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ON-SITE AIR BAG INVESTIGATION

CASE NUMBER - IN97-033
LOCATION - TEXAS
VEHICLE - 1997 CHEVROLET CAMARO Z28
CRASH DATE - May, 1997

Submitted:

October 21, 1998
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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 an air bag deployment crash that involved a 1997 Chevrolet Camaro Z28 (case vehicle), a 1981 Ford LTD Crown Victoria (1st other vehicle), and a 1991 Chevrolet C2500 pick-up (2nd other vehicle). This crash is of special interest because the case vehicle's front right passenger (4-year-old female) sustained fatal cervical injuries from the deploying front right air bag. The case vehicle was traveling west in the inside lane of a four-lane, divided, state trafficway (both the east and west roadways had two through lanes). The Ford was traveling west in the outside lane of the same, two-lane roadway and was changing lanes to the left in order to avoid stopping traffic (i.e., crash ahead in the outside lane). The Chevrolet pickup was stopped in the outside, westbound lane of the roadway. The case vehicle's driver steered to the right (i.e.,toward the outside lane) and braked, attempting to avoid the Ford which was merging. The crash occurred near the center of the westbound roadway. The front of the case vehicle impacted the back of the Ford, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. After impacting the Ford, the case vehicle veered to the right into the outside lane where the left side of the case vehicle's struck the back of the Chevrolet pickup. The case vehicle's driver (27-year-old male) was seated with his seat track located between its middle and forward-most positions, and the tilt steering wheel was located between its middle and up-most positions. He was not using his available, active, three-point, lap-and-shoulder, safety belt system and sustained minor injuries which included: an abrasion to his left arm, and contusions to his chest wall, scalp (unknown aspect), and left knee. The front right passenger was seated upright with her seat track located between its middle and forward-most positions, and she was not using her available, active, three-point, lap-and-shoulder, safety belt system. She was transported by ambulance to the hospital and pronounced dead approximately 13 hours post-crash. According to her autopsy, she sustained fatal injuries which included: a spinal cord injury with C_1 fracture and an atlanto-occipital separation, cerebral edema, and diffuse basal subarachnoid hemorrhage. In addition, she had contusions to her face and scalp, and multiple abrasions (i.e., below her chin and about the level of the thyroid cartilage; scattered on her right cheek; and on her right side, dorsal surface).			
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BACKGROUND IN97-033

This on-site investigation was brought to NHTSA's attention on September 19, 1997 by an attorney. This crash involved a 1997 Chevrolet Camaro Z28 (case vehicle), a 1981 Ford LTD Crown Victoria (1st other vehicle), and a 1991 Chevrolet C2500 pick-up (2nd other vehicle). The crash occurred in May, 1997, at 2:06 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 (4-year-old female) sustained a fatal injury from the deploying front right air bag. This contractor inspected the scene and vehicles on 2-3 October, 1997. This contractor interviewed the driver of the case vehicle on October 21, 1997. This report is based on the Police Crash Report, interviews with the investigating police officer and case vehicle's driver, scene and vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling west in the inside lane of a four-lane, divided, state trafficway and intended to continue traveling west (both the east and west roadways had two through lanes). The Ford was traveling west in the outside lane of the same, two-lane roadway and was attempting to change lanes to the left in order to avoid stopping traffic (i.e., there was a crash ahead in the outside lane). The Chevrolet pickup was stopped in the outside, westbound lane of the same, two-lane roadway. The case vehicle's driver steered to the right (i.e.,toward the outside lane) and braked, attempting to avoid the Ford which was merging. The crash occurred on the westbound roadway near the line separating the two through lanes; see **CRASH DIAGRAM** below.

The front of the case vehicle impacted the back of the Ford, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. After impacting the Ford, the case vehicle veered to the right into the outside lane where the left side of the case vehicle struck the back of the Chevrolet pickup.

The case vehicle's front right passenger [99 centimeters and 18 kilograms (39 inches, 39 pounds)] was not using her available, active, three-point, lap-and-shoulder, safety belt system. An inspection of the tethered front right air bag, which was located in the top of the instrument panel, revealed skin transfers to the top and front portions. An inspection of the air bag module's cover flap revealed no evidence of occupant contact. In addition, the inspection of the front right passenger's seat belt webbing, and latch plate showed no evidence of loading.

The case vehicle's driver steered to the right and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the nonuse of her available safety belts, the front right passenger most likely moved slightly forward and to her left just prior to impact. The case vehicle's primary impact with the Ford, not only deployed the front right air bag, but thrust the front right passenger forward and slightly leftward.

At impact the front right passenger contacted her deploying air bag under the chin, knocking her rearward into the right front door surface and the right side of her seat back. As the case vehicle veered to the right and swiped the back of the Chevrolet pickup with its left side, the

passenger rebounded off the seat back and moved leftward and forward down onto the floorboard. At final rest the front right passenger was found laying in a fetal position on the front right floorboard with her head facing towards the center instrument panel and her feet towards the seat.

The front right occupant was transported by ambulance to the hospital. She sustained fatal injuries and was pronounced dead approximately 13 hours post-crash. The results of the autopsy showed that the case vehicle's front right passenger sustained the following injuries: a spinal cord injury with C_1 fracture and an atlanto-occipital separation, cerebral edema, diffuse basal subarachnoid hemorrhage, a periorbital ecchymosis and edema, a scalp contusion, and abrasions (i.e., below her chin and about the level of the thyroid cartilage, scattered on her right cheek, and on her right side, dorsal surface).

The 1997 Chevrolet Camaro Z28 was a rear wheel drive, two-door coupe (VIN: 2G1FP22P3V2------). The case vehicle was equipped with anti-lock brakes. The 1981 Ford LTD Crown Victoria is a rear wheel drive, four-door sedan (VIN: 1FABP35D9BU------). The 1991 Chevrolet C2500 is a rear wheel drive, ¾-ton, 4x2, extended cab pickup truck (VIN: 2GCGC29KXM1------). The case vehicle and the Ford were both towed due to damage; the Chevrolet pickup was driven from the scene. Based on the case vehicle's inspection and the available photographs, the CDCs were determined to be: **12-FYEW-1 (0)** and **11-LPMS-1 (320)** for the case vehicle [maximum crush for the frontal impact was 16 centimeters (6.3 inches) at the bumper and 27 centimeters (10.6 inches) above the bumper] and **07-BZEW-1 (200)** for the Ford (photographs only). The CDC is unknown for the Chevrolet pickup (left scene, no photos). The WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 17.8 km.p.h. (11.1 m.p.h.), -17.8 km.p.h. (-11.1 m.p.h.), and 0 km.p.h. (0 m.p.h).

According to the case vehicle's driver (i.e., father), immediately prior to the crash the case vehicle's front right passenger was seated upright with her back against the seat back, her legs outstretched in front of her with her feet hanging off the front edge of the seat cushion, and both hands on her lap twiddling her thumbs. Her seat track was located between its middle and forward-most positions, and the seat back was upright. During the vehicle inspection, the front right seat was found located between its middle and rearmost positions. In this contractor's opinion, the seat track was most likely moved by investigative or tow personnel.

The case vehicle's driver [27-year-old male; 165 centimeters and 102 kilograms (65 inches, 225 pounds)] was seated slightly reclined with his back against the seat back, his left foot on the floor, his right foot on the brake, and both hands on the steering wheel. His seat track was located between its middle and forward-most positions, and the tilt steering wheel was located between its middle and up-most positions.

The case vehicle's driver was not using his available, active, three-point, lap-and-shoulder, safety belt system. An inspection of the driver's air bag, which was located in the steering wheel hub, revealed skin and oil smears between the 11 and 12 o'clock section of the air bag. An inspection of the module's cover flap revealed no evidence of contact.

The driver sustained minor injuries and was treated and released. The injuries sustained by the case vehicle's driver included: an abrasion to his left arm, and contusions to his chest wall, scalp (unknown aspect) and left knee.

CRASH CIRCUMSTANCES

Figure 1: On-scene view looking east in the outside westbound lane; case vehicle and Ford were westbound and are shown at final rest--case vehicle at left and Ford straddling median (case photo #54)

All three involved vehicle's were traveling westward in the westbound roadway of a four-lane, divided, state trafficway (both the east and west roadways had two through lanes). The westbound roadway was bituminous, straight, and level at the area of impact (**Figure 1**). The roadway was wet, and it was raining at the time of the crash. The two westbound lanes were separated by a dashed white line with a white edge line along the northern edge and a solid yellow line along the southern edge. The westbound roadway is bordered by bituminous shoulders on each side, with the northern shoulder being wide enough for emergency stopping. The only traffic control was a regulatory SPEED LIMIT sign. The legal limit is 105 km.p.h. (65 m.p.h.). The trafficway has controlled access with a frontage road. The estimated coefficient of friction for the westbound roadway is 0.75% when dry. The surrounding area is primarily urban commercial with some undeveloped areas.

Figure 2: On-scene view of case vehicle at final rest; Note: underride type damage to front and swiping type damage to left side (case photo #58)

Figure 3: Close-up showing direct damage width to case vehicle's front left bumper (case photo #14)

The case vehicle was traveling west in the inside lane of and intended to continue traveling west. The Ford was traveling west in the outside lane of the same, two-lane roadway and was attempting to change lanes to the left in order to avoid stopping traffic (i.e., there was a crash ahead in the outside lane). The Chevrolet pickup was stopped in the outside, westbound lane of the same, two-lane roadway. The case vehicle's driver steered to the right (i.e.,toward the outside lane) and braked, attempting to avoid the Ford which was merging. The case vehicle's anti-lock brakes engaged on the wet asphalt, but did not keep the case vehicle from impacting the Ford. The crash occurred on the westbound roadway near the line separating the two through lanes; see **CRASH DIAGRAM** below.

The front of the case vehicle (**Figures 2** and **3**) impacted the back of the Ford, slightly under

riding it because of its sloped low profile front. The frontal impact caused the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. After impacting the Ford, the case vehicle veered to the right into the outside lane where the middle of the left side of the case vehicle (**Figure 4**) struck the back of the Chevrolet pickup. After colliding with the Chevrolet pickup, the case vehicle rotated approximately 60 degrees counterclockwise and came to rest primarily on the north shoulder of the westbound roadway heading west-northwest.

Figure 4: Swiping type damage to case vehicle's left side from subsequent post-deployment impact with Chevrolet pickup (case photo #18)

As a result of the impact with the case vehicle, the Ford rotated approximately 270 counterclockwise where it came to rest straddling the inside westbound lane and the south (median) shoulder heading north. Following the impact with the case vehicle, the Chevrolet pickup moved slightly forward coming to rest in the outside, westbound lane, heading west. The case vehicle and the Ford were both towed due to damage; the Chevrolet pickup was driven from the scene.

CASE VEHICLE

The case vehicle was a rear wheel drive 1997 Chevrolet Camaro Z28, two-door coupe (VIN: 2G1FP22P3V2------). The case vehicle had a 257 centimeter (101.1 inches) wheelbase, and was equipped with power-assisted rack and pinion steering, a six-speed manual transmission, and 5.7 liter MFI V-8 engine. Braking was achieved by a power-assisted, four wheel anti-lock system. The case vehicle's odometer was electronic, and as a result, the recorded total miles is unknown.

The interior of the case vehicle had front bucket seats with folding backs and integral head restraints. The transmission was manual, floor-mounted, and a part of the center console. It had manual, three-point, lap-and-shoulder, safety belt systems in the four outboard seating positions. The vehicle was equipped with knee bolsters on both the driver and front right passenger sides, neither of which were deformed. The rear had a bench seat with separate back cushions. The case vehicle was not equipped with manually operated height adjusters for the front "D"-rings. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of frontal air bags for both the driver and front right passenger. An examination of the case vehicle's interior revealed evidence of contact

Figure 5: Tethered cover flap from case vehicle's front right passenger air bag module; Note: cover flap contacted windshield causing glazing damage (case photo #37)

to the front right sun visor, blood smears to the right front door window sill, and blood splatters to the driver's and front right passenger's seat backs. The windshield on the passenger side was moderately damaged from the tethered cover flap (**Figure 5** above) of the front right passenger's air bag module.

CASE VEHICLE DAMAGE

The initial contact involved the front left half of the case vehicle's bumper against the back right half of the Ford's bumper (**Figure 3** above and **Figure 10** below). The case vehicle's direct contact damage consisted of under riding type damage to the front bumper and hood, beginning 2 centimeters (0.8 inches) right of the center and extending 72 centimeters (28.4 inches) to the front left bumper corner. The impact was primarily a wide engagement that extended backwards (i.e., maximum crush) 16 centimeters (6.3 inches) from the bumper and 27 centimeters (10.6 inches) above the bumper. Direct damage from the second impact started 39 centimeters (15.4 inches) behind the left front axle (**Figure 4** above) and moved rearward down the left side a distance of 145 centimeters (57.1 inches), stopping just before the left "B"-pillar. The CDCs for the case vehicle were determined to be: **12-FYEW-1 (0)** and **11-LPMS-1 (320)**. The WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 17.8 km.p.h. (11.1 m.p.h.), -17.8 km.p.h. (-11.1 m.p.h.), and 0 km.p.h. (0 m.p.h). The case vehicle's hood, bumper fascia, bumper, grille, left fender, left wheel assembly, left headlight assembly, and left front door were all deformed, in the two impacts. The driver's door glazing was disintegrated from the impact with the Chevrolet pickup. The case vehicle's left front tire was not deflated, but it was physically restricted. The wheelbase on the left side was shortened 2 centimeters (0.8 inches). There was no evidence of intrusion to the case vehicle's interior.

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 air bags deployed as a result of the frontal impact with the back of the Ford. The driver's air bag was mounted in the steering wheel hub. The driver air bag module's cover was in an I-configuration, with cover flap dimensions of 20 centimeters (7.9 inches) at the upper and lower horizontal seams and 11.5 centimeters (4.5 inches) vertically. The air bag was 64 centimeters (25.2 inches) in diameter but was not tethered. The driver's air bag had two vent ports which were 2 centimeters (0.8 inches) in diameter and located at the 9 and 3 o'clock positions.

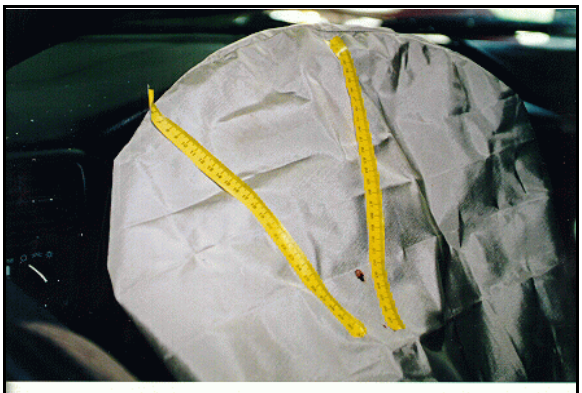


Figure 6: Skin evidence and a blood drop on case vehicle's driver air bag (case photo #27)

An inspection of the driver's air bag revealed what appeared to be a skin transfer and a blood spot to the upper left side of the air bag in the 10-11 o'clock area (**Figure 6**). One contact

area began 7 centimeters (2.8 inches) to the left of the center of the air bag and extended for 8 centimeters (3.2 inches). A second area was 14 centimeters (5.5 inches) in length and started 3 centimeters down from the top edge. In addition, there was a blood spot towards the center of the air bag, 34 centimeters (13.4 inches) down from the top edge and was 1 centimeter (0.4 inches) in width. An inspection of the driver air bag module's cover flaps revealed no visible evidence of direct contact from the driver.

The front right passenger air bag was mounted on the top of the right instrument panel. The air bag module had a single, symmetrical, tethered cover flap. The cover flap were made of thick vinyl with a metal frame backing. The flap's dimensions were 34 centimeters (13.4 inches) horizontally and 23 centimeters (9.1 inches) high, slanting toward the windshield. The profile of the case vehicle's instrument panel resulted in a 1 centimeter (0.4 inches) setback of the leading edge of the cover flap from the front of the right instrument panel.

Figure 7: Vertical view of case vehicle's front right passenger air bag showing skin transfers to air bag; Note: sun visor contact and windshield damaged from cover flap (case photo #33)

The cover flap opened at the designated tear points along the outer edges of the flap. The cover flap contacted the windshield fracturing it in a elongated spider web pattern (**Figures 5** and **7**). The cover flap had scrapes and small tears to its vinyl top from impacting and cracking the windshield.

Examination of the front right passenger air bag revealed two areas of brown skin, one to the top--which continued onto the front portion (**Figures 7** and **8**), and the other solely on the front portion of the air bag. The examination also revealed a yellowish and purple cloth transfer to the top portion, from the clothes the front right passenger was wearing. The skin evidence that was on both the top and front of the air bag is described first. On the top of the air bag the skin area was 10 centimeters (3.9 inches) wide, started 15 centimeters (5.9 inches) to the right of the left edge of the air bag, and was 7 centimeters (2.8 inches) in length. On the front of the air bag, the skin evidence extended downward 10 centimeters (3.9 inches) from the top horizontal edge of the air bag and was 15 centimeters (5.9 inches) in from the left vertical edge. The second skin transfer

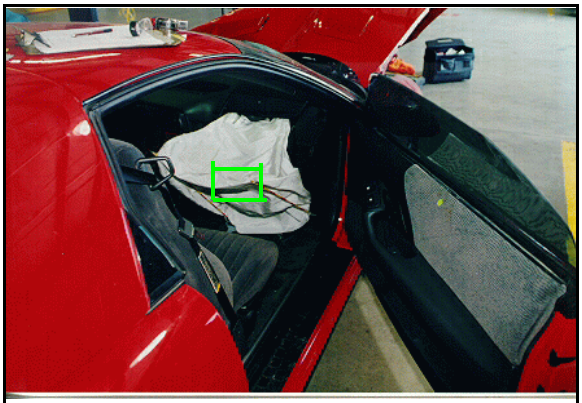


Figure 8: Skin transfer to top of case vehicle's front right passenger air bag viewed from outside right front door; Note: blood smear (green dot) on right front door's window sill (case photo #34)

area (**Figure 7** above) started 21 centimeters (8.3 inches) down from the top horizontal edge (front) and extended downward an additional 27 centimeters (10.6 inches), angling toward the front left corner. The top of second skin area was located 10 centimeters (3.9 inches) in from right side edge and was 8 centimeters wide (3.2 inches).

The front right passenger air bag was tethered by four internal straps that were 7.5 centimeters (3 inches) in width. The top two tethers were sewn to the interior face of the air bag at a point that was approximately 15 centimeters (15.9 inches) below the top horizontal edge of the bag. The bottom two tethers were located approximately 14 centimeters (5.5 inches) above the bottom horizontal edge. The air bag's front face was 40 centimeters (15.8 inches) wide and 62 centimeters (24.4 inches) tall. The front right passenger air bag had two vent ports, each 5 centimeters in diameter and located at the 10 and 2 o'clock positions.

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

According to the case vehicle's driver (i.e., father), immediately prior to the crash the case vehicle's front right passenger [4-year-old female, 99 centimeters and 18 kilograms (39 inches, 39 pounds)] was seated upright with her back against the seat back, her legs outstretched in front of her with her feet hanging off the front edge of the seat cushion, and both hands on her lap twiddling her thumbs. Her seat track was located between its middle and forward-most positions, and the seat back was upright. During the vehicle inspection, the front right seat was found located between its middle and rearmost positions. In this contractor's opinion, the seat track was most likely moved by investigative or tow personnel.

The front right passenger was not using her available, active, three-point, lap-and-shoulder, safety belt system. The inspection of the front right passenger's seat belt webbing, and latch plate showed no evidence of loading. In addition, there was no mention of belt pattern bruising and/or abrasions in her autopsy.

Figure 9: Slight blood smear on case vehicle's front right sun visor (case photo #47)

The case vehicle's driver steered to the right and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the nonuse of her available safety belts, the front right passenger moved slightly forward and to her left just prior to impact. This movement put her forward excursion very close to the instrument panel. The case vehicle's primary impact with the Ford, not only deployed the front right air bag, but thrust the front right passenger further forward and slightly upward towards the 360 degree Direction of Principal Force (Direction of Principle Force). The top of the deploying front right passenger air bag contacted the passenger's chin and neck, lifting her upwards into the sun visor (**Figure 9**). The passenger's interaction with the deploying air bag resulted in her spinal cord injury, cervical fracture, and brain lesions. The contact to the sun visor most likely caused a parietal scalp hematoma.

As the case vehicle veered to the right after impacting the Ford, the front right passenger rebounded off the sun visor, landing first against the door window sill and second, against the right side of her front right seat back. As the case vehicle deflected clockwise and swiped the back of the Chevrolet pickup with its left side, the passenger rebounded off the seat back and moved leftward and forward towards the **320** degree Direction of Principal Force and down onto the floorboard. At final rest the front right passenger was found laying in a fetal position on the front right floorboard with her head facing towards the center instrument panel and her feet towards the seat.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The case vehicle's front right passenger was transported by ambulance to the hospital where she was stabilized and transferred to a trauma center. She sustained fatal injuries and was pronounced dead approximately 13 hours post-crash. According to her autopsy, she sustained: a spinal cord injury with C_1 fracture and an atlanto-occipital separation, cerebral edema, diffuse basal subarachnoid hemorrhage, a periorbital ecchymosis and edema, a scalp contusion, and abrasions (i.e., below her chin and about the level of the thyroid cartilage, scattered on her right cheek, and on her right side, dorsal surface).

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Injury {not specified} to spinal cord {presumably at C_1 level} with fracture of C_1 and separation of C_1 from base of skull (i.e., atlanto-occipital)	640236.6[1] untreatable	Air bag, front right passenger's	Certain	Autopsy
2	Edema and brain swelling, cerebral, not further specified as to severity or aspect	140660.3[2] serious	Air bag, front right passenger's	Certain	Autopsy
3	Hemorrhage, subarachnoid, diffuse basal [Aspect = Unknown]	140684.3 serious	Air bag, front right passenger's	Certain	Autopsy
4	Hematoma, 5.0 cm (2 in), parietal area (i.e., subgaleal} [Aspect = Unknown]	190402.1 minor	Sun visor, front right	Probable	Autopsy
5	Contusion {ecchymosis}, periorbital, slight [Aspect = Unknown]	297402.1 minor	Air bag, front right passenger's	Possible	Autopsy

[1] The choice of injury code is difficult because the NASS CDS Injury Coding manual presumes, first, that one knows whether the spinal lesion is either a contusion or a laceration (i.e., no option for "unknown" is provided, and second, whether there was a complete or an incomplete cord syndrome. Because the only available medical record is an autopsy, the syndrome issue is not discernable (i.e., you cannot determine the difference in a dead person). In the absence of protocol, this contractor chooses to assume the lesion was a contusion and that the syndrome was complete.

[2] This code is based on NASS CDS injury coding rule #25(a).

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
6	Abrasions, scattered, right cheek	290202.1 minor	Air bag, front right passenger's	Certain	Autopsy
7	Abrasions, submental and anterior neck, 8.9 x 2.5 cm (3.5 x 1 in) in maximum dimensions	390202.1 minor	Air bag, front right passenger's	Certain	Autopsy
8	Abrasions right side dorsal surface	990200.1 minor	Right side interior surface, excluding hardware and/or armrest	Possible	Autopsy

CASE VEHICLE DRIVER KINEMATICS

The case vehicle's driver [27-year-old male; 165 centimeters and 102 kilograms (65 inches, 225 pounds)] was seated slightly reclined with his back against the seat back, his left foot on the floor, his right foot on the brake, and both hands on the steering wheel. His seat track was located between its middle and forward-most positions, and the tilt steering wheel was located between its middle and up-most positions. The case vehicle's driver was not using his available, active, three-point, lap-and-shoulder, safety belt system. An inspection of the driver's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading to the "D"-ring from the belt webbing.

The driver's avoidance maneuvers (braking and steering right) would have caused him to brace his arms against the steering wheel, while leaning to the left just prior to impact. The driver responded to the frontal impact by moving forward and slightly upwards into the deploying air bag (360 Direction of Principal Force). There was evidence (skin transfer) of driver contact on the air bag (**Figure 6** above). There was no evidence of compression of the energy absorbing shear capsules in the base of the steering column and no deformation to the steering wheel rim. As the case vehicle veered rightward toward the Chevrolet pickup, the driver rebounded back off the deploying air bag and moved to the right toward the center console and right side of his seat back . Upon striking and swiping the back of the Chevrolet pickup near the case vehicle's left front door area, the driver moved leftward and forward (-40 Direction of Principal Force) contacting the roof side rail over the left front door. After impacting the Chevrolet pickup, the case vehicle rotated approximately 60 degrees counterclockwise to final rest. This rotation swung the driver back to the right. As the case vehicle came to rest, the driver remained in his seat leaning to the right.

CASE VEHICLE DRIVER INJURIES

The case vehicle's driver was transported by ambulance to the hospital. He sustained minor injuries and was treated and released. The injuries sustained by the case vehicle's driver

included: an abrasion to his left arm, and contusions to his chest wall, scalp (unknown aspect) and left knee.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion anterior chest wall	490402.1 minor	Air bag, driver's	Certain	Emergency room records
2	Contusion to head, unspecified location [Aspect = Unknown]	190402.1 minor	Left roof side rail	Possible	Interviewee (same person)
3	Abrasion left arm, location not specified	790202.1 minor	Air bag, driver's	Probable	Interviewee (same person)
4	Contusion left knee	890402.1 minor	Left instrument panel and below	Probable	Interviewee (same person)

1ST OTHER VEHICLE

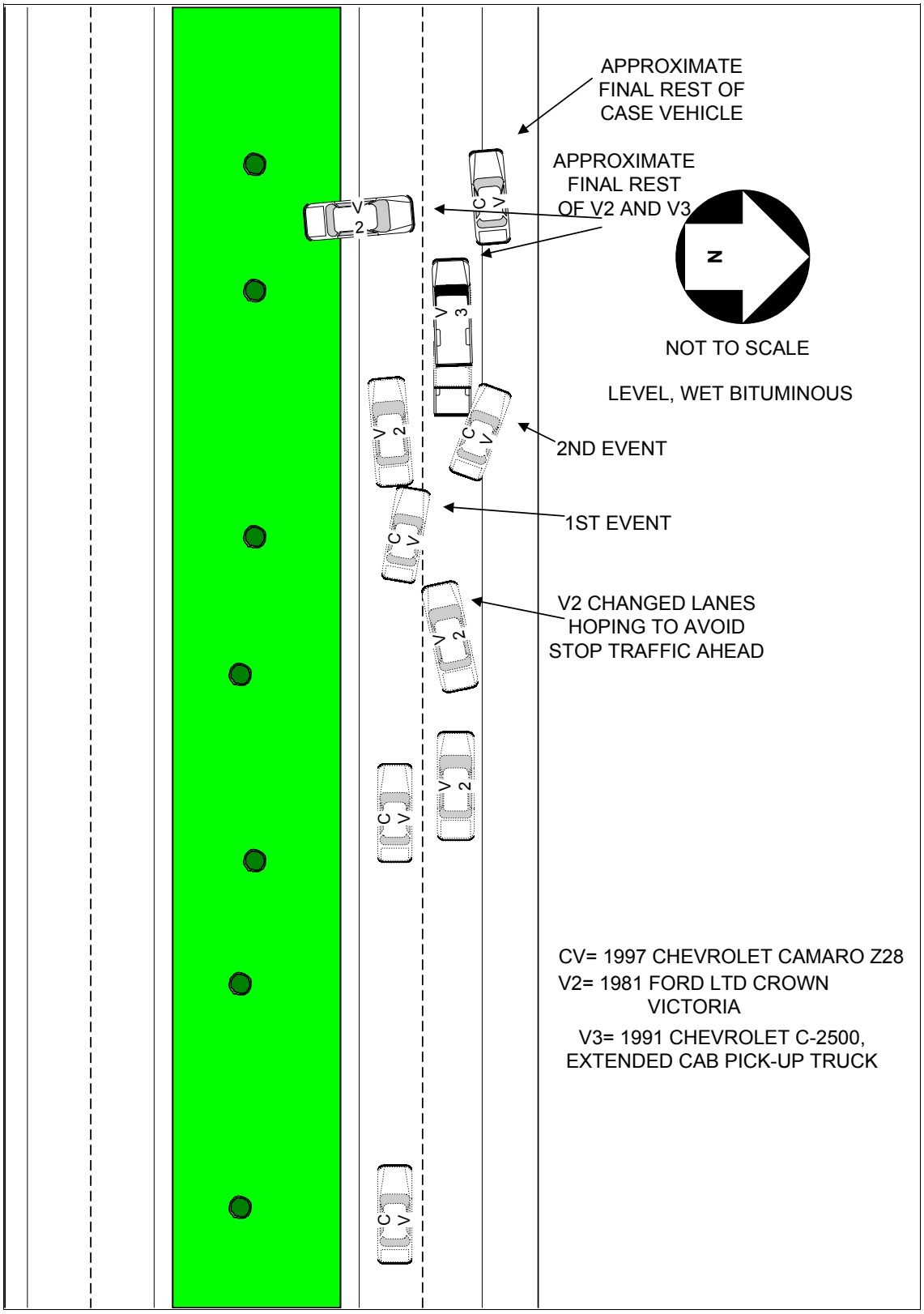
The 1981 Ford LTD Crown Victoria is a rear wheel drive, four-door sedan (VIN: 1FABP35D9BU------). The Ford had a 290 centimeter (114.3 inches) wheelbase, and was equipped with a four-speed automatic transmission and a 4.2 liter, V-8 engine. The vehicle was not inspected, and there are no available interior photographs. Based on the VIN, the Ford was equipped with active belts.

Based on the available photographs, the direct damage to this vehicle was to the back right half (**Figure 10**). The CDC for the Ford is estimated as: **07-BZEW-1 (200)**. The WinSMASH reconstruction program, missing vehicle algorithm, was used on the Ford's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 17.0 km.p.h. (10.6 m.p.h.), +16.0 km.p.h. (+9.9 m.p.h.), and +5.8 km.p.h. (+3.6 m.p.h). The back bumper, trunk lid, right quarter panel, and the right rear taillight assembly were all obviously deformed.

Figure 10: On-scene, close-up view of deformation to the Ford's back; Note: underride damage, particularly to back right (case photo #56)

2ND OTHER VEHICLE

The 1991 Chevrolet C-2500 is a rear wheel drive, ¾-ton, 4x2, extended cab pickup truck (VIN: 2GCGC29KXM1------). The vehicle departed the scene prior to on-scene photos being taken by the police; consequently, the type of damage is unknown. Based on the VIN the extended cab pick-up truck was equipped with a 5.7 liter V-8 engine. No other information is available.


APPROXIMATE
FINAL REST OF
CASE VEHICLE
APPROXIMATE
FINAL REST
OF V2 AND V3
N
NOT TO SCALE
LEVEL, WET BITUMINOUS
2ND EVENT
1ST EVENT
V2 CHANGED LANES
HOPING TO AVOID
STOP TRAFFIC AHEAD
CV= 1997 CHEVROLET CAMARO Z28
V2= 1981 FORD LTD CROWN
VICTORIA
V3= 1991 CHEVROLET C-2500,
EXTENDED CAB PICK-UP TRUCK