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ON-SITE CHILD AIR BAG-RELATED FATALITY INVESTIGATION

CASE NUMBER - IN01-008
LOCATION - TEXAS
VEHICLE - 1995 PLYMOUTH NEON
CRASH DATE - April, 2001

Submitted:

March 13, 2003

Contract Number: DTNH22-94-D-17058

Prepared for:

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

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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

1. *Report No.* IN01-008	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* On-Site Child Air Bag-Related Fatality Investigation Vehicle - 1995 Plymouth Neon Location - Texas		5. *Report Date:* September 13, 2002 6. *Performing Organization Code*	
7. *Author(s)* Special Crash Investigations Team #2		8. *Performing Organization Report No.* Task #s 0254 and 0276	
9. *Performing Organization Name and Address* Transportation Research Center Indiana University 222 West Second Street Bloomington, Indiana 47403-1501		10. *Work Unit No. (TRAIS)* 11. *Contract or Grant No.* DTNH22-94-D-17058	
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation (NRD-32) 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: April, 2001 14. *Sponsoring Agency Code*	

15. *Supplementary Notes*
On-site air bag deployment investigation involving a 1995 Plymouth Neon, four-door sedan, with manual safety belts and dual front air bags, and a 1994 Chevrolet Beretta, two-door coupe

16. *Abstract*

This report covers an on-site investigation of an air bag deployment crash that involved a 1995 Plymouth Neon (case vehicle) and a 1994 Chevrolet Beretta (other vehicle). This crash is of special interest because the case vehicle's front right passenger (2-year-old female) sustained a fatal cervical injury from the deploying front right passenger air bag. The case vehicle was traveling east in the inside through lane of a seven-lane, divided, state highway and was approaching a controlled intersection.(i.e., both the east and westbound roadways had three through lanes and one opposing left-hand turn lane). The Chevrolet had been stopped in the left-hand turn lane of the intersecting five-lane, divided, city street (i.e., both the north and southbound roadways had two through lanes and one opposing left-hand turn lane). The Chevrolet traveled northward into the intersection, intending to turn left and travel westward. The crash occurred in the four-leg intersection of the two trafficways. The front of the case vehicle impacted the left side of the Chevrolet, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle's front right passenger was seated with her seat track in its middle position and was not restrained in either a child safety seat or using her available, active, three-point, lap-and-shoulder, safety belt system. She sustained, according to her medical records, a fatal laceration of her spinal cord with associated atlanto-occipital dislocation. In addition, her injuries included: a critical nonanatomic brain injury; severe cerebral edema; subarachnoid hemorrhage; adrenal contusion; teeth avulsion; abrasions to her posterior scalp, face, anterior neck, and right upper extremity; and contusions to her posterior scalp, face, anterior neck, and bilateral upper thighs. This occupant's primary cervical and brain injuries were caused by her contact with the case vehicle's front right passenger air bag. The case vehicle's driver (17-year-old female) was seated with her seat track located in its forward-most position, and the case vehicle was not equipped with a tilt steering wheel. She was not using her available, active, three-point, lap-and-shoulder, safety belt system and sustained, according to her interview, minor injuries which included: small lacerations (i.e., scratches, cuts) to her left cheek and on both of her hands, abrasions on her forearms, bilaterally, and a right thigh contusion. The case vehicle's back left (2-month-old male) and back right (1-year-old male) passengers were each seated in a child safety seat, but neither was restrained in their seat and neither was secured by the vehicle's available, active, three-point, lap-and-shoulder, safety belt system. The back bench seat was not adjustable. According to the interview with their mother (i.e., driver), they did not sustain any injuries as a result of this crash.

17. *Key Words* 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* 19	22. *Price* $10,500

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

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BACKGROUND

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This on-site investigation was brought to NHTSA's attention on April 11, 2001 by a newspaper article in the applicable city newspaper. This crash involved a 1995 Plymouth Neon (case vehicle) and a 1994 Chevrolet Beretta (other vehicle). The crash occurred in April, 2001, at 3:22 p.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's front right passenger [2-year-old, White (Hispanic) female] sustained a fatal cervical injury from the deploying front right passenger air bag. This contractor inspected the scene and vehicles on 12-13 April, 2001. This contractor interviewed the driver for the case vehicle on May 2, 2001. This report is based on the Police Crash Report, interviews with the case vehicle's driver and the investigating police officer, scene and vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling east in the inside through lane of a seven-lane, divided, state highway and was approaching a controlled intersection, intending to continue eastward.(i.e., both the east and westbound roadways had three through lanes and one opposing left-hand turn lane on both the east an west legs of the four-leg intersection). The Chevrolet had been stopped in the left-hand turn lane of the intersecting five-lane, divided, city street (i.e., both the north and southbound roadways had two through lanes and one opposing left-hand turn lane on both the north and south legs of the same four-leg intersection). The Chevrolet traveled northward into the intersection, intending to cross the eastbound roadway and turn left and travel west on the westbound roadway. The case vehicle's driver attempted to brake immediately prior to the crash. The crash occurred in the four-leg intersection of the two trafficways; see **CRASH DIAGRAM** at end.

The front of the case vehicle impacted the left side of the Chevrolet, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle continued northward a short distance while rotating approximately 20 degrees counterclockwise and came to rest in the intersection heading east-northeast. The Chevrolet rotated approximately 100 degrees counterclockwise before coming to rest in the intersection heading southwest.

The 1995 Plymouth Neon was a front wheel drive, four-door sedan (VIN: 1P3ES47C2SD------). The case vehicle was not equipped with anti-lock brakes. Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FDEW-1 (10)**. The WinSMASH reconstruction program, damage only algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 22.0 km.p.h. (13.7 m.p.h.), -21.7 km.p.h. (-13.5 m.p.h.), and -3.8 km.p.h. (-2.4 m.p.h.). These results appear reasonable to this contractor. The case vehicle was towed due to damage.

The case vehicle's contact with the Chevrolet involved the entire front. Direct damage began at the right bumper corner and extended to the left bumper corner, a measured distance of 130 centimeters (51.2 inches). Maximum crush was measured as 7 centimeters (2.8 inches) at C_1.

The case vehicle's wheelbase was unaltered from the crash. The case vehicle's front bumper fascia, grille, and front left headlight and turn signal assemblies were directly damaged and crushed rearward. The case vehicle's left front tire was physically restricted by the left fender; none of the tires were deflated. In addition, the hood and both fenders sustained induced damage. No obvious induced damage or remote buckling was noted to the remainder of the case vehicle's exterior.

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module's cover flap and the air bag fabric revealed that the cover flap opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flap. The driver's air bag was designed with three tethers, each approximately 6 centimeters in width. The driver's air bag had one vent port, approximately 3 centimeters (1.2 inches) in diameter, located at the 12 o'clock position. The deployed driver's air bag was round with diameter 62 centimeters (24.4 inches). An inspection of the driver's air bag fabric revealed that there was contact evidence (i.e., mascara, skin, and blood) readily apparent to the front right half of the air bag's fabric toward the 3 o'clock position.

The front right passenger's air bag was located in the top of the instrument panel. An inspection of the front right air bag module's cover flap and the air bag fabric revealed that the cover flap opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flap. The front right passenger's air bag was designed with four tethers, each approximately 7.5 centimeters (3.0 inches) in width. The front right air bag had one vent port, approximately 6 centimeters (2.4 inches) in diameter, located at the 12 o'clock position. The deployed front right air bag was rectangular with a height of approximately 64 centimeters (25.2 inches) and a width of approximately 47 centimeters (18.5 inches). An inspection of the front right passenger's air bag fabric revealed that there was contact evidence readily apparent on the front right air bag's fabric. Specifically there was an area of pink cloth transfer on the left side of the bottom surface, a smaller area of pink cloth transfer on the top surface to the right of the vent port, some black scuffs on the top surface to the left of the vent port, and finally, an obliquely oriented area containing both skin and pink cloth transfers on the air bag's front surface, left of the midline, and located between the middle and top of the front surface.

Inspection of the case vehicle's interior revealed two spider web contacts to the windshield's glazing, one from the front right passenger's head located underneath the front right sun visor and the other from the left corner of the rearview mirror, which was rotated into the glazing, possibly by the front right passenger. Furthermore, hair was present in the windshield's header on the right side and on the right sun visor. The windshield's header was indented from the impact of the front right passenger's head. In addition there were two knees scuffs to the glove box from contact by the unrestrained front right passenger. There was no evidence of intrusion to the case vehicle's interior, no evidence of compression to the energy absorbing shear capsules in the steering column, and no deformation to the steering wheel rim.

The child safety seat used by the case vehicle's back left passenger was a convertible infant carrier/rear facing child safety seat (RFCSS) manufactured by Cosco Products on January 11,

2000 and was identified by Model name "**Arriva #02-758**". The seat was designed to have a five-point harness attached to the shell, but at this investigator's inspection it was not equipped with any type of harness or shield. It was designed with three different shoulder height levels (dependent on height and size of child) that the shoulder harness webbing could be adjusted to fit through. The infant seat was designed with a pop-up carry handle which locks into place to use as a carrier or locks along the side when used as a Rear Facing Child Safety Seat. Although the infant child seat was only fifteen months old, it showed excessive wear-and-tear to the padding (i.e., torn and moldy) and plastic shell (deep scratches). There was visible evidence of stress to the plastic prongs protruding from underneath the base of the shell. These prongs appear to fit into a base (optional, not available) used to stabilize the seat when on a flat surface.

The child safety seat used by the case vehicle's back right passenger was a convertible child safety seat manufactured by Fischer-Price Products in 1984 and was identified by Model number "9100". The seat was equipped with a three-point harness with T-shield and two different shoulder height levels (dependent on height and size of child) that the webbing could be adjusted to fit through. In addition, the seat was designed with a retractor for the three-point harness and T-shield. There was only one slot for the buckle to connect the T-shield/harness portion between the child's legs. The inspection showed no visible evidence of stress to the metal braces or plastic shell of the back right passenger's forward facing child safety seat.

The 1994 Chevrolet Beretta was a front wheel drive, two-door coupe (VIN: 1G1LV15M7RY------). The Chevrolet was equipped with four-wheel, anti-lock brakes. Based on the vehicle inspection the CDC for the Chevrolet was determined to be: **10-LZEW-2 (290)** [maximum crush was measured as 22 centimeters (8.7 inches) between C_3 and C_4. The WinSMASH reconstruction program, damage only algorithm, was used on the Chevrolet's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 18.0 km.p.h. (11.2 m.p.h.), -9.0 km.p.h. (-5.6 m.p.h.), and +15.6 km.p.h. (+9.7 m.p.h.). The Chevrolet was towed due to damage.

Immediately prior to the crash the case vehicle's front right passenger [91centimeters and 14 kilograms (36 inches, 32 pounds)] was seated in a reclined posture with her back against the seat back, her legs out straight in front of her with her feet on the seat's cushion, and her right hand holding some food. The exact location of her left hand is unknown. At the time of the vehicle inspection, the front right seat track was located in its rearmost position, and the seat back was upright. According to the driver, however, she thought the front right seat track was closer to the middle position. Based on this contractor's interior inspection and the injuries sustained by the front right passenger, the seat was most likely in its middle position and had been moved by police or rescue personnel post-crash.

The case vehicle's front right passenger was neither restrained in a child safety seat nor using her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was no evidence of belt pattern bruising and/or abrasions to the front right passenger's body, and the inspection of the front right passenger's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

According to the case vehicle's driver, she braked immediately prior to the crash. As a result of this attempted avoidance maneuver and the nonuse of either a child safety seat or the available safety belts, the front right passenger moved forward and slightly upward just prior to impact. The case vehicle's impact with the Chevrolet enabled the front right passenger to continue forward, upward, and slightly rightward toward the **10** degree Direction of Principal Force as the case vehicle decelerated. As the air bag deployed her forward momentum combined with the air bag's upward deployment lifted her upwards into the windshield's glazing. In addition, her upper thighs contacted the glove box. Her legs were most likely forced somewhat apart by the bottom surface of the air bag resulting in the wide contact pattern on the glove box and the pink cloth transfers on the air bag's bottom surface. As the air bag continued to expand, her head and torso were lifted upwards into the windshield's header and sun visor. The front right passenger most likely contacted the lower right corner of the rearview mirror because there was hair found in the cracked mirror. This contact could have occurred by her left arm or by her lower torso as the case vehicle rotated approximately 20 degrees counterclockwise to final rest. According to her medical records and the case vehicle's driver (i.e., mother), at final rest the front right passenger was laying atop the dash between the windshield and the deployed front right passenger air bag.

The front right passenger was transported by ambulance to the hospital. She sustained critical injuries, was hospitalized, and subsequently pronounced dead seventeen hours post-crash. According to the interview with the case vehicle's driver and her medical records, the injuries sustained by the case vehicle's front right passenger included: a transection of her cervical spinal cord with accompanying atlanto-occipital dislocation; a critical nonanatomic brain injury; severe cerebral edema; subarachnoid hemorrhage; adrenal contusion; teeth avulsion; abrasions to her posterior scalp, face, anterior neck, and right upper extremity; and contusions to her posterior scalp, face, anterior neck, and bilateral upper thighs. This occupant's primary cervical and brain injuries were caused by her contact with the case vehicle's front right passenger air bag.

The case vehicle's driver [17-year-old, White (Hispanic) female; 152 centimeters and 63 kilograms (60 inches, 139 pounds)] was seated but leaning to her right and slightly bent over retrieving food from a bag, with her left foot on the floor, her right foot on the brake, and only her left hand on the steering wheel. Her seat track was located in its forward-most position, and the seat back was upright. The case vehicle was not equipped with a tilt steering wheel.

The case vehicle's driver was not using her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there were no self-reported belt pattern bruising and/or abrasions to the driver's body, and the inspection of the driver's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

The driver was transported by ambulance to the hospital. She sustained minor soft tissue injuries but refused treatment. According to her interview, the injuries sustained by the case vehicle's driver included: small lacerations (i.e., scratches, cuts) to her left cheek and on both of her hands, abrasions on her forearms, bilaterally, and a right thigh contusion.

The case vehicle's back left passenger [2-month-year-old, White (Hispanic) male; 56 centimeters and 6 kilograms (22 inches, 14 pounds)] was seated in an infant carrier in a reclined

posture with his back against the back of the carrier and his feet dangling over the front edge of the infant carrier. In addition, both of his hands were most likely in his lap. His seat track and seat back were not adjustable.

The case vehicle's back left passenger was neither restrained in his infant carrier nor was the infant carrier properly secured by the available, active, three-point, lap-and-shoulder, safety belt system. It should be noted that the infant carrier was also improperly positioned (i.e., facing forward). The back left passenger was checked out by EMS personal and released to a relative at the scene. According to the case vehicle's driver, the back left passenger did not sustain any injuries as a result of this crash.

The case vehicle's back right passenger [1-year-old, White (Hispanic) male; 71 centimeters and 10 kilograms (28 inches, 22 pounds)] was seated in a convertible child safety seat which was used in its forward facing configuration, and he was in a reclined posture. The child had his back against the child seat's back, his feet were hanging down over the front edge of the safety seat and the seat cushion of the vehicle's bench seat, and both hands were on his lap. His seat track and seat back were not adjustable. Based on witness statements and the on-scene photos, the unsecured convertible child safety seat, along with the unrestrained child, were found pinned between the back of the front right seat back and the back seat's right seat cushion.

The case vehicle's back right passenger was unrestrained in the convertible, forward facing, child safety seat. The child seat was not secured by the available, active, three-point, lap-and-shoulder, safety belt system. The back right passenger was also checked out by EMS personal and released to a relative at the scene. According to the case vehicle's driver, the back right passenger did not sustain any injuries as a result of this crash.

CRASH CIRCUMSTANCES

Figure 1: Case vehicle's eastward path of travel in inside through lane of eastbound roadway (case photo #00)

Figure 2: Chevrolet's northward path of travel in left-hand turn lane prior to four-leg intersection (case photo #05)

The case vehicle was traveling east in the inside through lane of a seven-lane, divided, state highway (**Figure 1**) and was approaching a controlled intersection, intending to continue eastward.(i.e., both the east and westbound roadways had three through lanes and one opposing left-hand turn lane on both the east an west legs of the four-leg intersection). The Chevrolet had been stopped in the left-hand turn lane (**Figure 2**) of the intersecting five-lane, divided, city street (i.e., both the north and southbound roadways had two through lanes and one opposing left-hand

turn lane on both the north and south legs of the same four-leg intersection). The Chevrolet traveled northward into the intersection, intending to cross the eastbound roadway and turn left and travel west on the westbound roadway. The case vehicle's driver attempted to brake immediately prior to the crash. The crash occurred in the four-leg intersection of the two trafficways; see **CRASH DIAGRAM** at end.

The case vehicle's state highway was straight and level at the area of impact. The pavement was concrete, and the width of the inside eastbound lane was 3.7 meters (12 feet). The eastbound roadway was bordered by barrier curbs with the curb on the north associated with a unprotected grassy median. The grassy median was approximately 5 meters (16.5 feet) wide, separating the east and westbound roadways. Pavement markings consisted of a single solid white lane line that separated the eastbound left-hand turn lane from the inside through lane while the three through lanes were divided by dashed white lines. In addition, no edge line was present on the north side while a solid white edge line was present just prior to the south curb. The estimated coefficient of friction was 0.70. Traffic controls consisted of three on-colors, pre-timed, horizontal mounted traffic control signals that were located on the southeast quadrant of the four-leg intersection. The statutory speed limit was 72 km.p.h. (45 m.p.h.). No regulatory speed limit sign was posted near the crash site.

Figure 3: Case vehicle's damaged front with contour gauge present (case photo #24)

Figure 4: Overhead view of case vehicle's frontal damage with contour gauge present (case photo #13)

The other vehicle's city roadway was straight and level at the area of impact. The pavement was concrete, and the width of the northbound left-hand turn lane was 3.7 meters (12 feet). The northbound roadway was bordered by barrier curbs with the curb on the west associated with a 1 meter (3.3 foot) raised paved median. Pavement markings consisted of a single solid white lane line that separated the outside northbound through lane from the inside through lane. No lines were used to separate the inside through lane from the left-hand turn lane. In addition, the west curb was painted yellow, and no edge lines were present. The estimated coefficient of friction was 0.70. Traffic controls consisted of three on-colors, pre-timed, horizontal mounted traffic control signals that were located on the northeast quadrant of the four-leg intersection. The statutory speed limit was 56 km.p.h. (35 m.p.h.). No regulatory speed limit sign was posted near the crash site.

At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the road pavement was dry. Traffic density was moderate and the site of the crash was urban commercial.

The front of the case vehicle (**Figures 3** and **4** above) impacted the left side of the Chevrolet (**Figure 5**), causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle continued northward a short distance while rotating approximately 20 degrees counterclockwise and came to rest in the intersection heading east-northeast (**Figure 6**). The Chevrolet rotated approximately 100 degrees counterclockwise before coming to rest in the intersection heading southwest (**Figure 7**).

Figure 5: On-scene view of Chevrolet's left side damage; Note: Chevrolet is heading southwest (case photo #70)

Figure 6: On-scene view looking west-southwest at case vehicle's final rest position (case photo #71)

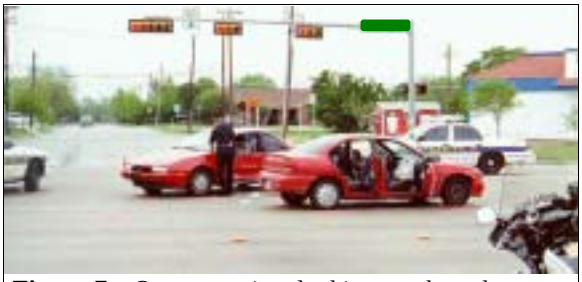


Figure 7: On-scene view looking north at the case vehicle (doors open) and the Chevrolet at final rest; Note: case vehicle is heading east-northeast (case photo #67)

CASE VEHICLE

The 1995 Plymouth Neon was a front wheel drive, five-passenger, four-door sedan VIN: 1P3ES47C2SD------) equipped with a 2.0L, I-4 engine and a three-speed automatic transmission. The case vehicle was not equipped with anti-lock brakes. Braking was achieved by a power-assisted, front disc and rear drum system. The case vehicle's wheelbase was 264 centimeters (104.0 inches), and the odometer reading at inspection was 173,362 kilometers (107,722 miles).

Inspection of the vehicle's interior revealed adjustable front bucket seats with adjustable head restraints; a non-adjustable back bench seat with integral head restraints for the back outboard seating positions; continuous loop, three-point, lap-and-shoulder, safety belt systems at the front and back outboard positions; and a two-point, lap belt system at the back center position. The front seat belt systems were equipped with manually operated, upper anchorage adjusters for the "D"-rings. Both the driver and front right passenger had their upper anchorage adjusters located in the down-most positions. The vehicle was equipped with knee bolsters for both the driver and front right passenger; no contact evidence was noted on either knee bolster. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a frontal air bag for the driver and front right passenger seating positions. Both frontal air bags deployed as a result of the case vehicle's frontal impact with the Chevrolet.

The case vehicle's contact with the Chevrolet involved the entire front. Direct damage began at the right bumper corner and extended to the left bumper corner, a measured distance of 130 centimeters (51.2 inches). In fact, the Chevrolet's left rear wheel made an imprint on the front right of the case vehicle's front bumper, depositing a tire scuff on the bumper and a slight tear in the bumper fascia from the Chevrolet's left rear wheel well (**Figure 8**). Maximum crush was measured as 7 centimeters (2.8 inches) at C_1 (**Figure 4** above). The case vehicle's wheelbase was unaltered from the crash. The case vehicle's front bumper fascia, grille, and front left headlight and turn signal assemblies were directly damaged and crushed rearward. The case vehicle's left front tire was physically restricted by the left fender; none of the tires were deflated. In addition, the hood and both fenders sustained induced damage. No obvious induced damage or remote buckling was noted to the remainder of the case vehicle's exterior.

Figure 8: Elevated view of case vehicle's frontal damage with contour gauge present on bumper; Note: black scuffs toward front right corner are from Chevrolet's left rear tire (case photo #12)

Figure 9: Exterior view of impacts to case vehicle's right front windshield glazing (case photo #25)

Inspection of the case vehicle's interior revealed two spider web contacts to the windshield's glazing (**Figure 9**), one from the front right passenger's head located underneath the front right sun visor (**Figure 10** and **Figure 11** below) and the other from the left corner of the rearview mirror, which was rotated into the glazing, possibly by the front right passenger. Furthermore, hair was present in the windshield's header on the right side and on the right sun visor

Figure 10: Vertical view of case vehicle's deployed front right passenger air bag; Note: pink cloth transfer to air bag's front surface and contacts to windshield's glazing and header, and sun visor (case photo #37)

(**Figure 12**). The windshield's header was indented from the impact of the front right passenger's head. In addition there were two knees scuffs to the glove box (**Figure 13**) from contact by the unrestrained front right passenger. There was no evidence of intrusion to the case vehicle's interior, no evidence of compression to the energy absorbing shear capsules in the steering column, and no deformation to the steering wheel rim.

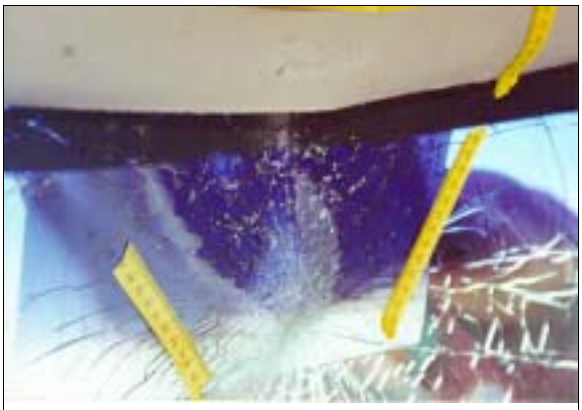


Figure 11: Close-up of front right passenger's head contact to case vehicle's right windshield, header, and sun visor (case photo #39)

Figure 12: Case vehicle's contacted front right windshield header toward left side of front right sun visor showing hair and indentation in header (case photo #38)

Figure 13: Contacts to case vehicle's glove box by front right passenger's thighs (case photo #35)

Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FDEW-1 (10)**. The WinSMASH reconstruction program, damage only algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 22.0 km.p.h. (13.7 m.p.h.), -21.7 km.p.h. (-13.5 m.p.h.), and -3.8 km.p.h. (-2.4 m.p.h.). These results appear reasonable to this contractor. The case vehicle was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a Supplemental Restraint System (SRS) that contained frontal air bags at the driver and front right passenger positions. Both frontal air bags deployed as a result of the frontal impact with the Chevrolet. The case vehicle's driver air bag was located in the steering wheel hub. The module cover consisted of a single trapezoidal, curvilinear, cover flap made of thick vinyl with overall dimensions of 19 centimeters (7.5 inches) at the top horizontal seam, 21.5 centimeters (8.5 inches) at the bottom horizontal seam, and 14 curvilinear centimeters (5.5 inches) vertically. There was approximately 5 centimeters (2.0 inches) from the apex of the curve to the top horizontal seam and 9 centimeters (3.5 inches) to the bottom horizontal seam. An inspection of the air bag module's cover flap and the air bag fabric revealed that the cover flap opened at the designated tear points, and there was no evidence of damage

during the deployment to the air bag or the cover flap. The driver's air bag was designed with three tethers, each approximately 6 centimeters in width. The driver's air bag had one vent port, approximately 3 centimeters (1.2 inches) in diameter, located at the 12 o'clock position. The deployed driver's air bag was round with diameter 62 centimeters (24.4 inches). An inspection of the driver's air bag fabric revealed that there was contact evidence (i.e., mascara, skin, and blood) readily apparent to the front right half of the air bag's fabric toward the 3 o'clock position (**Figures 14** and **15**).

Figure 14: Case vehicle's driver air bag showing area of contact evidence (skin, mascara, and blood) highlighted (case photo #29)

Figure 15: Close-up of contact evidence (i.e., skin, mascara, and blood) on case vehicle's driver air bag (case photo #30a)

The front right passenger's air bag was located in the top of the instrument panel. There was a single, essentially rectangular, modular cover flap. The cover flap was made of a thick vinyl over a thick cardboard type frame. The flap's dimensions were 34 centimeters (13.4 inches) at the lower horizontal seam and 15.5 centimeters (6.1 inches) along both vertical seams. The profile of the case vehicle's instrument panel resulted in a 3 centimeter (1.2 inch) setback of the leading edge of the cover flap relative to the protruding right instrument panel. An inspection of the front right air bag module's cover flap and the air bag fabric revealed that the cover flap opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flap. The front right passenger's air bag was designed with four tethers, each approximately 7.5 centimeters (3.0 inches) in width. The front right air bag had one vent port, approximately 6 centimeters (2.4 inches) in diameter, located at the 12 o'clock position. The deployed front right air bag was rectangular with a height of approximately 64 centimeters (25.2 inches) and a width of approximately 47 centimeters (18.5 inches). An inspection of the front right passenger's air bag fabric revealed that there was contact evidence readily apparent on the front right air bag's fabric. Specifically there was an area of pink cloth transfer on the left side of the bottom surface (**Figure 16**), a smaller area of pink cloth transfer on the top surface to the right of the

Figure 16: Case vehicle's deployed front right passenger air bag showing more pink cloth transfers on bottom surface (case photo #37a)

vent port, some black scuffs on the top surface to the left of the vent port, and finally, an obliquely oriented area containing both skin and pink cloth transfers on the air bag's front surface, left of the midline, and located between the middle and top of the front surface (**Figure 10** above).

CHILD SAFETY SEATS

The child safety seat used by the case vehicle's back left passenger was a convertible infant carrier/rear facing child safety seat (RFCSS) manufactured by Cosco Products on January 11, 2000 and was identified by Model name "**Arriva #02-758**". The seat was designed to have a five-point harness attached to the shell, but at this investigator's inspection it was not equipped with any type of harness or shield (**Figure 17**). It was designed with three different shoulder height levels (dependent on height and size of child) that the shoulder harness webbing could be adjusted to fit through. The infant seat was designed with a pop-up carry handle which locks into place to use as a carrier or locks along the side when used as a Rear Facing Child Safety Seat. Although the infant child seat was only fifteen months old, it showed excessive wear-and-tear to the padding (i.e., torn and moldy) and plastic shell (deep scratches). There was visible evidence of stress to the plastic prongs protruding from underneath the base of the shell (**Figure 18**). These prongs appear to fit into a base (optional, not available) used to stabilize the seat when on a flat surface.

Figure 17: Overhead view of Cosco Arriva infant carrier seat that contained case vehicle's back left passenger; Note: absence of five-point harness (case photo #46)

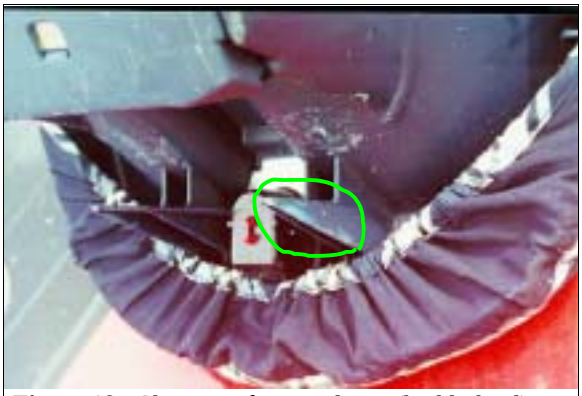


Figure 18: Close-up of stressed area (highlighted) on underneath surface of Cosco Arriva infant carrier that contained case vehicle's back left passenger; Note: heavy scratching directly above stressed area (case photo #45)

The child safety seat used by the case vehicle's back right passenger was a convertible child safety seat manufactured by Fischer-Price Products in 1984 and was identified by Model number "**9100**" (**Figure 19** below). The seat was equipped with a three-point harness with T-shield and two different shoulder height levels (dependent on height and size of child) that the webbing could be adjusted to fit through. In addition, the seat was designed with a retractor for the three-point harness and T-shield. There was only one slot for the buckle to connect the T-shield/harness portion between the child's legs. The inspection showed no visible evidence of

stress to the metal braces or plastic shell of the back right passenger's forward facing child safety seat.

Figure 19: Frontal view of Fischer-Price convertible child safety seat used by case vehicle's back right passenger (case photo #51)

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's front right passenger [91centimeters and 14 kilograms (36 inches, 32 pounds)] was seated in a reclined posture with her back against the seat back, her legs out straight in front of her with her feet on the seat's cushion, and her right hand holding some food. The exact location of her left hand is unknown. At the time of the vehicle inspection, the front right seat track was located in its rearmost position, and the seat back was upright. According to the driver, however, she thought the front right seat track was closer to the middle position. Based on this contractor's interior inspection and the injuries sustained by the front right passenger, the seat was most likely in its middle position and had been moved by police or rescue personnel post-crash.

The case vehicle's front right passenger was neither restrained in a child safety seat nor using her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was no evidence of belt pattern bruising and/or abrasions to the front right passenger's body, and the inspection of the front right passenger's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

According to the case vehicle's driver, she braked immediately prior to the crash. As a result of this attempted avoidance maneuver and the nonuse of either a child safety seat or the available safety belts, the front right passenger moved forward and slightly upward just prior to impact. The case vehicle's impact with the Chevrolet enabled the front right passenger to continue forward, upward, and slightly rightward toward the **10** degree Direction of Principal Force as the case vehicle decelerated. As the air bag deployed her forward momentum combined with the air bag's upward deployment lifted her upwards into the windshield's glazing (**Figures 10** and **11** above). In addition, her upper thighs contacted the glove box (**Figure 13** above). Her legs were most likely forced somewhat apart by the bottom surface of the air bag resulting in the wide contact pattern on the glove box and the pink cloth transfers on the air bag's bottom surface. As the air bag continued to expand, her head and torso were lifted upwards into the windshield's header and sun visor (**Figure 12** above and **Figures 20** and **21** below). The front right passenger most likely contacted the lower right corner of the rearview mirror because there was hair found in the cracked mirror. This contact could have occurred by her left arm or by her lower torso as

the case vehicle rotated approximately 20 degrees counterclockwise to final rest. According to her medical records and the case vehicle's driver (i.e., mother), at final rest the front right passenger was laying atop the dash between the windshield and the deployed front right passenger air bag.

Figure 20: On-scene view from driver's seat showing dislodged rear view mirror and contacts to right windshield's glazing and header (case photo #69)

Figure 21: On-scene close-up of evidence (i.e., hair and indentation) on case vehicle's right windshield header from contact by front right passenger (case photo #68)

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger was transported by ambulance to the hospital. She sustained critical injuries, was hospitalized, and subsequently pronounced dead seventeen hours post-crash. According to the interview with the case vehicle's driver and her medical records, the injuries sustained by the case vehicle's front right passenger included: a transection of her cervical spinal cord with accompanying atlanto-occipital dislocation; a critical nonanatomic brain injury; severe cerebral edema; subarachnoid hemorrhage; adrenal contusion; teeth avulsion; abrasions to her posterior scalp, face, anterior neck, and right upper extremity; and contusions to her posterior scalp, face, anterior neck, and bilateral upper thighs. This occupant's primary cervical and brain injuries were caused by her contact with the case vehicle's front right passenger air bag.

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; no response to painful stimuli; GCS = 3; pupils fixed and dilated; absent cornea, gag, cough reflexes, and negative cold calorics {exam consistent with brain death}; with complications of DIC (disseminated intravascular coagulation) and development of diabetes insipidus	160824.5 critical	Air bag, front right passenger's	Certain	Hospitalization records

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
2	Edema, cerebral, severe, diffuse with complete effacement of ventricles [Aspect = Unknown]	140666.5 critical	Air bag, front right passenger's	Certain	Hospitalization records
3	Hemorrhage, subarachnoid, not further specified [Aspect = Unknown]	140684.3 serious	Air bag, front right passenger's	Probable	Hospitalization records
4	Contusion {hematoma} adrenal gland, not further specified [Aspect = Unknown]	540210.1 minor	Air bag, front right passenger's	Probable	Hospitalization records
5	Laceration {transection} cervical spinal cord with atlanto-occipital dislocation {dissociation}	640274.6[1] untreatable	Air bag, front right passenger's	Certain	Hospitalization records
6	Avulsed teeth in bottom, not further specified	251406.1 minor	Windshield's glazing, front right	Probable	Emergency room records
7	Abrasion posterior scalp {occiput}, not further specified	190202.1 minor	Windshield roof header, front right passenger's	Certain	Emergency room records
8	Contusion posterior scalp {occiput}, not further specified	190402.1 minor	Windshield roof header, front right passenger's	Certain	Emergency room records
9	Abrasions face, not further specified	290202.1 minor	Air bag, front right passenger's	Probable	Emergency room records
10	Contusions face, not further specified	290402.1 minor	Windshield's glazing, front right	Possible	Emergency room records
11	Abrasions anterior neck, not further specified	390202.1 minor	Air bag, front right passenger's	Certain	Emergency room records
12	Contusion neck, not further specified	390402.1 minor	Air bag, front right passenger's	Certain	Emergency room records
13	Abrasion, small, right upper extremity, not further specified	790202.1 minor	Air bag, front right passenger's	Possible	Emergency room records
14	Contusion {bruising} on right upper thigh	890402.1 minor	Glove box door	Probable	Emergency room records
15	Contusion {bruising} on left thigh, not further specified	890402.1 minor	Glove box door	Probable	Emergency room records

[1] The choice of injury code is difficult because the NASS CDS Injury Coding manual presumes that one knows whether there was a complete or an incomplete cord syndrome. The only available medical record that specifically addressed this lesion was a Death Summary, and the syndrome issue was not discussed. In the absence of protocol, this contractor chooses to assume that the syndrome was complete.

The case vehicle's driver [17-year-old, White (Hispanic) female; 152 centimeters and 63 kilograms (60 inches, 139 pounds)] was seated but leaning to her right and slightly bent over retrieving food from a bag, with her left foot on the floor, her right foot on the brake, and only her left hand on the steering wheel. Her seat track was located in its forward-most position, and the seat back was upright. The case vehicle was not equipped with a tilt steering wheel.

The case vehicle's driver was not using her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there were no self-reported belt pattern bruising and/or abrasions to the driver's body, and the inspection of the driver's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

According to the case vehicle's driver, she braked immediately prior to the crash. As a result of this attempted avoidance maneuver and the nonuse of her available safety belts, she moved forward and slightly upward just prior to impact. The case vehicle's impact with the Chevrolet enabled the driver to continue forward, upward, and slightly rightward toward the **10** degree Direction of Principal Force as the case vehicle decelerated. As a result, she contacted her deploying air bag, depositing makeup, skin, and blood along the right side of the air bag's fabric toward the 3 o'clock position (**Figure 15** above). As the air bag continued to deploy, the case vehicle's driver was most likely driven backwards and slightly leftwards into the center of her seat back as the case vehicle rotated approximately 20 degrees counterclockwise to final rest. According to the case vehicle's driver, at final rest she remained in her seat, but leaning to her right side.

CASE VEHICLE DRIVER INJURIES

The driver was transported by ambulance to the hospital. She sustained minor soft tissue injuries but refused treatment. According to her interview, the injuries sustained by the case vehicle's driver included: small lacerations (i.e., scratches, cuts) to her left cheek and on both of her hands, abrasions on her forearms, bilaterally, and a right thigh contusion.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Laceration {scratch} left cheek	290600.1 minor	Air bag, driver's	Certain	Interviewee (same person)
2	Abrasions bilateral forearms, not further specified	790202.1 minor	Air bag, driver's	Probable	Interviewee (same person)
3	Lacerations {cuts} right wrist, not further specified	790600.1 minor	Air bag, driver's	Probable	Interviewee (same person)
4	Laceration {cut} left finger, not further specified	790600.1 minor	Air bag, driver's	Probable	Interviewee (same person)
5	Contusion {bruise} right thigh, not further specified	890402.1 minor	Steering wheel rim	Probable	Interviewee (same person)

The case vehicle's back left passenger [2-month-year-old, White (Hispanic) male; 56 centimeters and 6 kilograms (22 inches, 14 pounds)] was seated in an infant carrier in a reclined posture with his back against the back of the carrier and his feet dangling over the front edge of the infant carrier. In addition, both of his hands were most likely in his lap. His seat track and seat back were not adjustable.

The case vehicle's back left passenger was neither restrained in his infant carrier nor was the infant carrier properly secured by the available, active, three-point, lap-and-shoulder, safety belt system (**Figure 22**). It should be noted that the infant carrier was also improperly positioned (i.e., facing forward). In addition, the inspection of the vehicle's back left seat belt webbing and latch plate showed no evidence of usage during this crash.

Figure 22 On-scene view from left of case vehicle's back seat showing unsecured child safety seats (case photo #66)

According to the case vehicle's driver, she braked immediately prior to the crash. As a result of this attempted avoidance maneuver and the nonuse of either the infant child seat's restraints or the vehicle's available safety belts, the back left passenger moved forward and slightly upward just prior to impact. The case vehicle's impact with the Chevrolet enabled the back left passenger to continue forward, upward, and slightly rightward toward the **10** degree Direction of Principal Force as the case vehicle decelerated. As a result, the infant child safety seat and its contained occupant struck the back of the driver's seat back. As the case vehicle rotated approximately 20 degrees counterclockwise to final rest, the child separated from the child seat, and the child fell to the floor between the driver's seat back and the back seat's cushion. According to witnesses, at final rest, he was found laying on the floor behind the driver's seat on his back under some blankets.

CASE VEHICLE BACK LEFT PASSENGER INJURIES

The back left passenger was checked out by EMS personal and released to a relative at the scene. According to the case vehicle's driver, the back left passenger did not sustain any injuries as a result of this crash.

CASE VEHICLE BACK RIGHT PASSENGER KINEMATICS

The case vehicle's back right passenger [1-year-old, White (Hispanic) male; 71 centimeters and 10 kilograms (28 inches, 22 pounds)] was seated in a convertible child safety seat which was used in its forward facing configuration, and he was in a reclined posture. The child had his back against the child seat's back, his feet were hanging down over the front edge of the safety seat and the seat cushion of the vehicle's bench seat, and both hands were on his lap. His seat track and seat back were not adjustable. Based on witness statements and the on-scene photos, the unsecured

convertible child safety seat, along with the unrestrained child, were found pinned between the back of the front right seat back and the back seat's right seat cushion (**Figure 23**).

Figure 23: Case vehicle's back seat viewed from right showing unsecured child safety seats; Note: Fischer-Price seat contacted front right seat back (case photo #49)

The case vehicle's back right passenger was unrestrained in the convertible, forward facing, child safety seat. The child seat was not secured by the available, active, three-point, lap-and-shoulder, safety belt system. In addition, the inspection of the vehicle's back right seat belt webbing and latch plate showed no evidence of usage during this crash.

According to the case vehicle's driver, she braked immediately prior to the crash. As a result of this attempted avoidance maneuver and the nonuse of either the convertible child seat's restraints or the vehicle's available safety belts, the back right passenger moved forward and slightly upward just prior to impact. The case vehicle's impact with the Chevrolet enabled the back right passenger to continue forward, upward, and slightly rightward toward the **10** degree Direction of Principal Force as the case vehicle decelerated. As a result, the convertible child safety seat and its contained occupant struck the back of the front right passenger's seat back. As the case vehicle rotated approximately 20 degrees counterclockwise to final rest, child seat and child dropped downward onto the floor between the front right passenger's seat back and the back seat's cushion. Once again, based upon the available evidence, at final rest he was pinned in the child safety seat between the seat back and the back seat's cushion.

CASE VEHICLE BACK RIGHT PASSENGER INJURIES

The back right passenger was also checked out by EMS personal and released to a relative at the scene. According to the case vehicle's driver, the back right passenger did not sustain any injuries as a result of this crash.

OTHER VEHICLE

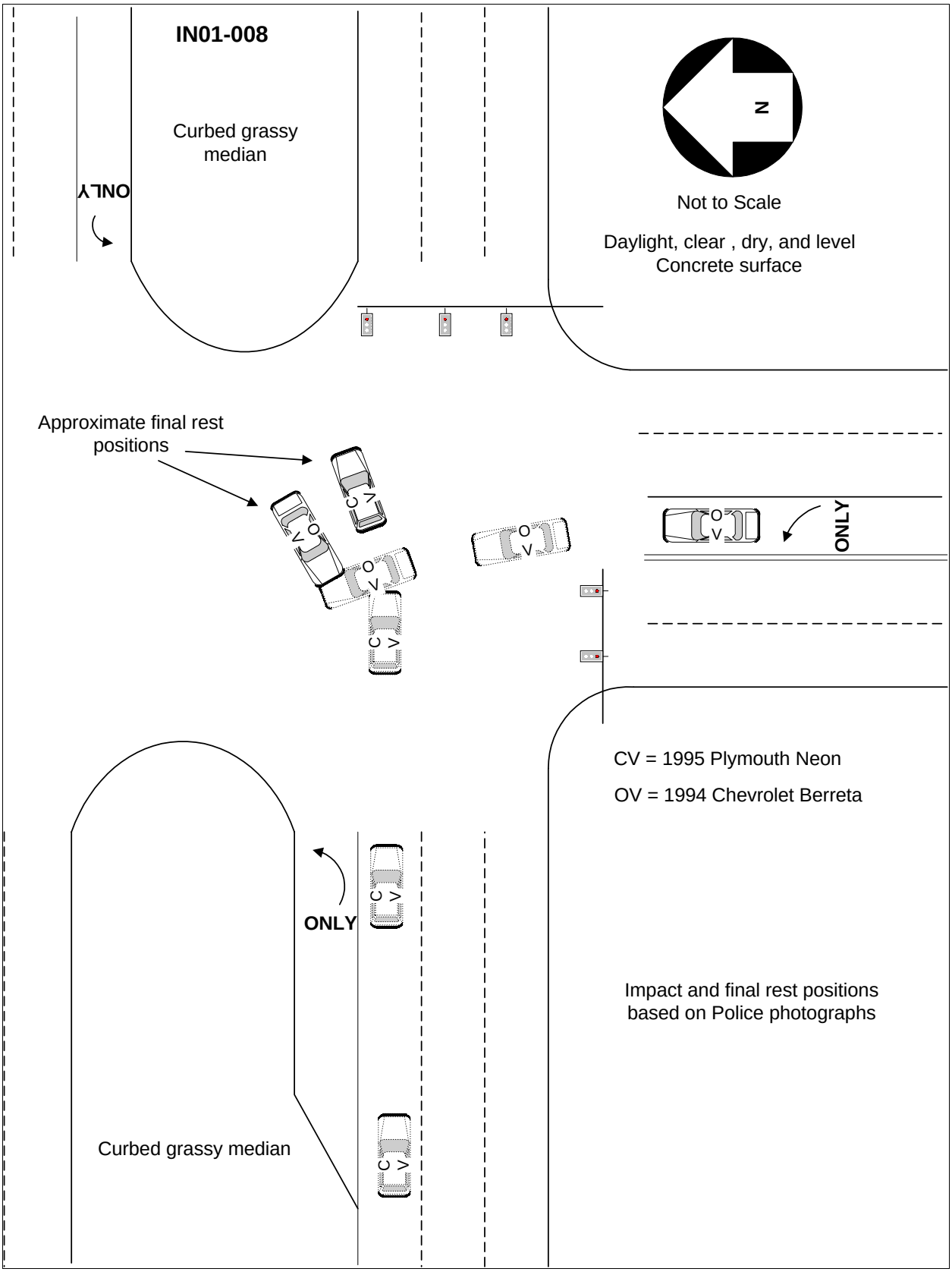
The 1994 Chevrolet Beretta was a front wheel drive, five-passenger, two-door coupe (VIN: 1G1LV15M7RY------) equipped with a 3.1L, V-6 engine and a three-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum, four-wheel, anti-lock system. The case vehicle's wheelbase was 263 centimeters (103.4 inches), and the odometer reading was not recorded.

Figure 24: Chevrolet's damaged left side; Note: tape indicates six C-measurements (case photo #58)

Based on the vehicle inspection the CDC for the Chevrolet was determined to be: **10-LZEW-2 (290)** [maximum crush was measured as 22 centimeters (8.7 inches) between C_3 and C_4–**Figure 24** above and **Figures 25** and **26**]. The WinSMASH reconstruction program, damage only algorithm, was used on the Chevrolet's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 18.0 km.p.h. (11.2 m.p.h.), -9.0 km.p.h. (-5.6 m.p.h.), and +15.6 km.p.h. (+9.7 m.p.h.). These results appear reasonable to this contractor. The Chevrolet was towed due to damage.

Figure 25: Overhead view of Chevrolet's left side damage and stringline placement case photo #61)

Figure 26: Chevrolet's left side damage viewed from front along stringline (case photo #62)


IN01-008
Curbed grassy median
ONLY
N
Not to Scale
Daylight, clear , dry, and level
Concrete surface
Approximate final rest positions
ONLY
CV = 1995 Plymouth Neon
OV = 1994 Chevrolet Berreta
ONLY
Curbed grassy median
Impact and final rest positions based on Police photographs