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ON-SITE CHILD SAFETY SEAT INVESTIGATION

CASE NUMBER - IN-04-038
LOCATION - OHIO
VEHICLE - 1997 HONDA ACCORD EX
CRASH DATE - November 2004

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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. *Abstract*

This report covers an on-site investigation of a crash involving a child safety seat and an air bag deployment that involved a 1997 Honda Accord EX (case vehicle) and a 1997 Honda Civic (other vehicle), which collided front to right side in the intersection of a four-lane divided state highway. This crash is of special interest because the case vehicle's back right passenger [1-year-old, White (non-Hispanic) male] was restrained in a child safety seat and sustained only a minor injury as a result of the crash. The case vehicle was westbound in the outside lane of a four-lane divided state highway approaching a "Tee" intersection with a county road. The Civic was eastbound in the inside lane of the state highway, and the driver executed a left turn across the path of the case vehicle. The front of the case vehicle impacted the right side of the Civic causing both vehicle's driver and front right air bags to deploy. The Civic rotated clockwise approximately 190 degrees as the case vehicle rotated clockwise, and the right front bumper corner of the Civic impacted the right front corner of the case vehicle. The Civic departed the north side of roadway, and the front impacted a county road sign. The Civic traveled into a ditch and came to rest facing northwest. The case vehicle continued to rotate clockwise and came to rest in the westbound lane facing northeast. The driver of the Civic was ejected through the right front door during the crash. The case vehicle's back right passenger (1-year-old, male) was seated upright, restrained in his 5-point, forward facing convertible child seat and was wearing a heavy coat. The impact with the Civic caused him to continue forward and to the left along a path opposite the case vehicle's 340 degree direction of principal force as the case vehicle decelerated and rotated clockwise. He bruised the left side of his neck on the harness strap. The back right passenger remained securely restrained in his child safety seat throughout the crash. He was removed from his child safety seat by emergency medical personnel and transported by ambulance to a local hospital and treated and released. The back right passenger's use of the child safety seat prevented any interaction with the case vehicle's interior surfaces and prevented him from sustaining possible serious injury. The case vehicle's driver sustained a "B" (non-incapacitating-evident) injury, and the case vehicle's back left passenger sustained no injury. Both the driver and back left passenger were transported to a local hospital and treated and released.

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This investigation was brought to NHTSA's attention on November 23, 2004 by local newspaper articles. This crash involved a 1997 Honda Accord EX (case vehicle) and a 1997 Honda Civic (other vehicle). The crash occurred in November 2004, at 1:55 p.m., in Ohio and was investigated by the county sheriff's department. This crash is of special interest because the case vehicle's back right passenger [1-year-old, White (non-Hispanic) male] was restrained in a child safety seat, which was secured by the case vehicle's lap-and-shoulder safety belt, and he sustained only a minor injury as a result of the crash. This contractor inspected the scene and the case vehicle on December 2, 2004, and inspected the Honda Civic on December 3, 2004. The case vehicle's driver was interviewed on November 27, 2004 and arrangements were made to inspect the child safety seat on December 2, 2004, however, the driver did not show up at the appointed time and refused to allow the inspection when she was subsequently contacted. This report is based on the police crash report, police on-scene photographs, an interview with the case vehicle's driver, scene and vehicle inspections, local newspaper articles, medical records, occupant kinematic principles, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was westbound in the outside lane of a four-lane divided state highway approaching a "Tee" intersection with a county road. The Civic was eastbound in the inside lane of the state highway, and the driver executed a left turn through a median cut into the path of the case vehicle. The front of the case vehicle impacted the right side of the Civic causing both vehicles' driver and front right passenger air bags to deploy. The Civic rotated clockwise approximately 190 degrees as the case vehicle rotated clockwise, and the right front bumper corner of the Civic impacted the right front corner of the case vehicle. The Civic departed the north side of roadway, and the front impacted a county road sign. The Civic traveled into a ditch and came to rest facing northwest. The case vehicle continued to rotated clockwise and came to rest in the westbound lane facing northeast. The driver of the Civic was ejected through the right front door during the crash. 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 light and the site of the crash was rural residential.

The CDCs for the case vehicle were determined to be: **11-FDEW-2** (**340** degrees) for the front impact with the Civic's right side and **04-RF99-1** (**120** degrees, columns 5 and 6 are unknown) for the right front impact with the Civic's right front bumper corner (columns five and six are unknown due to overlapping damage). The WinSMASH reconstruction program, damage algorithm, calculated the case vehicle's Total, Longitudinal and Lateral Delta Vs respectively as: 35 km.p.h. (21.7 m.p.h.), -32.9 km.p.h (-2.4 m.p.h.) and 12.0 km.p.h. (7.5 m.p.h.).

The CDCs for the Honda Civic were determined to be: **02-RPEW-4** (**50** degrees) for the right side impact with the front of the case vehicle, **03-RFLE-2** (**90** degrees) for the right front bumper corner impact with the right front of the case vehicle and **03-FZLS-1** (**80** degrees) for the impact with the county road sign post. The WinSMASH reconstruction program, damage algorithm, calculated the Civic's Total, Longitudinal and Lateral Delta Vs for the initial impact

with the case vehicle respectively as: 41 km.p.h. (25.4 m.p.h.), -26.4 km.p.h (-16.4 m.p.h.) and -31.4 km.p.h. (-19.5 m.p.h.).

Immediately prior to the crash, the case vehicle's back right passenger (1-year-old, male) was seated upright, restrained in his 5-point, forward facing child safety seat and was wearing a heavy coat. The driver applied the brakes just prior to the impact, and the back right passenger's safety belt retractor most likely locked, and he moved forward in his child safety seat and loaded the harness straps. The impact with the Honda Civic caused him to continue forward and to the left along a path opposite the case vehicle's 340 degree direction of principal force as the case vehicle decelerated and rotated clockwise, and he bruised the left side of his neck on the harness strap. The back right passenger remained securely restrained in his child safety seat throughout the crash. He was removed from his child safety seat by emergency medical personnel and transported by ambulance to a local hospital where he was treated and released. The back right passenger's use of the child safety seat prevented any interaction with the case vehicle's interior surfaces and prevented him from sustaining possible serious injury.

Immediately prior to the crash, the case vehicle's driver (23-year-old, female) was seated in an upright position with her left foot on the floor, right foot on the brake, her back against the seat, and both hands on the steering wheel. Her seat track was located in its middle position, her seat back was slightly reclined, the tilt steering wheel was located in its full down position, and she was not restrained by her lap-and-shoulder safety belt system. The impact with the Honda Civic caused the driver to continue forward and to the left along a path opposite the case vehicle's 340 degree direction of principal force as the case vehicle decelerated. Both of her knees impacted the knee bolster bruising her knees, and her face and chest impacted her deployed air bag, slightly compressing the steering column and displacing it upward. The driver remained in her seat as the case vehicle rotated clockwise, sustained a secondary impact with the Civic and came to final rest. She was removed from the vehicle by emergency personnel and transported to a local hospital where she was treated and released. The deployment of the driver's air bag reduced her interaction with the steering wheel and instrument panel, which mitigated her injuries.

Immediately prior to the crash the case vehicle's back left passenger (6-year-old, female) was asleep, leaning over to the right onto the seat cushion. Her feet were dangling over the front edge of the seat cushion, and the position of her arms and hands is not known. She was allegedly restrained by the lap-and-shoulder safety belt. As a result of the driver's pre-impact braking, the back left passenger most likely moved forward in her seat, and her safety belt retractor locked. The impact with the Civic caused her to continue forward and to the left along a path opposite the case vehicle's 340 degree direction of principal force as the case vehicle decelerated and her left hip most likely impacted the case vehicle's left side armrest abrading her hip. She remained restrained in the seat throughout the crash and was removed from the case vehicle by emergency medical personnel and transported to a local hospital where she was treated and released.

Crash Environment: The trafficway on which both vehicles were traveling was a four-lane, divided, state highway traversing in an east and west direction. There was a two lane county road that intersected the highway from the north to form a "Tee" intersection, which included a median cut approximately 25.6 meters (84 feet) in width. Each travel lane of the highway was approximately 3.5 meters (11.5 feet) in width, and the roadway was divided by a curbed, grass median approximately 4.8 meters (15.7 feet) in width. The outside and median shoulders were constructed of bituminous and were approximately 1 meter (3.3 feet) in width. Pavement markings consisted of white outside edge lines, broken white center lines with intermittent pavement reflectors and yellow median edge lines. The speed limit for both vehicles was 88 km.p.h. (55 m.p.h.). At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was new, level, dry bituminous with an estimated coefficient of friction of 0.75. Traffic density was light and the site of the crash was rural residential. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle was westbound in the outside lane of the highway approaching the "Tee" intersection **(Figure 1)** at a driver estimated speed of 88 km.p.h. (55 m.p.h.), and the driver was intending to continue westbound. The Civic was eastbound, and the driver was in the process of making a left turn through the median cut (**Figure 2**) to travel north on the county road. The case vehicle's driver stated that she applied the brakes in an attempt to avoid the crash. The crash occurred within the "Tee" intersection in the outside westbound lane of the highway (**Figure 3** below).

Figure 1: Approach of case vehicle westbound in outside lane , arrow shows area of impact, number shows meters to impact

Figure 2: Approach of V2 eastbound to left turn through median cut, number shows meters to impact area

Crash: The front of the case vehicle **(Figure 4** below) impacted the right side passenger compartment of the Civic (**Figure 5** below) causing both vehicle's driver and right front passenger air bags to deploy. The case vehicle rotated clockwise approximately 85 degrees and the Civic rotated clockwise approximately 190 degrees, and the right front bumper corner of the Civic impacted the case vehicle's right fender and front bumper corner. The impact knocked the front bumper off the case vehicle (**Figures 6** and **7** below).

Figure 3: On-scene photo of impact gouges, post impact tire marks and final rest positions of case vehicle and V2

Figure 4: Damage to front of case vehicle due to impact with right side of V2, bumper placed back on vehicle for measurement

Figure 5: Damage to right side of V2, yellow tape below door handle is center of direct damage

Figure 6: View southwest to rest position of case vehicle and V2, red arrow show's case vehicle's front bumper, blue arrow shows V2's front bumper cover

Post-Crash: As a result of the impact, the case vehicle rotated clockwise a total of about 130 degrees, traveled about 22 meters (72.2 feet) and came to final rest in the outside westbound lane of the highway facing northeast with the front of the vehicle partially on the north shoulder (**Figures 3** and **6**). The impact caused the Honda Civic to rotate clockwise and travel northwest off the roadway where the front bumper impacted a county road sign knocking the bumper cover off the Civic (**Figures 6** and **7**). The Civic continued to rotate clockwise, and traveled down into a ditch and came to rest on the front slope of the ditch facing northwest (**Figure 6**) about 10 meters (32.8 feet) off the roadway. The Civic traveled a total of about 21 meters (68.9 feet) and rotated a total

Figure 7: Damage to V2's front bumper from county road sign impact (blue arrow) and secondary impact to right fender and bumper corner of case vehicle (red arrow)

of about 279 degrees from the initial impact with the case vehicle to final rest. The driver of the Civic was ejected during the post impact rotation of the vehicle. His final rest position is not known.

Figure 8: Top view of crush to case vehicle's front bumper, each increment on rods is 5 cm (2 in)

Figure 9: Top view of case vehicle's hood level crush

CASE VEHICLE

The 1997 Honda Accord EX was a front wheel drive, four-door sedan (VIN: 1HGCD5683VA------) equipped with four-cylinder engine and four-speed automatic transmission. The front seating row was equipped with bucket seats with adjustable head restraints, tilt steering column, driver and front right passenger air bags and manual, three-point, lap-and-shoulder safety belts. The back seating row was equipped with a bench seat with manual, three-point, lap-and-shoulder safety belts in the outboard seat positions and a lap belt in the middle position. The case vehicle was not equipped with anti-lock brakes. The case vehicle's wheelbase was 272 centimeters (107 inches), and the odometer reading at the inspection was 168,039 kilometers (104,418 miles).

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's impact with the Civic involved the full width of the front end. The case vehicle's front bumper, grille, hood, headlamp/turn lamp assemblies and both fenders sustained direct damage and were crushed rearward. Direct damage began at the case vehicle's left front bumper corner and extended 158 centimeters (62.2 inches) across the full width of the front bumper. Crush measurements were taken at the bumper level and hood level. The residual maximum bumper level crush was 19 centimeters (7.5 inches) occurring at C_3 (**Figure 8**). The residual maximum crush at the hood level was 44 centimeters (17.3 inches) occurring at C_6 (**Figure 9** below). There was a secondary impact to the front of the case vehicle's right fender and bumper corner by the Civic's right front bumper corner. There was no measurable crush from this impact due to overlapping damage from the front impact. The table below shows the average of the case vehicle's bumper level and above bumper level crush profiles.

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	158	44	158	14	14	19	15	24	29	0	0
in		62.2	17.3	62.2	5.5	5.5	7.5	5.9	9.4	11.4	0.0	0.0

The case vehicle's right side wheelbase was shortened 8 centimeters (3.1 inches) while the left side wheelbase was unchanged. Induced damage involved both fenders and the hood. The hood was buckled up in the middle and displaced rearward, but it did not contact the windshield. The left front door and fender were damaged when the door was opened into the displaced fender following the crash.

The recommended tire size was: P185/70R14; however, the vehicle was equipped with tires size P195/65R15. The case vehicle's tire data are shown in the table below.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kpa	psi	kpa	psi	milli-meters	32nd of an inch			
LF	110	16	221	32	6	8	None	No	No
RF	110	16	221	32	6	8	None	Yes	No
LR	152	22	221	32	7	9	None	No	No
RR	172	25	221	32	6	8	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior revealed occupant contact marks on the driver's left and right knee bolsters (**Figure 10** and **Figure 11** below). In addition, the unrestrained driver had loaded the deployed air bag and displaced the steering assembly (**Figure 12** below). The steering column appeared slightly compressed and displaced upward. It was found partially jammed between its center and full up tilt position during the inspection. The driver stated she had the steering column adjusted to its full down position prior to the crash. There was no deformation of the steering wheel rim, and no other occupant contact evidence was found. Finally, there was no evidence of occupant compartment intrusion.

Figure 10: Damage to case vehicle's left knee bolster from impact by driver's left knee

Figure 11: Damage to case vehicle's right knee bolster due to impact by driver's right knee

Figure 12: On-scene photo of case vehicle's driver air bag, steering wheel and steering column

Damage Classification: Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **11-FDEW-2** (**340** degrees) for the front impact with the Civic's right side and **04-RF99-1** (**120** degrees, columns 5 and 6 are unknown) for the right front impact with the Civic's right front bumper corner (columns 5 and 6 are unknown due to overlapping damage). The WinSMASH reconstruction program, damage algorithm was used to reconstruct the case vehicle's Delta V for the front impact. The Total, Longitudinal and Lateral Delta Vs are respectively: 35 km.p.h. (21.7 m.p.h.), -32.9 km.p.h (-2.4 m.p.h.) and 12.0 km.p.h. (7.5 m.p.h.). The results appear low. The case vehicle was towed due to damage.

Figure 13: Case vehicle's driver air bag, steering wheel is rotated CW about 170 degrees

Figure 14: Case vehicle's driver air bag vent ports

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with non-redesigned air bags at the driver and front right passenger positions. Both of these air bags deployed as a result of the case vehicle's front impact with the right side of the Civic.

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module cover flaps and the air bag fabric revealed that the cover flaps opened at the designated tear points. There was no evidence of damage during the deployment to the air bag or the module cover flaps. The deployed driver's air bag (**Figure 13**) was round with a diameter of about 61 centimeters (24 inches). The air bag was designed with two tethers, each approximately 7

centimeters (2.8 inches) in width and had two vent ports (**Figure 14** above), each approximately 4 centimeters (1.6 inches) in diameter, located at the 11 and 1 o'clock positions. The top air bag module cover flap was rectangular in shape and measured 14.5 centimeters (5.7 inches) in length and 12 centimeters (4.7 inches) in height. The bottom air bag module cover flap was irregularly shaped and measured 14.5 centimeters (5.7 inches) in length and 6 centimeters (2.4 inches) in height. The cover flaps were constructed of pliable vinyl. There were several small dispersed areas of black dirt or grease at the top of the air bag; however, these did not appear to be occupant contact marks.

Figure 15: Overview of case vehicle's front right instrument panel and location of front right air bag

The front right passenger's air bag was located on the top of the instrument panel (**Figure 15**). The air bag module cover flap opened at the designated tear points, and there was no evidence of damage to the air bag or the module flap. The deployed front right passenger air bag (**Figure 16** below) was approximately 53 centimeters (20.9 inches) in width and about approximately 60 centimeters (23.6 inches) in height. The air bag was designed without tethers and had two vent ports, each approximately 8 centimeters (3.1 inches) in diameter (**Figure 17**) located at the 3 and 9 o'clock positions. There was a single rectangular-shaped, pliable vinyl air bag module cover flap measuring 25 centimeters (9.8 inches) in width and 7 centimeters (2.8 inches) in height. There was a small dispersed area of black dirt or grease at the top left quadrant of the air bag. There was no passenger seated in the front right seat.

Figure 16: Case vehicle's front right passenger air bag

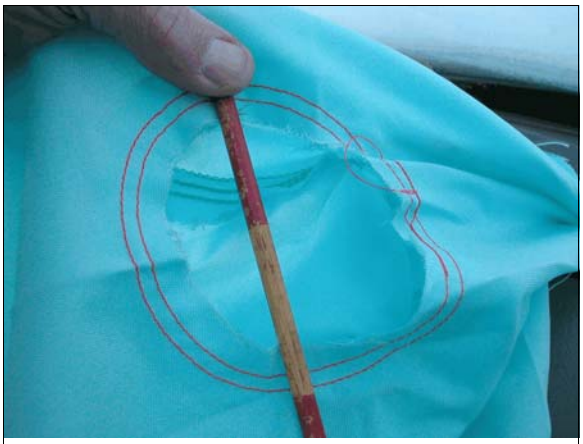


Figure 17: Right vent port of case vehicle's front right passenger air bag

CHILD SAFETY SEAT

The case vehicle's back right passenger was seated in a "Touriva" convertible child safety seat manufactured by Cosco. Due to the driver's refusal, subsequent to her interview, to allow an inspection of the child safety seat, the seat's model name, model number and date of manufacture are not known. The driver was unable to obtain this information during the interview. Based on the driver's interview, the child safety seat

Figure 18: Overview of case vehicle's back right seat position, child safety seat was secured here with lap-and-shoulder safety belt

was equipped with a 5-point harness. It was positioned in the case vehicle's back right seat position (**Figure 18**) facing forward and was secured by the manual, three-point lap and shoulder safety belt. The harness straps were located in the middle slots and were positioned at the child's shoulder level. The harness retainer clip was buckled at the time of the crash and was positioned at the child's armpit level. There was about "one finger" of space between the harness and the child's chest, and the child was wearing a heavy coat at the time. The driver stated she could not figure out how to loosen the harness strap to allow more space. The driver purchased the child safety seat new and used it on a daily basis. She had owned the child seat for about five months and read the owner's manual prior to using the seat. However, she stated she did not refer to the case vehicle owner's manual regarding how to install the child seat with the vehicle's safety belts. She secured the child safety seat with the lap-and-shoulder belt routed through the back of the child seat. The driver was not clear as to the specifics of how she secured the child seat in the case vehicle. She would only say she "just pulled on the seat belt". Inspection of the safety belt assembly revealed no load marks, only historical use scratches on the latch plate were observed. It appears unlikely she pulled the seat belt out to switch the retractor to automatic locking mode. Lastly, the driver stated the child seat was not damaged during the crash.

CASE VEHICLE BACK RIGHT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's back right passenger [1-year-old, White (non-Hispanic) male; 61 centimeters and 8 kilograms (24 inches, 17 pounds)] was seated upright, restrained in his 5-point, forward facing child safety seat. He was wearing a heavy coat.

As a result of the driver's pre-impact braking, the back right safety belt retractor most likely locked, and the back right passenger moved forward in his child safety and loaded the harness straps. The impact with the Civic caused him to continue forward and to the left along a path opposite the case vehicle's 340 degree direction of principal force as the case vehicle decelerated, and he bruised the right side of neck on the harness strap. The passenger then moved to his right along a path opposite the case vehicle's 120 degree direction of principle force as a result of the secondary impact between the case vehicle's right fender and bumper corner and the Civic's right front bumper corner. As the case vehicle rotated clockwise, the back right passenger moved to the left within his child safety seat. The back right passenger remained securely restrained in his child safety seat throughout the crash. The driver stated that following the crash, the child safety seat was still secured in the back right seat. The child was removed from his child seat by emergency medical personnel and removed from the case vehicle. The back right passenger's use of the child safety seat prevented his interaction with the case vehicle's interior surfaces and prevented him from sustaining possible serious injury.

The police crash report indicated the back right passenger sustained no injury, but was transported by ambulance to a local hospital where he was treated and released. The emergency medical records indicated that the back right passenger sustained an abrasion to the right side of his neck. The back right passenger 's injury and injury contact mechanism is presented in the table below.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion, small, 1 x 2 cm (0.4 x 0.8 in) on right side of neck, top of trapezius {muscle}	minor 390202.1,1	Child safety seat harness straps	Certain	Emergency room records

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [23-year-old, White (non-Hispanic) female; 173 centimeters and 52 kilograms (68 inches, 115 pounds)] was seated in an upright posture. The driver had her left foot on the floor, right foot on the brake, her back was against the seat, and both hands were on the steering wheel. Her seat track was located in its middle position, her seat back was slightly reclined, and the tilt steering wheel was located in its full down position.

The case vehicle's driver stated she was not restrained by her manual, three-point, lap-and-shoulder, safety belt system. Inspection of the seat belt assembly also revealed no load marks on the seat belt webbing, latch plate, or "D"-ring.

The case vehicle driver's pre-crash braking most likely did not alter her seated position significantly. The impact with the Civic caused the driver to continue forward and to the left along a path opposite the case vehicle's 340 degree direction of principal force as the case vehicle decelerated. Both of the driver's knees impacted the knee bolster bruising her knees, and her face and chest impacted her deployed air bag, slightly compressing the steering column and displacing it upward. The driver moved to her left as the case vehicle rotated clockwise and likely contacted the left front door. She then moved to her right along a path opposite the case vehicle's 120 degree direction of principle force as a result of the secondary impact between the case vehicle's right fender and bumper corner and the Civic's right front bumper corner. As the case vehicle continued to rotate clockwise to final rest, the driver moved to the left and most likely contacted the left front door again. The driver stated she was in her seat at final rest, and emergency medical personnel removed her from the case vehicle through the left front door. The deployment of the driver's air bag reduced her interaction with the steering wheel and instrument panel and mitigated her injuries.

The police crash report indicated the case vehicle's driver sustained a "B" (non-incapacitating-evident) injury and was transported by ambulance to a local hospital for treatment. The driver stated she was treated and released, and received follow-up treatment on two occasions for headaches and back pain. The driver was not working at the time of the crash. The driver's injuries and injury contact mechanisms are presented in the table below.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion {bruise} left knee with swelling	minor 890402.1,2	Knee bolster, driver's, left of steering column	Certain	Emergency room records
2	Contusion {bruise} right knee with swelling	minor 890402.1,1	Knee bolster, driver's, right of steering column	Certain	Emergency room records
3	Contusion, multiple, not further specified	minor 990400.1,9	Unknown contact mechanism	Unknown	Emergency room records

CASE VEHICLE BACK LEFT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's back left passenger [6-year-old, White (non-Hispanic) female; 91 centimeters and 20 kilograms (36 inches, 45 pounds)] was asleep, laying over to the right onto the seat cushion. Her feet were dangling over the front edge of the seat cushion. The position of her arms and hands is not known. There was no seat track and the seat back was not adjustable.

The case vehicle's driver stated the back left passenger was restrained by her manual, three-point, lap-and-shoulder safety belt system. However, since the child was allegedly laying over to the right on the seat cushion, it is unclear how the safety belt was positioned. However, it is likely that the shoulder belt was not across the passenger's chest due to her abnormal seating posture. Inspection of the safety belt assembly revealed no load marks on the safety belt webbing or latch plate. However, there were scratch marks on the latch plate indicating moderate historical usage of the safety belt. The "D"-ring was located in the C-pillar and could not be inspected.

As a result of the driver's pre-impact braking, the back left passenger most likely moved forward in her seat and her safety belt retractor locked. The impact with the Civic caused her to continue forward and to the left along a path opposite the case vehicle's 340 degree direction of principal force as the case vehicle decelerated, and her left hip most likely impacted the case vehicle's left side arm rest abrading her hip. The passenger then moved to her right along a path opposite the case vehicle's 120 degree direction of principal force as a result of the secondary impact between the case vehicle's right fender and bumper corner and the Civic's right front bumper corner. As the case vehicle rotated clockwise to final rest, the back left passenger moved

to the left and most likely contacted the left rear door again. The driver stated that following the crash the back left passenger was in her seat, but released herself from her safety belt and tried to get in the front seat with the driver. The back left passenger was subsequently removed from the case vehicle by emergency medical personnel through the left rear door.

CASE VEHICLE BACK LEFT PASSENGER INJURIES

The police crash report indicated the back left passenger sustained no injury, but was transported by ambulance to a local hospital. The hospital medical record indicated that the back left passenger was not injured. However, the case vehicle's driver indicated the back left passenger sustained a hip abrasion, but could not identify which hip. This contractor believes the abrasion was most likely located on her left hip. The back left passenger 's injury and injury contact mechanism is presented in the table below.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion on hip, not further specified as to location or aspect	minor 590202.1,9	Left side interior hardware and/or armrest	Possible	Interviewee (driver)

OTHER VEHICLE

The 1997 Honda Civic was a front wheel drive, two-door coupe (VIN: 1HGEJ6128VL------) equipped with a four-cylinder engine and five-speed manual transmission. The front seating row was equipped with bucket seats with adjustable head restraints, driver and front right passenger air bags and manual, three-point, lap-and-shoulder safety belts. The back seating row was equipped with a bench seat with manual, three-point, lap-and-shoulder safety belts in the outboard seat positions and a lap belt in the middle position. The vehicle was not equipped with anti-lock brakes. The Civic's wheelbase was 262 centimeters (103 inches).

Exterior Damage: The Civic's initial impact with the case vehicle involved the right front door and right quarter panel. They were directly damaged and crushed inward, and the right side windows were broken out. Crush measurements were taken at the mid-door level and at the sill level due to separation of the right front door latch. Maximum residual crush at the mid-door level occurred between C_2 and C_3 (**Figure 19**) and was measured as 74 centimeters (29.1 inches). Maximum crush at the sill level occurred at C_3 and was measured

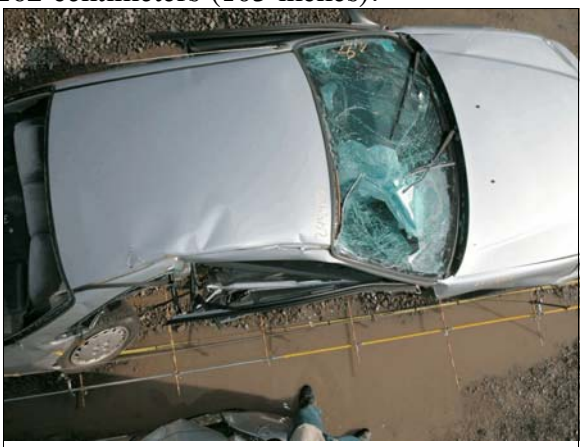


Figure 19: Top view of crush to right side of V2

as 42 centimeters (16.5 inches). The average of the Civic's door level and sill level crush profiles is shown in the table below.

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	224	64	196	0	53	51	44	13	0	-37	-7
in		88.2	25.2	77.2	0.0	20.9	20.1	17.3	5.1	0.0	-14.6	-2.8

There was no measurable crush to the Civic's right front bumper corner from the impact with the case vehicle's right fender. The direct damage to the Civic's front bumper fascia from the impact with the county road sign began 10 centimeters right of the Civic's centerline and extended 26 centimeters to the left. The maximum crush to the bumper fascia occurred at C_4 and was measured as 1 centimeter (0.4 inch). The front bumper crush profile for the county road sign impact is shown in the table below.

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	26	1	148	0	0	0	1	0	0	23	0
in		10.2	0.4	58.3	0.0	0.0	0.0	0.4	0.0	0.0	9.1	0.0

The Civic's right side wheelbase was reduced 4 centimeters (1.6) while the left side wheelbase was extended 5 centimeters (2 inches). Induced damaged involved the right fender, right and left quarter panel, roof and front bumper, and the windshield was broken and the backlight was broken out.

The recommended tire size was: P185/65R14; and the Civic was equipped with tires of this size. The case vehicle's tire data are shown in the table below.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kpa	psi	kpa	psi	milli-meters	32nd of an inch			
LF	165	24	207	30	7	9	None	No	No
RF	159	23	207	30	7	9	None	No	No
LR	186	27	200	29	8	10	None	Yes	No
RR	159	23	200	29	8	10	None	No	No

Damage Classification: Based on the vehicle inspection the CDCs for the Civic were determined to be: **02-RPEW-4** (**50** degrees) for the right side impact with the front of the case vehicle, **03-RFLE-2** (**90** degrees) for the right front bumper corner impact with the case vehicle's right fender and **03-FZLS-1** (**80** degrees) for the impact with the county road sign post. The WinSMASH reconstruction program, damage algorithm, was used to reconstruct the Civic's Delta V for the initial impact. The Total, Longitudinal and Lateral Delta Vs are respectively: 41 km.p.h. (25.4 m.p.h.), -26.4 km.p.h (-16.4 m.p.h.) and -31.4 km.p.h. (-19.5 m.p.h.). The results appear low. The Civic was towed due to damage.

Civic's Occupants: According to the police crash report, the Civic's driver [39-year-old, (unknown race and ethnic origin) male] was not restrained by his manual, three-point, lap-and-shoulder, safety belt system. The police crash report indicated the driver was totally ejected from the vehicle during the crash and sustained a "B" (non-incapacitating-evident) injury and was transported by ambulance to a local hospital for treatment. Inspection of the Civic indicated the driver was ejected through the right front door. There was evidence of occupant contact on the right front door, and the latch and striker had separated during the crash allowing the door to open.

According to the police crash report, the Civic's back left passenger [6-year-old, (unknown race and ethnic origin) male] was restrained by his manual, three-point, lap-and-shoulder, safety belt system. The police crash report did not indicate an injury code for this passenger. However, the child was transported by medical helicopter to a children's hospital for treatment and, based on a local newspaper article, was placed on life support. There was severe intrusion into the back seat due to the impact with the case vehicle. The back left passenger most likely received his injuries from the intruding right side surface of the Civic (**Figure 20**).

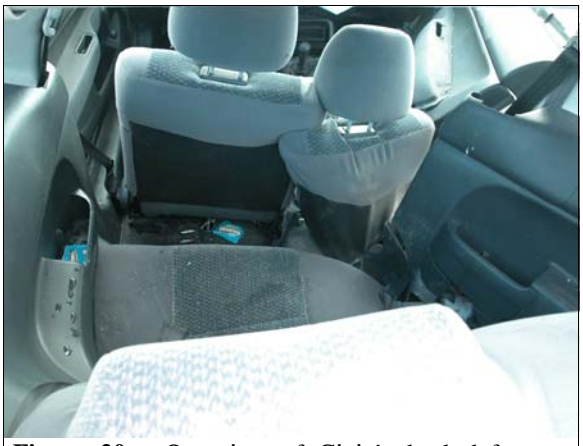
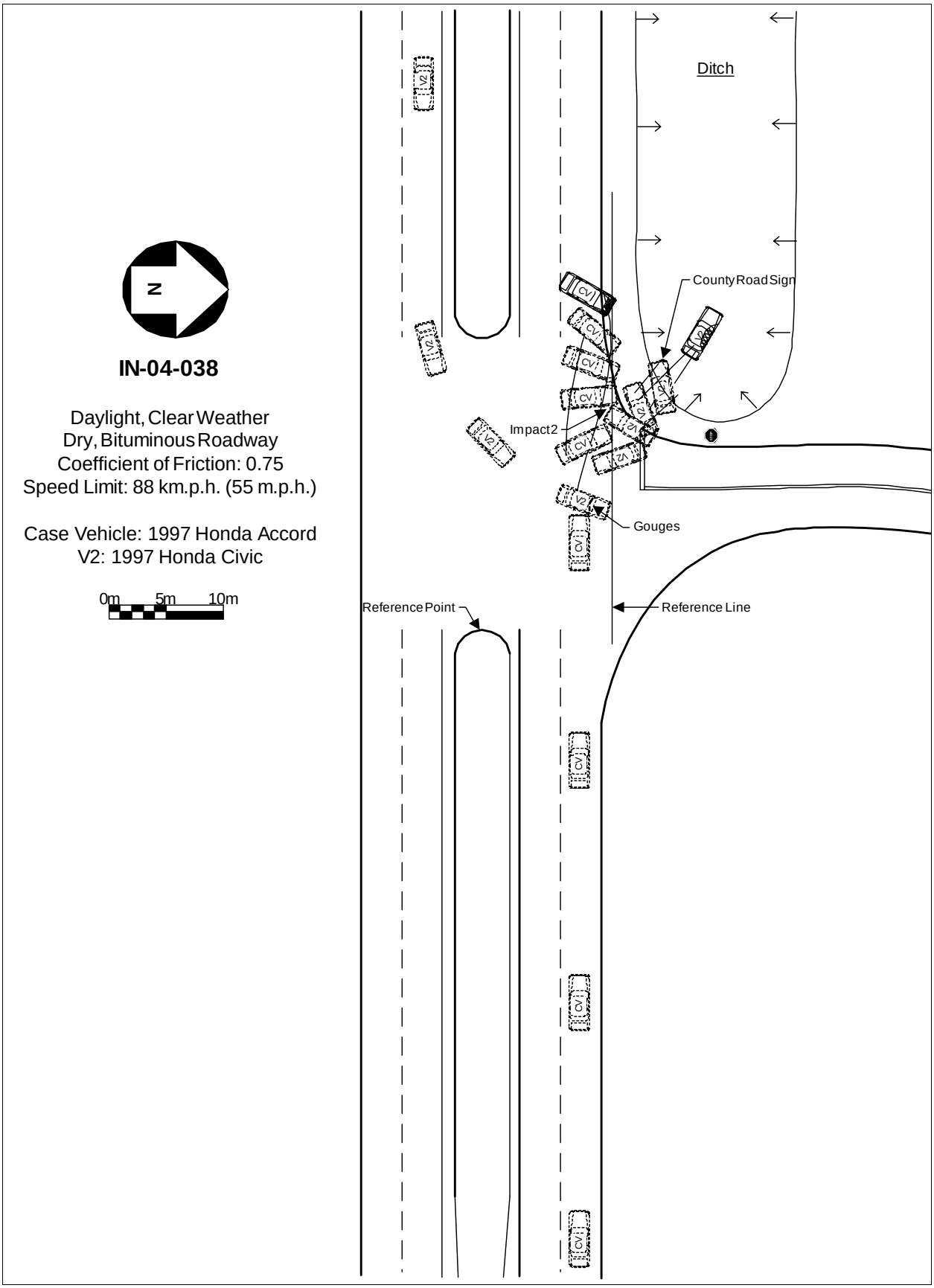


Figure 20: Overview of Civic's back left seat position and passenger compartment intrusion, photo taken through broken backlight


N
IN-04-038
Daylight, Clear Weather
Dry, Bituminous Roadway
Coefficient of Friction: 0.75
Speed Limit: 88 km.p.h. (55 m.p.h.)
Case Vehicle: 1997 Honda Accord
V2: 1997 Honda Civic
0m 5m 10m
Ditch
County Road Sign
Impact 2
Gouges
Reference Point
Reference Line