5	None	No	No
RF	193	28	221	32	6	7	None	No	No

Figure 11: Honda's front seating area showing removed interior surface of driver's door and undeformed steering wheel rim

Figure 12: Honda's driver seating area showing no apparent occupant contact evidence or loading on steering wheel

Interior Damage: Inspection of the Honda's interior revealed that the interior surface of the driver's door had been removed prior to this contractor's inspection (**Figure 11**). As a result, there was no direct evidence of occupant contact on this interior surface of the vehicle. The driver's door was jammed shut as a result of the crash, and there was evidence of lateral intrusion to the upper [i.e., 6 cm (2.4 in)] and lower [7 cm (2.8 in)] portions of the driver's door. There was no evidence of compression to the energy absorbing shear capsules in the steering column, and no deformation to the steering wheel rim (**Figure 12**).

MANUAL RESTRAINT SYSTEM

Restraints: The Honda's manual restraint systems are shown in the table below.

	Left	Center	Right
First Row	Continuous loop, lap-and-shoulder, safety belt system without upper anchorage adjustor for the D-ring; sliding type latch plate with ELR		Continuous loop, lap-and-shoulder, safety belt system without upper anchorage adjustor for the D-ring; sliding type latch plate with switchable retractor type
Second Row	Continuous loop, lap-and-shoulder, safety belt system; sliding type latch plate with switchable retractor type; lower anchor present; top tether anchor located behind the seat back	Continuous loop, lap-and-shoulder, safety belt system; sliding type latch plate with switchable retractor type; no lower anchor present; top tether anchor located behind the seat back	Continuous loop, lap-and-shoulder, safety belt system; sliding type latch plate with switchable retractor type; lower anchor present; top tether anchor located behind the seat back

ELR = Emergency Locking Retractor Switchable = either ALR = Automatic Locking Retractor

The driver's seat belt exhibited indications of historical usage. The driver was the only occupant in the vehicle. The inspection of the driver's safety belt webbing, D-ring, and latch plate revealed that the safety belt would not retract because the pretensioner actuated. Stress marks were present on the safety belt near the D-ring (**Figure 13**) indicating loading evidence.

Figure 13: Stress marks on Honda's driver safety belt indicating loading evidence near D-ring

AUTOMATIC RESTRAINT SYSTEM

The Honda was equipped with AOPS features that consisted of dual stage frontal air bags at the driver and front right passenger positions. The Honda's driver air bag was located in the steering wheel hub **(Figure 12**) and the front right passenger's air bag was located in the top of the instrument panel. Neither of these air bags deployed in this side impact crash.

The case vehicle's driver and right front side impact inflatable occupant protection systems (air bags) were located near the middle of the driver's and front right passenger's seat backs, respectively. The bags were attached on the outboard surface of the seat back and deployed through a seam (**Figure 14**). An inspection of the driver side impact air bag module's deployment area and the air bag's fabric revealed that the module opened along the seam at the designated tear points, and there appeared to be scuff on the front inboard surface near the 3 o'clock position–when viewed from the inboard side of the vehicle, that probably occurred during the deployment of the air bag (**Figure 15**). The driver's side air bag was designed without any tethers or vent ports; although, there was a circular stitched area near the center of the air bag that was designed to act like a tether (i.e., the stitching help the air bag maintained its designed shape). The deployed side impact air bag was elliptical with a height of approximately 34 cm (13.4 in) and a width (i.e., forward excursion) of approximately 22 cm (8.7 in). An inspection of the driver's air bag fabric revealed no contact evidence on either the outboard or inboard surfaces of the driver side air bag's fabric.

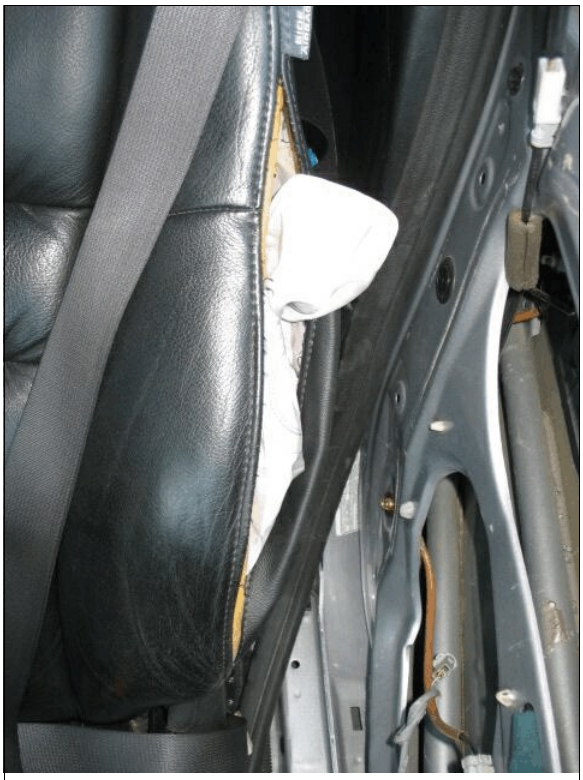


Figure 14: Honda's driver side seat back-mounted side impact air bag positioned on outboard side of driver's seat

Figure 15: Inboard surface of Honda's deployed driver side air bag showing center circular stitching and deployment scuff toward front of bag

The Honda's left IC air bag was housed within the left roof side rail (**Figure 11**). The IC air bag extended along the front and second seat rows. It was designed to provide protection for an occupant's head during a side impact. The IC air bag was anchored to the left A-pillar and left C-pillar. There was no tether cord at either the front or back of the air bag. The whole left IC air bag was designed with a length of 140 cm (55.1 in) but the inflatable chamber was 115 cm (45.3 in) in length, and the air bag's height was 30 cm (11.8 in). The air bag was designed with irregularly shaped inflatable chambers adjacent to the driver and second row left seat positions (**Figures 16** and **17**). The IC was designed without any tethers or vent ports; however, there were three areas of circular stitching that are designed to enable the air bag to maintain its designed shape. Inspection of the IC revealed no evidence of damage due to deployment on either the outboard or inboard surfaces. An inspection of the IC's fabric revealed no contact evidence on the interior surfaces of the fabric.

Figure 16: Front portion of Honda's deployed left IC air bag

Figure 17: Rear and middle portions of Honda's deployed left IC air bag

CASE VEHICLE KINEMATICS–OVERVIEW

It is unknown if the Honda's driver made any pre-crash avoidance maneuvers prior to the crash, but she probably did not because this driver had the right-of-way. As a result and independent of the use of her available safety belts, the driver's pre-impact body position did not change just prior to impact. The Honda's impact with the 2002 Chevrolet enabled the driver to continue forward and leftward along a path opposite this vehicle's **300** degree principal direction of force as the vehicle decelerated. After the Honda achieved maximum engagement with the Chevrolet, the driver was redirected toward her right and probably forward as the vehicle moved to final rest.

DRIVER KINEMATICS

Immediately prior to the crash, the posture of Honda's driver (31-year-old, female) was unknown; however based on the vehicle inspection, the driver of the Honda was probably seated in slightly reclined posture with her back against the seat back, her left foot on the floor, her right foot on the accelerator, and at least one of her hands on the steering wheel. Her seat track was located between its middle and forward-most positions, the seat back was slightly reclined, the location of steering column's tilt adjustment was full down, and the location of the column's telescoping adjustment was full back.

The driver was restrained by her lap-and-shoulder, safety belt system. As a result of the impact with the Chevrolet, the driver loaded her safety belts and contacted her deploying side impact and side curtain air bags.

When the vehicles separated following maximum engagement, the driver probably moved rightward and continued to load her safety belts. As her vehicle moved along its post-crash trajectory, the driver continued to load her safety belts and moved slightly forward as her vehicle decelerated to final rest.

The driver was transported by ambulance to a hospital. She sustained minor soft tissue injuries and was treated and released.

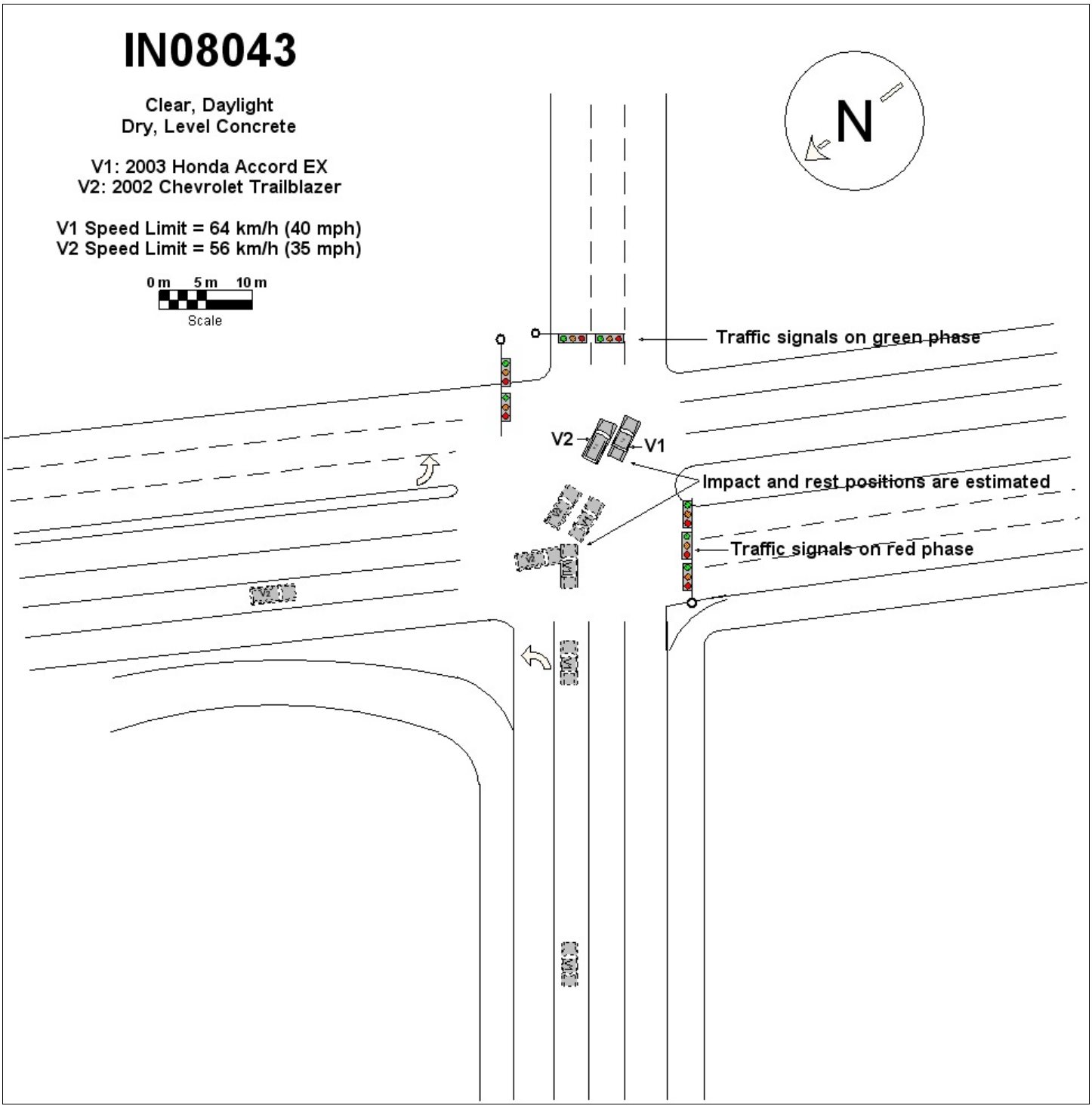
Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Strain, acute, cervical, with straightening of usual lordosis	minor 640278.1,6	Noncontact injury: impact forces	Possible	Emergency room records
2	Contusion over left clavicular area, not further specified	minor 790402.1,2	Air bag, driver's side inflatable curtain	Probable	Emergency room records
3	Contusion left knee, not further specified	minor 890402.1,2	Left front door panel, forward lower quadrant	Probable	Emergency room records

OTHER VEHICLE

Based on the VIN and manufacturer's specifications, the 2002 Chevrolet Trailblazer was a rear-wheel drive, 5-passenger, 4-door sport utility vehicle (VIN: 1GNDS13S922------) equipped with a 4.2-liter, I-6 engine and 4-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum, 4-wheel, anti-lock system. The Chevrolet was also equipped with AOPS features, including dual stage driver and front right passenger air bag inflators, and driver and front right passenger seat belt buckle switch sensors. According to the police crash report, the Chevrolet's front air bags did not deploy during this crash. In addition, the vehicle was equipped with front seat back-mounted side impact air bags. The Chevrolet's wheelbase was 287 cm (113.0 in). This vehicle was not inspected.

The WinSMASH reconstruction program, missing vehicle algorithm, was used on the Chevrolet's highest severity frontal impact. The Total, Longitudinal, and Lateral Delta Vs were, respectively: 8.0 km/h (5.0 mph), -5.1 km/h (-3.2 mph), and -6.1 km/h (-3.8 mph). The results were based on the Honda's crush profile, and these results should be considered borderline reconstruction for the Chevrolet's Delta Vs.

Chevrolet's Occupants: According to the police crash report, the Chevrolet's driver (26-year-old, male) was restrained by his lap-and-shoulder, safety belt. The driver was not transported by ambulance to the hospital, and did not sustain any police-reported injuries as a result of this crash.


IN08043
Clear, Daylight
Dry, Level Concrete
V1: 2003 Honda Accord EX
V2: 2002 Chevrolet Trailblazer
V1 Speed Limit = 64 km/h (40 mph)
V2 Speed Limit = 56 km/h (35 mph)
0 m 5 m 10 m
Scale
N
Traffic signals on green phase
V2
V1
Impact and rest positions are estimated
Traffic signals on red phase