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ON-SITE CHILD SAFETY SEAT FATALITY INVESTIGATION

CASE NUMBER - IN-06-001

LOCATION - INDIANA

VEHICLE - 2002 DODGE NEON

CRASH DATE - December 2005

Submitted:

December 28, 2006

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Contract Number: DTNH22-01-C-07002

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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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15. <i>Supplementary Notes</i> On-site child safety seat fatality investigation involving a 2002 Dodge Neon equipped with manual safety belts, dual front air bag system and rear-facing child safety seat installed in the back center seating position.					
16. <i>Abstract</i> This report covers an on-site child safety seat investigation that involved a 2002 Dodge Neon (case vehicle) and a 1996 Chevrolet Cavalier (other vehicle), which were involved in a rear-end crash on a snow and ice covered, two-lane, state highway. This crash is of special interest because the case vehicle's back center passenger [6-month-old, White (non-Hispanic) male] was restrained in a child safety seat and sustained a fatal injury as a result of the crash. . The case vehicle was traveling east in the eastbound lane. The Chevrolet was traveling west in the westbound lane. The case vehicle's driver lost control of the vehicle on the snow and ice covered roadway and it rotated counterclockwise and entered the westbound lane of traffic. The back left of the case vehicle was impacted by the front of the Chevrolet. The case vehicle rotated clockwise and came to a final rest on the north roadside heading northwest. The Chevrolet also rotated clockwise and came to rest in the roadway heading north. The case vehicle's back center passenger was restrained in a rear-facing infant seat and sustained fatal injury. The driver was unrestrained and sustained fatal injury. The front right passenger was unrestrained and sustained a fractured left forearm.					
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This on-site investigation was brought to NHTSA's attention on or before January 4, 2006 through an on-line article by a local television station. This crash involved a 2002 Dodge Neon (case vehicle) and a 1996 Chevrolet Cavalier (other vehicle), which were involved in a rear-end crash on a snow and ice covered two-lane state highway. The crash occurred in December, 2005, at 5:44 p.m., in Indiana and was investigated by the applicable county sheriff department. This crash is of special interest because the case vehicle's back center passenger [6-month-old, White (non-Hispanic) male] was restrained in a child safety seat and sustained a fatal injury as a result of the crash. This contractor inspected both vehicles and interviewed the Chevrolet's right front passenger on January 18, 2006 and downloaded the data from the Chevrolet's event data recorder (EDR). The scene inspection was completed on January 19, 2006, and the interview with the case vehicle's front right passenger was completed on January 23, 2006. This report is based on the police crash report, interviews with both vehicle's front right passengers, scene and vehicle inspections, case vehicle's front right passengers medical records, back center passenger's medical records and autopsy records, occupant kinematic principles, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling east in the eastbound lane. The Chevrolet was traveling west in the westbound lane. The case vehicle's driver lost control of his vehicle on the snow and ice covered roadway and it rotated counterclockwise and entered the westbound lane of traffic. The front of the Chevrolet then impacted the back left of the case vehicle. The impact caused the Chevrolet's driver and front right passenger air bags to deploy. No air bags deployed in the case vehicle because the impact was to the back of the vehicle. The case vehicle rotated clockwise and came to a rest on the north roadside heading northwest. The Chevrolet also rotated clockwise and came to rest in the roadway heading north. It is unknown what avoidance actions the case vehicle's driver may have taken. At the time of the crash the light condition was dark and it was snowing.

The CDC for the case vehicle was determined to be: **06-BDEW-7 (170 degrees)**. The case vehicle sustained 145 centimeters (57.1 inches) of maximum residual crush to its back end occurring at C₁. The WinSMASH reconstruction program, damage only algorithm, calculated the case vehicle's Total, Longitudinal, and Lateral Delta Vs respectively as: 66.0 km.p.h. (41.0 m.p.h.), 65.0 km.p.h. (40.4 m.p.h.), and -11.5 km.p.h. (-7.1 m.p.h.). The case vehicle was towed due to damage.

The CDC for the Chevrolet was determined to be: **12-FDEW-3 (0 degrees)**. The Chevrolet sustained 67 centimeters (26.4 inches) of maximum residual crush to its front end occurring at C₄. The WinSMASH reconstruction program, damage only, algorithm calculated the Chevrolet's Total, Longitudinal, and Lateral Delta Vs respectively as: 66.0 km.p.h. (41.0 m.p.h.), -66 km.p.h. (-41.0 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The Chevrolet was towed due to damage.

The case vehicle's back center passenger [6-month-old, White (non-Hispanic) male [61 centimeters and 7 kilograms (24 inches, 15 pounds)] was restrained in a rear-facing infant seat

with five-point harness. The infant seat was manufactured by Graco on July 12, 2002, and was identified as model number 846MAC and model "Snug Ride". The infant seat and its base were broken and deformed in the crash due to the extensive crush to the back of the case vehicle and intrusion of the back seat. The infant was restrained in the infant seat by its five-point harness. The harness retainer clip was positioned at the infant's chest level. The infant seat was secured by the case vehicle's three-point, lap-and-shoulder safety belt. The retractor was switched to automatic locking mode and the belt pulled tightly to secure the infant seat base. The infant sustained numerous brain injuries due to impact with the intruding case vehicle's back seat, seat back. He was transported by ambulance to a hospital and pronounced dead.

The driver and front right passenger were not restrained by their manual, three-point, lap-and-shoulder safety belts. The driver was fatally injured and entrapped in the case vehicle. The front right passenger sustained a fractured left forearm due to contact with the center console. She was transported by ambulance to a hospital and treated and released.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which both vehicles were traveling was a two-lane, undivided, bituminous state highway, traversing in a general east-west direction. The westbound travel lane was 3.8 meters (12.5 feet) in width bordered by a bituminous shoulder 2.3 meters (7.5 feet) in width. The eastbound travel lane was 3.5 meters (in width bordered by a bituminous shoulder 1 meter in width. Roadway pavement markings consisted of solid white edge lines and a broken yellow center line. The speed limit was 89 k.m.p.h (55 m.p.h.). There was no regulatory speed limit sign posted near the crash site. At the time of the crash the light condition was dark, the atmospheric condition was snow, and the roadway was covered with snow and ice. Traffic density was light and the site of the crash was rural/agricultural. In addition, there was a residential driveway directly north of the crash site. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle was traveling east in the eastbound lane (**Figure 1**). The case vehicle's driver was intending to continue straight ahead. The Chevrolet was traveling west in the westbound lane (**Figure 2** below). The Chevrolet's driver was also intending to continue straight ahead. The case vehicle began to rotate counterclockwise on the snow and ice covered roadway and entered the westbound lane of traffic. It is unknown what avoidance actions the case vehicle's driver may have taken. The crash occurred in the westbound lane of the roadway (**Figure 3** below).

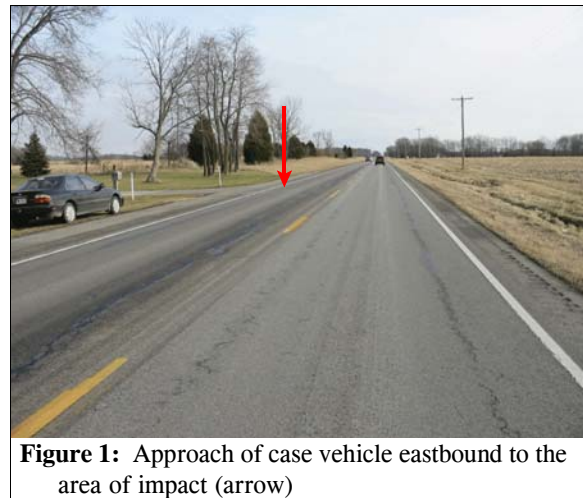


Figure 1: Approach of case vehicle eastbound to the area of impact (arrow)



Figure 2: Approach of the Chevrolet westbound to the area of impact (arrow)



Figure 3: View northeast from case vehicle's approach to area of impact (red arrow), blue arrow show final rest of Chevrolet, green arrow shows final rest of case vehicle



Figure 4: Left side view of damage to case vehicle from impact with Chevrolet, each increment on rods is 5 cm (2 in)



Figure 5: Left front overview of damage to Chevrolet from impact with case vehicle

Crash: The back left of the case vehicle (**Figure 4**) was impacted by the front of the Chevrolet (**Figure 5**). The impact caused the Chevrolet's driver and front right passenger air bags to deploy. No air bags deployed in the case vehicle because the impact was to the back of the case vehicle.

Post-Crash: As the crash progressed, the Chevrolet underrode the case vehicle and it rotated clockwise and came to a final rest on the north roadside with the front of the vehicle just off the edge of the shoulder (**Figure 3**). The Chevrolet also rotated clockwise. It came to final rest heading north with the front of the vehicle in the westbound lane and the rear of the vehicle in the eastbound lane (**Figure 3**).

CASE VEHICLE

The 2002 Dodge Neon was a front wheel drive, four-door sedan (VIN: 1B3ES26C52D-----) equipped with a 2.0L, I-4 engine and four-speed automatic transmission. The front seating row was equipped with bucket seats with adjustable head restraints, driver and front right passenger air bags and driver and front right passenger manual, three-point , lap-and-shoulder safety belt systems. The back seating row was equipped with a bench seat with folding backs, integral head restraints in the outboard seating positions and three-

point, lap-and-shoulder safety belts in all three back seating positions. Side impact air bags were an option but the case vehicle was not so equipped. In addition, four-wheel anti-lock brakes were an option, but it is unknown if the case vehicle was so equipped. The case vehicle’s wheelbase was 267 centimeters (105 inches). The case vehicle’s odometer reading at the time of the inspection could not be determined due to damage to the instrument panel. The interviewee (i.e., front right passenger) estimated the case vehicle had over 160,930 kilometers (100,000 miles) on it at the time of the crash.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle’s contact with the Chevrolet involved the back plane. The back bumper, bumper fascia, trunk lid, left rear tire, left side tail lamp assembly, and trunk were directly damaged and crushed forward. Direct damage began at the left rear bumper corner and extended 50 centimeters (19.7 inches) to the right along the back plane. The crash deformed the back end of the case vehicle so severely that the field L was only 7 centimeters (2.8 inches) in length. Only two C-positions were used to determine the case vehicle’s crush to its back end. Residual maximum crush was measured as 145 centimeters (57.1 inches) occurring at C₁. The table below shows the cash vehicle’s back 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	172	145	7	145	59	N/A	N/A	N/A	N/A	-16	0
in		67.7	57.1	2.8	57.1	23.2	N/A	N/A	N/A	N/A	-6.3	0.0

The case vehicle’s left side wheelbase was shortened 128 centimeters (50.3 inches) while the right side wheelbase was extended 8 centimeters (3.1 inches). There was induced damage to essentially the entire vehicle due to the severity of the crash. All glazing was disintegrated or cut by rescue personnel when they cut the roof off the vehicle to extricate the occupants (**Figure 6**).

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

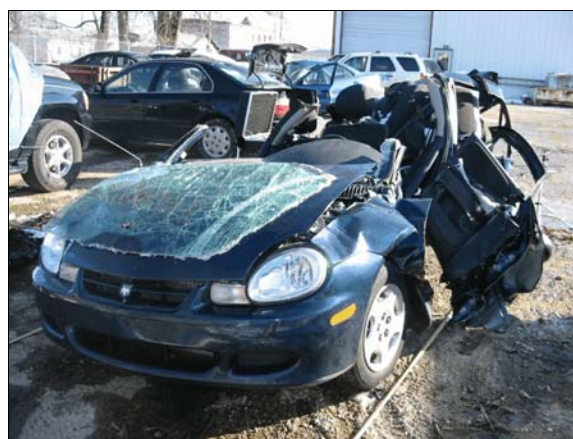


Figure 6: Left front view of damage to case vehicle from impact with the Chevrolet, roof cut off by rescue personnel

Tire	Measured Pressure		Recommend Pressure		Tread Depth		Damage	Restricted	Deflated
	kpa	psi	kpa	psi	milli-meters	32 nd of an inch			
LF	324	47	221	32	5	6	None	No	No
RF	0	0	221	32	3	4	Bead separation and rim damage	No	Yes
LR	0	0	221	32	2	3	Cut sidewalls	Yes	Yes
RR	0	0	221	32	3	4	Tire punctured	Yes	Yes

Vehicle Interior: Inspection of the case vehicle’s interior (**Figures 7 and 8 and Figure 9** below) revealed evidence of occupant contact on the interior surfaces. The steering wheel rim was completely collapsed and detached from the hub and the column was compressed and displaced upward (**Figure 10** below). This was a result of the back of the case vehicle being intruded by the Chevrolet and forcing the case vehicle’s driver forward into the steering assembly. The center instrument panel was also contacted, likely by the driver’s right knee. The case vehicle’s passenger compartment sustained numerous severe intrusions due to the severity of the crash. The primary intrusions involved the back left seat back, which intruded forward 86 centimeters (33.8 inches) while the seat cushion was forced upward 57 centimeters (22.4 inches) and forward 48 centimeters (19 inches). In addition, the left “C”-pillar intruded forward 70 centimeters (27.5 inches). Numerous other passenger compartment intrusions were identified and documented.



Figure 7: Left side view of case vehicle’s front seating row



Figure 8: Overview of steering wheel and instrument panel

Damage Classification: Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **06-BDEW-7 (170 degrees)**. The WinSMASH reconstruction program, damage only algorithm, was used to reconstruct the case vehicle’s Delta V. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 66.0 km.p.h. (41.0 m.p.h.), 65.0 km.p.h. (40.4 m.p.h.), and -11.5 km.p.h. (-7.1 m.p.h.). The crash fits the reconstruction model and the results appear reasonable. The case vehicle was towed due to damage.



Figure 9: Overview of case vehicle's back seating row



Figure 10: Left side overview of damage to case vehicle's steering wheel and steering column, air bag module torn open

AUTOMATIC RESTRAINT SYSTEM

The driver's air bag was located in the steering wheel hub, and the front right passenger air bag was located in the middle of the instrument panel. Neither these air bags deployed because the impact was to the back of the vehicle. However, due to the induced occupant contact to the steering wheel and instrument panel, both air bags were exposed in their modules.

CHILD SAFETY SEAT

The case vehicle's back center passenger was restrained in a rear-facing infant seat with five point harness. The infant seat (**Figure 11** and **Figure 12** below) was manufactured by Graco on July 12, 2002, and was identified as model number 846MAC and model "Snug Ride". The infant seat was a two-piece design with a plastic seat that snapped into a plastic base (**Figure 13** below), which was secured by the case vehicle's safety belt. The infant seat was designed to be used with or without the base. The infant seat was lined with a thin cloth covering the back and seat cushion. Warning labels in English and Spanish warned the owner regarding proper usage, and the prohibition of placing the infant seat in the front right seating position when an air bag is present. The same label designated the infant seat's weight and height limits as: 9 kilograms (20 pounds) and 66 centimeters (26 inches) respectively. There were also informational labels with schematics showing proper usage with and without vehicle safety belts, as well as securing the infant seat using a LATCH system.



Figure 11: Case vehicle's back center passenger's infant seat, right harness strap cut by rescue personnel

The infant was secured with a five-point harness, which buckled between the infant's legs. The harness clip was positioned at the infant's chest level. There were two harness strap slots for adjustment of the harness strap depending on the infant's height. The harness straps were threaded through the bottom slots. The right side harness strap was cut by rescue personnel to facilitate removal of the child and, as a result, the right harness strap latch plate was missing at the time of inspection.

The infant seat sustained large areas of stress and deformation to the entire plastic shell, as well as numerous cracks throughout the seat. Furthermore, the upper portion of the infant seat was twisted from the base in a left to right direction as a result of the crash. The carrier handle was broken off of the right side and the remainder was attached at the left side. The entire infant seat base sustained large areas of stress and was severely deformed and torn apart on its left side. In addition, there were scuff marks on the left side of the base. This was likely due to contact with the unoccupied booster seat in the left rear seating position. The damage to the infant seat indicated that it was compressed between the case vehicle's back seat, seat back and the front seat backs as the back seat, seat back was crushed forward during the crash.

CASE VEHICLE BACK CENTER PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's back center passenger [6-month-old, White (non-Hispanic) male [61 centimeters and 7 kilograms (24 inches, 15 pounds)] was seated in a reclined position in his rear-facing infant seat with both arms and legs contained within the infant seat.

The back center passenger was restrained in the infant seat by its five-point harness. The harness retainer clip was positioned at the infant's



Figure 12: Back of case vehicle's back center passenger's infant seat



Figure 13: Case vehicle's back center passenger's infant seat base

chest level. The infant seat was secured by the case vehicle's three-point, lap-and-shoulder safety belt (Figures 16 and 17). The retractor was switched to automatic locking mode and the belt pulled tightly to secure the infant seat base.

The case vehicle rotated counterclockwise just prior to the crash. As a result, the back center passenger most likely moved slightly to his right within his harness strap just prior to impact. The case vehicle's impact with the Chevrolet caused the case vehicle's back center passenger to continue rearward along a path opposite the case vehicle's 170 degree direction of principal force as the case vehicle decelerated. The passenger heavily loaded his harness straps causing a fractured sternum, two right rib fractures, bilateral lung contusions and a lacerated liver. His head was accelerated toward the back of the vehicle as the infant seat was squeezed between the intruding seat back and the front seat backs as they were displaced rearward due to loading by the driver and front right passenger. The back center passenger's head impacted the case vehicle's intruding back seat, seat back causing a nonanatomic brain injury, subdural hematoma, intraventricular hemorrhage, a lacerated corpus callosum and other brain injuries. In addition, the passenger loaded the back of his head into the infant seat's, seat back causing a complex basilar skull fracture. The passenger also sustained numerous contusions and abrasions. The roof was cut off the vehicle by rescue personnel and the back center passenger was removed from the vehicle by emergency medical personnel.



Figure 16: Case vehicle's back center safety belt cut by rescue personnel

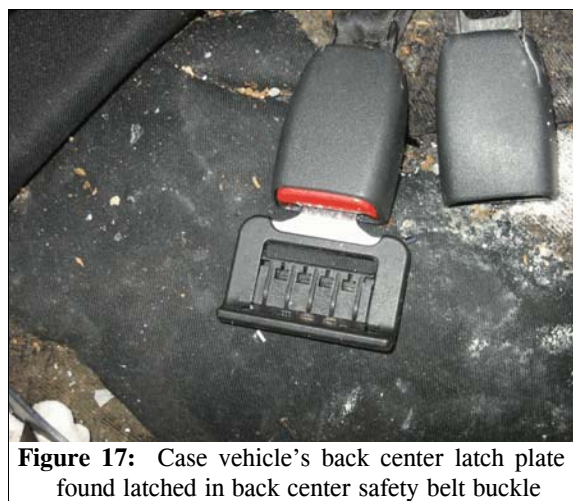


Figure 17: Case vehicle's back center latch plate found latched in back center safety belt buckle

CASE VEHICLE BACK CENTER PASSENGER INJURIES

The back center passenger was transported by ambulance to a hospital and was pronounced dead on arrival. The table below shows the back center passenger's injuries and injury mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury with loss of consciousness, unresponsive to painful stimuli, GCS = 3, pupils fixed and dilated	critical 160824.5,0	Seat back, back seat's	Probable	Emergency room records
2	Hematoma {ecchymoses}, subdural, thin, bilaterally over convexities <i>and</i> at base of brain, symmetrically, overlying brainstem	critical 140654.5,3	Seat back, back seat's	Probable	Autopsy
3 4	Swelling/edema cerebrum with diffuse flattening of gyri and narrowing of sulci; ventricles are slit-like, mild right-to-left shift, and decreased grey-white interface	serious 140660.3,1 140660.3,2	Seat back, back seat's	Probable	Autopsy
5	Hemorrhage, intraventricular, 4 th ventricle	severe 140678.4,9	Seat back, back seat's	Probable	Autopsy
6 7	Hemorrhage, subarachnoid, mild, diffusely overlying bilateral inferior temporal lobes, midbrain, pons, and anterior left occipital lobe	serious 140684.3,1 140684.3,2	Seat back, back seat's	Probable	Autopsy
8	Laceration corpus callosum, not further specified	severe 140688.4,9	Seat back, back seat's	Probable	Autopsy
9 10	Injury {hemorrhage perineural} bilateral optic nerves, slightly more severe on right and left	moderate 130699.2,1 130699.2,2	Seat back, back seat's	Probable	Autopsy
11	Injury {ecchymosis} tip of tongue	minor 243400.1,8	Seat back, back seat's	Probable	Autopsy
12	Contusions {ecchymoses} bilateral lungs, right greater than left, involving all right lobes	severe 441410.4,3	Child safety seat harness straps	Probable	Autopsy
13	Contusion {ecchymoses} anterior mediastinum	moderate 441804.2,4	Child safety seat harness straps	Probable	Autopsy
	Contusion {ecchymoses}, scattered, thymus	No code	Child safety seat harness straps	Probable	Autopsy
14	Laceration x 3, right lobe of liver, up to 3.0 cm with 40 ml of associated hemoperitoneum	moderate 541822.2,1	Child safety seat harness straps	Probable	Autopsy

Case Vehicle Back Center Passenger Injuries (Continued)

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Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
15	Fracture, linear, 2.8 cm (1.1 in), right posterior parietal vault, horizontally oriented	moderate 150402.2,1	Child safety seat's back top surface	Probable	Autopsy
16	Fracture, complex, basilar skull involving right anterior fossa, V-shaped, <i>and</i> right posterior cranial fossa, Y-shaped, diastatic, extending to foramen magnum	severe 150206.4,8	Seat back, back seat's	Probable	Autopsy
17	Fracture sternum at level of 2 nd and 3 rd ribs	moderate 450804.2,4	Child safety seat harness straps	Probable	Autopsy
18	Fracture right 5 th and 6 th ribs, posteriorly	moderate 450220.2,1	Child safety seat harness straps	Probable	Autopsy
19	Abrasions, superficial, scattered, scalp	minor 190202.1,0	Flying glass	Possible	Autopsy
20	Contusions {ecchymoses}, scattered, scalp	minor 190402.1,0	Flying glass	Possible	Autopsy
21	Contusions {ecchymoses}, 7 x 8 cm (2.8 x 3.1 in) subgaleal, left posterior parieto-occipital scalp	minor 190402.1,2	Child safety seat's back top surface	Probable	Autopsy
22	Laceration {cut}, very superficial, right upper temporal scalp	minor 190602.1,1	Child safety seat's back top surface	Probable	Autopsy
23	Abrasion, superficial, right eyebrow	minor 290202.1,7	Seat back, back seat's	Probable	Autopsy
24	Abrasion, superficial, right side of eye	minor 290202.1,1	Seat back, back seat's	Probable	Autopsy
25	Abrasions, superficial, V-shaped, left lower cheek	minor 290202.1,2	Seat back, back seat's	Probable	Autopsy
26	Abrasion, minor, chin-both sides, not further specified	minor 290202.1,8	Seat back, back seat's	Probable	Emergency room records
27	Contusion {ecchymoses}, L-shaped, right cheek	minor 290402.1,1	Seat back, back seat's	Probable	Autopsy
28	Contusion {ecchymoses}, V-shaped, left lower cheek	minor 290402.1,2	Seat back, back seat's	Probable	Autopsy
29	Contusion {ecchymoses} lower lip	minor 290402.1,8	Seat back, back seat's	Probable	Autopsy
30	Abrasion neck, not further specified	minor 390202.1,9	Child safety seat harness straps	Probable	Emergency room records
31	Contusion {ecchymoses} anterior neck, mild-to-moderate	minor 390402.1,5	Child safety seat harness straps	Possible	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
32	Contusion {ecchymosis} posterior neck overlying C ₃	minor 390402.1,6	Child safety seat's back top surface	Possible	Autopsy
33	Abrasions, multiple, central anterior chest	minor 490202.1,4	Child safety seat harness straps	Possible	Autopsy
34	Contusions {ecchymoses}, multiple, central anterior chest	minor 490402.1,4	Child safety seat harness straps	Possible	Autopsy
35	Contusions {ecchymoses} anterior left intercostal muscles 2 nd through 6 th	minor 490402.1,2	Child safety seat harness straps	Possible	Autopsy
36	Abrasions abdominal wall, left greater than right	minor 590202.1,2	Child safety seat harness straps	Possible	Autopsy
37	Contusions {ecchymoses} abdominal wall, left greater than right	minor 590402.1,2	Child safety seat harness straps	Possible	Autopsy
38 39	Contusions {ecchymoses} overlying bilateral hips	minor 590402.1,1 590402.1,2	Child safety seat harness straps	Possible	Autopsy
40	Contusion {ecchymoses} scattered back, right greater than left	minor 690402.1,0	Child safety seat's back surface	Possible	Autopsy
41	Contusion {ecchymoses} overlying posterior thoracic column, subpleural, near costovertebral junction	minor 690402.1,4	Child safety seat's back surface	Probable	Autopsy
42	Contusion {ecchymoses} right shoulder	minor 790402.1,1	Child safety seat harness straps	Probable	Autopsy
43	Contusion {ecchymoses} bilateral upper arms, medial and lateral	minor 790402.1,3	Seat back, back seat's	Probable	Autopsy
44	Contusion {ecchymoses} right upper buttock and sacral area	minor 890402.1,1	Child safety seat's back surface	Probable	Autopsy
45	Contusion {ecchymosis} left thigh, not further specified	minor 890402.1,2	Child safety seat harness straps	Probable	Autopsy

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash, the case vehicle's driver [25-year-old, White (non-Hispanic) male; 168 centimeters and 95 kilograms (66 inches, 210 pounds)] was seated in an upright position with his back against the seat back, his left foot on the floor, his right foot most likely on the brake, and both his hands on the steering wheel. His seat was adjusted to the middle track

position, and his seat back was adjusted to its upright position. The position of the tilt steering column could not be determined.

The case vehicle's driver was not restrained by his manual, three-point, lap-and-shoulder safety belt system. Inspection of the driver's safety belt webbing, "D"-ring, and latch plate revealed no evidence of loading. The interviewee also stated that the driver was not restrained.

It is unknown what actions the case vehicle driver may have taken to regain control of his rotating vehicle, but it is likely that due to the counterclockwise rotation, he moved slightly to his right just prior to impact. The case vehicle's impact with the Chevrolet caused the driver to initially move rearward and slightly to the right opposite the case vehicle's 170 degree direction of principal force as the case vehicle decelerated and he loaded his seat back. As the two vehicles reached maximum engagement, intrusion from the rear forced the case vehicle's driver forward into the steering assembly. It is also likely that he impacted his right knee on the center instrument panel. The driver's air bag did not deploy but the steering wheel was crushed and the housing surrounding the air bag was damaged and exposed the non-deployed air bag. The driver remained in his seat as the case vehicle came to final rest. He was entrapped in the vehicle and removed by rescue personnel.

CASE VEHICLE DRIVER INJURIES

The case vehicle's driver was pronounced dead at the crash scene. No post-mortem examination was performed. The table below shows the case vehicle driver's injury.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Laceration {cut} jugular vein, not further specified dead at scene	unknown 315999.7,0	Unknown contact mechanism	Unknown	Interviewee (other occupant)

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash, the case vehicle's front right passenger [22-year-old, White (non-Hispanic) female; 162 centimeters and 91 kilograms (64 inches and 200 pounds) was seated in an upright position. She stated that she believed she had just turned back toward the front after leaning into the back seat to tend to the infant just prior to the crash. Her seat was adjusted to the middle track position. The front right passenger was wearing glasses at the time of the crash.

The front right passenger was not restrained by her manual, three-point, lap-and-shoulder safety belt system. Inspection of the right front passenger's safety belt assembly showed no evidence of loading. In addition, the front right passenger stated she was not restrained.

The front right passenger most likely moved to the right due to the case vehicle's counterclockwise rotation just prior to the impact. The case vehicle's impact with the Chevrolet

caused the front right passenger to initially move rearward and slightly to the right opposite the case vehicle’s 170 degree direction of principal force as the case vehicle decelerated. The passenger loaded her seat back and her left forearm impacted the center console fracturing her left ulna. As the two vehicles reached maximum engagement, intrusion of the back seat back forced the center back infant seat into the passenger’s seat back and she moved forward. The passenger remained in her seat as the case vehicle rotated clockwise to its final rest position. She was removed from the case vehicle by rescue personnel.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The case vehicle’s front right passenger sustained a police reported “A” (incapacitating) injury and was transported by ambulance to a hospital and was treated and released. She made an unknown number of follow-up visits to her doctor. She was not working at the time of the crash. The table below shows the front right passenger’s injury and injury mechanism.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
	Complaint of pain to head, face, neck, and chest, without further information				Emergency room records
1	Fracture, comminuted, non-displaced, mid-shaft left ulna	serious 753204.3,2	Floor, center console	Probable	Emergency room records

OTHER VEHICLE

The 1996 Chevrolet Cavalier was a front wheel drive, four-door sedan (VIN: 3G1JC5240TS-----) equipped with a 2.2L, L4 engine and three-speed automatic transmission. The front seating row was equipped with bucket seats with adjustable head restraints manual, three-point, lap-and-shoulder safety belts and driver and front right passenger air bags, which deployed as a result this vehicle’s impact. The Chevrolet’s wheelbase was 265 centimeters (104.2 inches).

Exterior Damage: The Chevrolet’s impact with the case vehicle involved it’s entire frontal plane. The front bumper, bumper fascia, radiator, hood, right fender and right front door, right turn signal and headlamp assemblies, right A-pillar, and windshield were all directly damaged and crushed rearward. Direct damage began at the right front bumper corner and extended 79 centimeters (31.1 inches) along the bumper. The Field L was determined to be 83 centimeters (32.7 inches) and the residual maximum crush was measured as 67 centimeters (26.4 inches) occurring at C₄. The table below shows the Chevrolet’s front 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	79	67	83	0	30	56	67	60	57	13	0
in		31.1	26.4	32.7	0.0	11.8	22.0	26.4	23.6	22.4	5.1	0.0

The left wheelbase was extended 21 centimeters (8.3 inches) while the right wheelbase was shortened 22 centimeters (8.7 inches). There was induced damage to the left fender, left front door, right rear door, right roof rail and roof.

The Chevrolet's recommended tire size was P195/70R14; however, the vehicle was equipped with tires size P195/75R14. 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	32 nd of an inch			
LF	228	33	207	30	7	9	None	No	No
RF	0	0	207	30	6	7	Jammed into back of wheelhouse, tread likely punctured	Yes	Yes
LR	221	32	207	30	7	9	None	No	No
RR	207	30	207	30	8	10	None	No	No

Damage Classification: Based on the vehicle inspection, the CDC for the Chevrolet was determined to be: **12-FDEW-3 (0 degrees)**. The WinSMASH reconstruction program, damage only, algorithm, was used to reconstruct the Chevrolet's Delta Vs. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 66.0 km.p.h, (41.0 m.p.h.), -66 km.p.h. (-41.0 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h). The crash fits the reconstruction model and the results appear reasonable. The Chevrolet's EDR data indicated that the Chevrolet sustained a maximum longitudinal Delta V of -83.6 km.p.h. (-52 m.p.h.). The Chevrolet was towed due to damage.

Chevrolet's Occupants: According to the police crash report, the Chevrolet's driver [24-year-old, White (non-Hispanic) male]; and front right passenger [27-year-old, White (non-Hispanic) female] were restrained by their manual, three-point, lap-and-shoulder safety belt systems. Also, the back right passenger [7-year-old, White (non-Hispanic) male] was seated in a backless belt positioning booster seat and was restrained by the vehicle's manual, three-point, lap-and-shoulder safety belt system. The driver was not transported by ambulance to the hospital, but did sustain injuries as a result of this crash and was treated and released from a hospital emergency room later. The front right and back right passengers were both transported by ambulance to the hospital. The

Other Vehicle (Continued)

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front right passenger sustained a police reported "A" (incapacitating) injury and was hospitalized for one day. The back right passenger sustained a police reported "B" (non-incapacitating-evident) injury and was treated and released.

