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ON-SITE AIR BAG INVESTIGATION

CASE NUMBER - IN01-010
LOCATION - Illinois
VEHICLE - 1996 PLYMOUTH VOYAGER
CRASH DATE - April 2001

Submitted:

July 1, 2002

Contract Number: DTNH22-94-D-17058

Prepared for:

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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

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15. *Supplementary Notes*
On-site investigation of an air bag deployment crash involving a 1996 Plymouth Voyager with manual safety belts and dual front air bags, and three other vehicles.

16. *Abstract*
This report covers an on-site investigation of an air bag deployment crash involving a 1996 Plymouth Grand Voyager (case vehicle), a 1999 Nissan Frontier, a 1995 Oldsmobile Silhouette and a 1994 Ford Escort. This case is of special interest because the case vehicle's unrestrained front right passenger (8-year-old male) was decapitated by the deploying front right air bag. The case vehicle was traveling north in the northbound lane of a two-lane, undivided state highway. The Oldsmobile was traveling north ahead of the case vehicle, and the Ford was traveling north behind the case vehicle. The Nissan was traveling south in the southbound lane of the same roadway and unexplainably crossed the centerline. The crash occurred in the northbound lane when the front left corner and left side of the Nissan swiped along the left side of the Oldsmobile. This impact caused the Nissan to go into a slight counter-clockwise yaw while continuing to travel south in the northbound lane, where the front of the case vehicle was impacted by the front of the Nissan, causing the case vehicle's driver and front right passenger air bags to deploy. The case vehicle and the Nissan both were rotating counter-clockwise when the front of the Ford struck the right rear side of the Nissan. The case vehicle driver braked just prior to the impact, causing the unrestrained front right passenger to move forward such that he was directly in front of the front right air bag when it deployed. The air bag module cover flap caught him under his chin, tearing his neck open and lifting his head, with the expanding air bag completing the decapitation. The unrestrained case vehicle driver (28-year-old female) sustained serious injuries, including: lacerations of the liver and right kidney; multiple fractures of the left femur, tibia and fibula; multiple fractures and soft tissue damage to the right foot; and other injuries. She was hospitalized for 18 days. All four vehicles were towed from the scene due to disabling damage.

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BACKGROUND

IN01-010

This on-site investigation was brought to the NHTSA's attention on April 11, 2001 by a county coroner. This crash involved a 1996 Plymouth Grand Voyager (case vehicle), a 1999 Nissan Frontier (1st other vehicle), a 1995 Oldsmobile Silhouette (2nd other vehicle) and a 1994 Ford Escort (3rd other vehicle). The crash occurred in April 2001, at 3:16 p.m., in Illinois and was investigated by the applicable county sheriff. This crash is of special interest because the case vehicle's front right passenger (8-year-old male) was decapitated by his deploying front right passenger air bag, resulting in his death. This contractor contacted the investigating police agency on April 11, 2001. This contractor inspected the scene and vehicles on April 16-17, 2001 and interviewed the case vehicle driver on May 23, 2001. This report is based on the Police Crash Report, interviews with the case vehicle 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 north in the northbound lane of a two-lane, undivided state highway and intended to continue northbound. The Oldsmobile was traveling north in the northbound lane, ahead of the case vehicle, and the Ford was traveling north in the northbound lane, behind the case vehicle, both intending to continue traveling northbound. The Nissan was traveling south in the southbound lane of the same roadway and unexplainably crossed the centerline, entering the northbound lane. The crash occurred in the northbound lane when the front left corner and left side of the Nissan swiped the left side of the Oldsmobile. The Oldsmobile's left rear wheel was torn away, causing it to rotate counter-clockwise approximately 180 degrees, coming to rest 36.4 meters [120 feet] north of the point of impact, on the east gravel shoulder, heading south. This first impact caused the Nissan to go into a slight counter-clockwise yaw while continuing to travel south in the northbound lane, where it impacted the case vehicle approximately 27 meters [90 feet] south of the first collision. The case vehicle and the Nissan both were rotating counter-clockwise when the front of the Ford struck the right rear side of the Nissan.

The front of the case vehicle was impacted by the front of the Nissan, causing the case vehicle's driver and front right air bags to deploy. The impact force pushed the case vehicle rearward (southeast) approximately 2 meters [6.6 feet] onto the east gravel shoulder. The Ford's driver observed the crash ahead and braked with lockup, leaving 25 meters [82.5 feet] of braking skid marks. The front of the Ford impacted the right side of the Nissan and then the two vehicles side-slapped, with the right rear of the Ford impacting the right door of the Nissan. The Nissan came to rest heading south-southeast in the northbound lane. The Ford came to rest blocking the northbound lane heading west-northwest.

The case vehicle's front right passenger (8-year-old male, white, non-Hispanic, 155 centimeters, 25 kilograms [61 inches, 55 pounds]) was not using his available, active, three-point, lap-and-shoulder safety belt system. The inspection of the front right passenger's seat belt webbing, D-ring, and latch plate showed no evidence of loading.

The case vehicle's driver had no recollection of the crash circumstances, but she probably steered slightly to the right and braked, attempting to avoid the Nissan. As a result of these attempted avoidance maneuvers and the non-use of his available safety belt system, the front right passenger moved forward, putting him directly in front of the front right air bag module just prior to impact. The case vehicle's impact with the Nissan resulted in the front right passenger pressing against the right instrument panel as the case vehicle decelerated. Based on the contact evidence on the cover flap of the front right passenger's air bag module, the deploying cover flap caught him under his chin, lifting his head and tearing his neck open with the air bag expanding and subsequently completing the decapitation. The force of the impact pinned the passenger's lower torso against the instrument panel and glove box area while the air bag lifted his head upwards. At final rest, his body was found between the front right seat and the front right door. The front right passenger's head came to rest between the windshield and the plastic instrument panel which buckled upwards from the severe impact.

The front right passenger sustained fatal injuries, was pronounced dead at the scene and was transported by ambulance to the county morgue. The injuries sustained by the case vehicle's front right passenger consisted of complete decapitation and various soft tissue injuries over most of his body. This occupant's primary neck injuries were caused by his contact with the case vehicle's front right passenger air bag and the module cover flap. This was confirmed by the county coroner.

The 1996 Plymouth Grand Voyager SE was a front wheel drive, three-door minivan (VIN: 2P4GP4432TR------). The case vehicle was equipped with anti-lock brakes. The 1999 Nissan Frontier was a rear wheel drive, two-door King Cab pick-up truck (VIN: 1N6DD26S8XC------). The 1995 Oldsmobile Silhouette was a front wheel drive, three-door minivan (VIN: 1GHDU06LXST------). The 1994 Ford Escort was a front wheel drive, four-door station wagon (VIN: 1FARP15J2RW------). All four vehicles were towed due to damage.

Based on the vehicle inspections, the CDCs were determined to be: **11-FDEW-6 (340)** for the case vehicle's single impact (maximum crush was 133 centimeters [52.4 inches] on the engine hood (above bumper) and 118 centimeters [46.5 inches] at the front left bumper corner); **12-FLES-7 (350)**, **01-FDEW-3 (030)**, **02-RBEW-3 (070)** and **03-RYEW-2 (090)** for the 1999 Nissan Frontier's four impacts (maximum crush was 73 centimeters [28.7 inches] for its most severe (frontal) impact); **12-LDEW-1 (350)** for the 1995 Oldsmobile Silhouette's single impact (maximum crush was 6 centimeters [2.4 inches]); and **01-FDEW-2 (020)** and **03-RBEW-2 (090)** for the 1994 Ford Escort's two impacts (maximum crush was 25 centimeters [9.8 inches] for its most severe (frontal) impact). 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: respectively: 52 km.p.h. [32.3 m.p.h.],- 49 km.p.h. [-30.4 m.p.h.], and +18 km.p.h.[+11.1 m.p.h.]. The Barrier Equivalent Speed (BES) was 63 km.p.h. [39.1 m.p.h.]. These results appear reasonable.

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module's cover flaps and air bag fabric revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag

or the cover flaps. The driver's air bag was designed with two tethers each 7 centimeters wide located at the 11-1 and 7-5 o'clock positions. The driver's air bag had no vent ports. The deployed driver's air bag was round with diameter 62 centimeters [24.4 inches]. There was contact evidence (i.e., skin and blood) readily apparent on the front of the driver's air bag.

The front right passenger's air bag was located in the middle of the instrument panel. An inspection of the front right air bag module's cover flaps and air bag fabric revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage to the air bag. However, the top cover flap was torn in half from contact with the front right passenger's chin/neck. The front right passenger's air bag was designed without any tethers and had no vent ports. The deployed front right air bag was rectangular with a height of approximately 57 centimeters [22.4 inches] and a width of approximately 47 centimeters [18.5 inches]. There was an abundance of contact evidence (i.e., skin, blood and reddish cloth transfers) readily apparent to the top, front left and bottom portions of the front right air bag.

Immediately prior to the crash the case vehicle's front right passenger was seated in a slightly reclined posture with his back against the seat back and both his feet hanging down above the floor. The exact position of his hands is unknown. His seat track was located between its middle and rearmost positions, and the seat back was upright.

The case vehicle's driver (28-year-old female, white, non-Hispanic, 163 centimeters, 64 kilograms [64 inches, 140 pounds]) was seated in a slightly reclined posture with her back against the seat back, her left foot on the floor and her right on the brake, and both her hands on the steering wheel. Her seat track was found in its rearmost position, the seat back was upright and because of the severity of damage the exact position of the tilt steering wheel is unknown. According to the case vehicle driver she normally had the seat track in the middle position.

The case vehicle's driver was not using her available, active, three-point, lap-and-shoulder safety belt system. The driver was air lifted to a trauma hospital. She sustained severe injuries and was hospitalized. Her injuries included: lacerations of her liver and right kidney; multiple fractures of her right hand; right ankle fracture; permanent vascular, nerve and tendon damage to her right ankle; multiple left tibia and fibula fractures; multiple left femur fractures; deep abrasions to both thighs; and multiple lacerations over her whole body.

Figure 1: On-scene view looking north at case vehicle (right), Ford and Nissan at final rest; NOTE: tire skids from Ford (case photo #82)

CRASH CIRCUMSTANCES

The case vehicle was traveling north in the northbound lane of a two-lane, undivided state highway and intended to continue northbound. The Nissan pickup (1st other vehicle) was traveling south in the southbound lane of the same roadway and intended to continue southbound. The Oldsmobile Silhouette (2nd other vehicle) was traveling north in the northbound lane, ahead of

the case vehicle, and the Ford Escort (3rd other vehicle) was traveling north in the northbound lane, behind the case vehicle, both intending to continue traveling northbound. The roadway was relatively new asphalt, with wide gravel shoulders (**Figure 1**). The travel lanes were divided by a solid yellow painted line for northbound traffic and a broken yellow painted line for southbound traffic, with solid white edge lines along both roadway edges. It was daylight, the weather was clear, the roadway was without defects and the speed limit was 86 km.p.h. [55 m.p.h.]. The Police Crash Report notes that it was windy, with breezes at 42 km.p.h. [26 m.p.h.] from the southwest, gusting to 64 km.p.h. [40 m.p.h.]. The surrounding area was flat, open farmland and the roadway was generally level and straight. The stretch of road immediately north of the crash site, however, was an overpass, with W-beam guardrails along the outside of the shoulder on both sides of the built-up slope. The grade was measured as 3.5 percent, positive for northbound traffic. The coefficient of friction is estimated as 0.70 for the relatively new bituminous road surface.

Figure 2: On-scene, looking south at case vehicle (left), Nissan and Ford at final rest; NOTE: yaw marks from Nissan (case photo #80)

The southbound Nissan pickup was traversing the overpass, having just crested the rise and beginning the downhill slope. The northbound Oldsmobile was just beginning to travel up the slope when the Nissan came over the centerline. The police investigators speculated that the gusting wind may have caused a problem for the Nissan's driver, but there was insufficient evidence to support a definitive conclusion as to whether the wind gusts were strong enough to push the Nissan sideways. The front left corner and left side of the Nissan impacted the left side of the Oldsmobile (event #1) in a shallow, swiping-type engagement, with the Nissan's front left corner snagging and tearing off the Oldsmobile's left rear wheel and tire. The Oldsmobile rotated counterclockwise approximately 180 degrees and came to rest 36.4 meters [120 feet] north of the point of impact, on the east gravel shoulder heading south. The sideswipe caused the Nissan to go into a slight counterclockwise yaw while continuing to travel south in the northbound lane, where it impacted the case vehicle approximately 27 meters [90 feet] south of the first impact (event #2). The case vehicle and the Nissan both were rotating counterclockwise when the front of the Ford struck the right rear side of the Nissan (event #3) (**Figures 1** and **2**).

The front of the case vehicle was impacted by the front of the Nissan, causing the case vehicle's driver and front right air bags to deploy. The impact force pushed the case vehicle rearward (southeast) approximately 2 meters [6.6 feet] onto the east gravel shoulder. The Ford's driver observed the crash ahead and braked with lockup, leaving 25 meters [82.5 feet] of braking skid marks. The front of the Ford impacted the right side of the Nissan and then the two vehicles side-slapped, with the right rear of the Ford impacting the right door of the Nissan (event #4). The Nissan came to rest heading south-southeast in the northbound lane. The Ford came to rest blocking the northbound lane heading west-northwest.

The case vehicle was a front wheel drive 1996 Plymouth Grand Voyager SE three-door minivan (VIN: 2P4GP4432TR------), equipped with a 3.0 liter V-6 engine and an automatic transmission with a column-mounted selector lever. The case vehicle was equipped with four-wheel anti-lock brakes. Its wheelbase was 303 centimeters [119.3 inches]. Its odometer reading is not known. The case vehicle was towed due to disabling damage.

CASE VEHICLE DAMAGE

The case vehicle sustained direct contact damage across the left three-quarters of its front, measured as 120 centimeters [47.2 inches], with induced damage across the entire front (**Figure 3**). Maximum crush was 133 centimeters [52.4 inches] on the engine hood, with 118 centimeters [46.5 inches]) crush at the front left bumper corner (**Figure 4**). The front left bumper, the left part of the grille, the headlamp assembly and the left fender were displaced rearward, the left front wheel/tire assembly was pushed against the left A-pillar and the lower left A-pillar was displaced rearward such that the A-pillar was vertical (instead of sloping toward the front of the vehicle), causing upward buckling of the left windshield header, the left side rail and the roof (**Figure 9**). The engine hood was crushed and pushed rearward and contacted the upper left A-pillar and the left half of the windshield, fracturing the windshield and causing a large hole near the lower center. The glazing in the left first and second windows was disintegrated. The driver's door was compressed and buckled outward as the left A-pillar was pushed rearward, but remained latched. The wheelbase was shortened 64 centimeters [25.2 inches] on the left and lengthened 13 centimeters [5.1 inches] on the right.

Figure 3: Case vehicle's front and left side damage (case photo #18)

Figure 4: Overhead view of case vehicle's front end deformation (case photo #14)

The CDC for the case vehicle's single impact (event #2) was determined to be: **11-FDEW-6 (340)**. The WinSMASH reconstruction program, damage only algorithm based on the measured crush profile of both vehicles, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 52 km.p.h. [32.3 m.p.h.], -49 km.p.h. [-30.4 m.p.h.], and +18 km.p.h.[+11.1 m.p.h.]. The Barrier Equivalent Speed (BES) was 63 km.p.h. [39.1 m.p.h.]. These results appear reasonable.

The interior of the case vehicle showed heavy intrusion on the left side of the front seat row, with the left side of the instrument panel intruding 57 centimeters [22.4 inches], the left upper A-pillar 46 centimeters [18.1 inches] and the steering assembly 35 centimeters [13.8 inches] longitudinally. The windshield was shattered, with a tear/hole approximately 20 centimeters [7.9 inches] wide at the lower center. The top of the instrument panel was entirely loose and displaced, and the control cluster and ventilation ports at the center showed substantial deformation and disruption. There were glass shards and copious amounts of blood over the entire front seat and instrument panel area. There was evidence of occupant contact on the interior surfaces to the knee bolsters on the driver's side, and on the glove box door and windshield from the front right passenger on the right side.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with driver and front right passenger front air bags. The driver's air bag was in the steering wheel hub, with the module's cover flaps in the H-configuration. The flaps opened at the seams and there was no damage apparent on the air bag or cover flaps. The deployed air bag was round, with a diameter of 62 centimeters [24.4 inches], and had two tether straps each 7 centimeters wide located at the 11-1 and 7-5 o'clock positions, and no vent ports (**Figure 5**). The module cover flaps were 17 centimeters [6.7 inches] horizontally, with the top flap 3 centimeters [1.2 inches] and the bottom flap 8 centimeters [3.1 inches] vertically. The front of the driver's air bag had a scrub of skin near the center, with blood droplets and smears on the front.

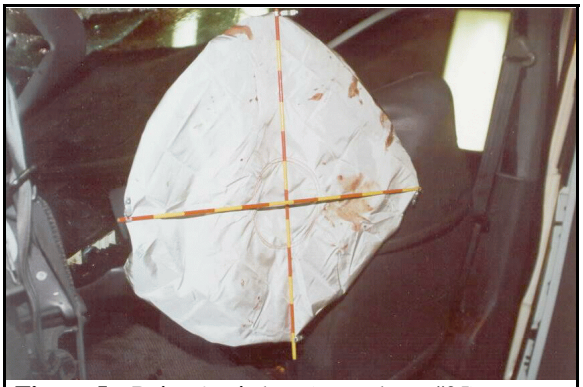


Figure 5: Driver's air bag (case photo #35)

The front right passenger's air bag was located in the front of the instrument panel, with the module's cover flaps in the H-configuration. The flaps were composed of a thin fiberboard material covered with a vinyl-like skin. The flaps measured 28 centimeters [11.0 inches] horizontally, with the upper flap 7 centimeters [2.8 inches] and the lower flap 5 centimeters [2.0 inches] vertically. The flaps opened at the seams and there was no damage apparent on the lower flap. The upper flap, however, was torn from the middle of the center seam upward to the hinge, dividing the flap into two pieces (**Figure 7**). The left half of the upper flap showed skin abrasions.

Figure 6: Front right passenger's air bag, showing contact on the left side (case photo #40)

It seems apparent that the left half of the upper cover flap caught the front right passenger under the chin, causing the flap to tear as the unobstructed right half was forced open by the expanding air bag. The front surface of the deployed air bag measured 47 centimeters [18.5 inches] horizontally and 57 centimeters [22.4 inches] vertically and was designed with no tether straps or vent ports. The air bag fabric had skin abrasions and blood smears on the left edge of the front, extending onto the top, and showed pinkish cloth transfers on the bottom (the front right passenger was wearing a red tee shirt) (**Figure 6**).

Figure 7: Front right passenger air bag module's torn upper cover flap (case photo #37)

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

The case vehicle's front right passenger (8-year-old male, white, non-Hispanic, 155 centimeters, 25 kilograms [61 inches, 55 pounds]) was not using his available, active, three-point, lap-and-shoulder safety belt system. The inspection of the front right passenger's seat belt webbing, D-ring, and latch plate showed no evidence of loading.

Immediately prior to the crash the case vehicle's front right passenger was seated in a slightly reclined posture with his back against the seat back, both his feet hanging down above the floor, however, the exact position of his hands is unknown. The seat was a box-mounted van-type bucket seat, with the seat track located between the middle and rearmost positions, and the seat back was upright (**Figure 8**).

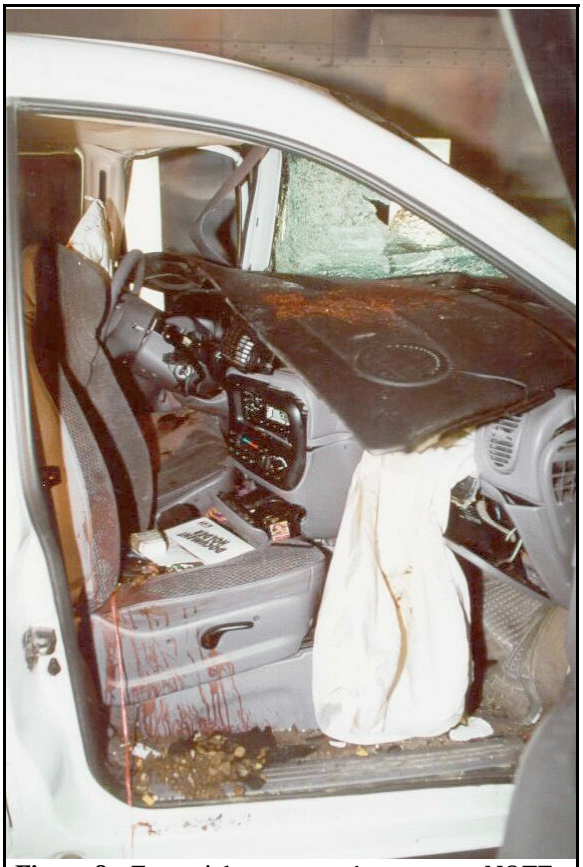


Figure 8: Front right passenger's seat area; NOTE, top surface of instrument panel entirely loose, blood on the top of the instrument panel shows final rest of decapitated head, blood on the seat shows final rest of torso (case photo #30)

The case vehicle's driver had no recollection of the crash circumstances, but she probably steered slightly to the right and braked, attempting to avoid the Nissan. (The speculation that she probably braked is support by the fact that she had extensive injuries to her right foot and ankle, indicating that she was braking with her right foot.) As a result of these attempted avoidance maneuvers and the non-use of his available safety

belts, the front right passenger moved forward and leftward, putting him directly in front of the front right air bag module just prior to impact. The force of the case vehicle's impact with the Nissan caused his torso and abdomen to be pressed against the right instrument panel and glove box door as the case vehicle decelerated. Based on the contact evidence on the front right passenger's air bag module the cover flap (**Figure 7**), the deploying cover flap caught him under his chin, lifting his head and tearing his neck open with the air bag expanding and subsequently completing the decapitation. As the case vehicle rotated counterclockwise, his body moved to the right and the air bag propelled him rearward, into the seat back. At final rest, his body was found between the front right seat and the front right door. His head came to rest between the windshield and the plastic instrument panel, which buckled upwards from the impact (**Figure 8**).

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Decapitation neck between C_2 and C_3 and including the following associated lesions: severance of carotid arteries; severed larynx; laceration anterior cervical muscles; and multiple abrasions and contusions about the face and right neck	311000.6 untreatable	Front right module's cover flap	Certain	Autopsy
2	Abrasions, extensive, upper trunk, extending down to 3rd sternal space, more extensive on right [Aspect = Whole]	490202.1 minor	Air bag, front right passenger's	Certain	Autopsy
3	Contusions, scattered, upper trunk, more extensive on right [Aspect = Whole]	490402.1 minor	Air bag, front right passenger's	Certain	Autopsy
4	Contusions, multiple, right lower and left abdomen [Aspect = Inferior]	590402.1 minor	Air bag, front right passenger's	Probable	Autopsy
5	Abrasions over lower vertebral column	690202.1 minor	Seat back, front right passenger's	Probable	Autopsy
6	Contusion over lower vertebral column	690402.1 minor	Seat back, front right passenger's	Probable	Autopsy
7	Contusion right shoulder, not further specified	790402.1 minor	Air bag, front right passenger's	Certain	Autopsy
8	Abrasion right upper arm, extending onto right forearm	790202.1 minor	Air bag, front right passenger's	Probable	Autopsy
9	Contusions, two, right wrist, not further specified	790402.1 minor	Right instrument panel and below	Possible	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
10 11	Abrasions and contusions, scattered, on volar surface from upper left arm, over brachial crease, down to mid-forearm	790202.1 minor 790402.1 minor	Air bag, front right passenger's	Probable	Autopsy
12	Contusion left elbow, not further specified	790402.1 minor	Center instrument panel and below	Possible	Autopsy
13	Contusion left forearm and left wrist, ulnar (medial) surface	790402.1 minor	Air bag, front right passenger's	Possible	Autopsy
14	Contusion left anterior hip	890402.1 minor	Air bag, front right passenger's	Possible	Autopsy
15	Contusions lower and right sacral region [Aspect = Posterior]	890402.1 minor	Seat back, front right passenger's	Probable	Autopsy
16	Contusions, scattered, around knees and shins, four on right leg, ten on left leg [Aspect = Bilateral]	890402.1 minor	Right instrument panel and below	Probable	Autopsy

CASE VEHICLE DRIVER KINEMATICS

The case vehicle driver (28-year-old female, white, non-Hispanic, 163 centimeters, 64 kilograms [64 inches, 140 pounds]) was not using her available, active, three-point, lap-and-shoulder safety belt system. She was air lifted to a trauma hospital. She sustained severe injuries and was hospitalized for 18 days.

Immediately prior to the crash, the case vehicle driver was seated in a slightly reclined posture with her back against the seat back, her left foot on the floor and her right on the brake, and both her hands on the steering wheel. Her seat track was found in its rearmost position, the seat back was upright and because of the severity of damage the exact position of the tilt steering wheel is unknown (**Figure 9**). According to the case vehicle driver she normally had the seat track in the middle position.

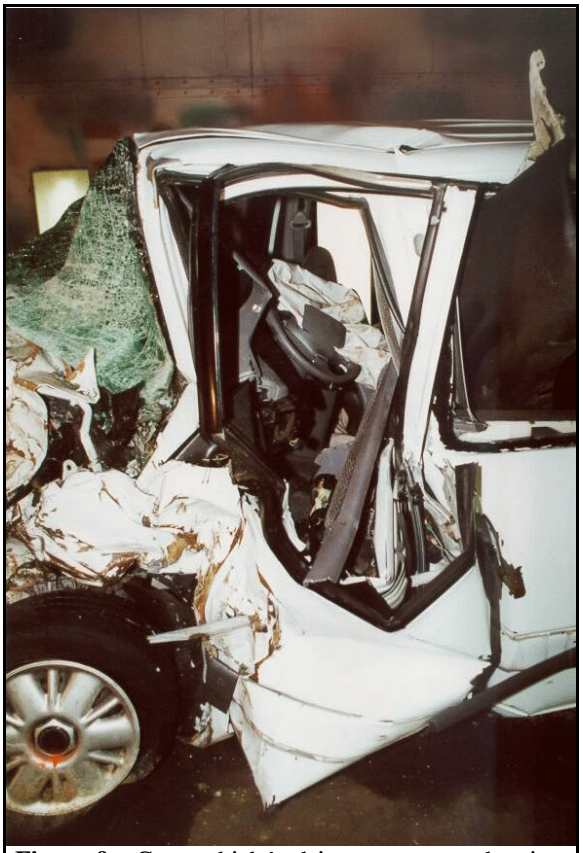


Figure 9: Case vehicle's driver seat area, showing heavy intrusion (case photo #19)

The driver braked immediately prior to the impact. As a result of this attempted avoidance maneuver, she moved forward. The case vehicle's impact caused her to move further forward and slightly to the left, toward the 340 degree direction of force, and caused the driver's air bag to deploy. As the vehicles reached maximum engagement and began rotating counterclockwise, the steering assembly, left instrument panel and the left toe pan intruded longitudinally. Her left leg contacted the knee bolster and lower instrument panel, causing fractures of her left femur, patella, tibia and fibula. With her right foot applying pressure on the brakes, the intruding brake pedal caused a fracture in her right ankle and extensive soft tissue damage in her right foot. The intruding steering assembly contacted her abdomen, causing lacerations of her right kidney and liver. Her right arm flailed and her right hand impacted the instrument panel, causing multiple fractures in her hand. She also sustained multiple lacerations over her entire body. Her position at final rest is not known.

CASE VEHICLE DRIVER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Fractures, multiple, left femur, not further specified	851800.3 serious	Knee bolster, driver's, left of steering column	Certain	Interviewee (same person)
2	Fractures, multiple, left tibia, not further specified	853404.2 moderate	Left instrument panel and below	Probable	Interviewee (same person)
3	Fractures, multiple, left fibula, not further specified	851605.2 moderate	Left instrument panel and below	Probable	Interviewee (same person)
4	Fracture {crushed} left patella	852400.2 moderate	Knee bolster, driver's, left of steering column	Certain	Other: attorney document
5	Fracture right ankle, not further specified as to bone	852002.2 moderate	Foot controls, including toe pan	Probable	Interviewee (same person)
6	Injury {damage} nerve right foot, not further specified	830699.2 moderate	Foot controls, including toe pan	Probable	Interviewee (same person)
7	Injury {damage} tendon right foot, not further specified	840802.2 moderate	Foot controls, including toe pan	Probable	Interviewee (same person)
8 9	Injury {serious damage} to vascular system right foot, not further specified	821099.1 821299.1 minor	Foot controls, including toe pan	Probable	Other: attorney document
10	Laceration right kidney, not further specified	541699.2 moderate	Steering wheel hub and/or spokes and rim	Probable	Interviewee (same person)
11	Laceration, severe, liver, not further specified	541820.2 moderate	Steering wheel hub and/or spokes and rim	Probable	Interviewee (same person)

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
12	Fracture, multiple, right hand, not further specified	752500.2 moderate	Left instrument panel and below	Possible	Interviewee (same person)
13	Abrasions, deep, on thighs bilaterally, not further specified	890202.1 minor	Air bag, driver's	Probable	Interviewee (same person)
14	Lacerations, multiple, over whole body	990600.1 minor	Unknown injury source	Unknown	Interviewee (same person)

1ST OTHER VEHICLE: 1999 NISSAN PICKUP

The first other vehicle was a rear wheel drive 1999 Nissan Frontier King Cab two-door pickup truck (VIN: 1N6DD26S8XC------), equipped with a 2.4 liter I4 engine and a manual transmission with a floor-mounted shift lever. The Nissan was not equipped with anti-lock brakes. Its wheelbase was 295 centimeters [116.1 inches]. The odometer reading is not known. The Nissan was towed from the scene due to disabling damage.

The Nissan was involved in all four of the crash events. The CDC for its most severe impact (with the case vehicle) is **01-FDEW-3 (030)** (event #2). Maximum crush was measured as 73 centimeters [28.7 inches] at the front left corner, but this includes overlapping damage from the first event (**Figure 10**). The WinSMASH reconstruction program, damage only algorithm based on the measured crush profile of both vehicles, was used on the Nissan's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 63 km.p.h. [39.1 m.p.h.], -55 km.p.h. [-34.2 m.p.h.], and -32 km.p.h.[-19.9 m.p.h.]. Because of the overlapping damage, this should be regarded as a borderline reconstruction, but the results appear reasonable.

Figure 10: Nissan's front and left side; NOTE driver's door buckled outward and swiping along left side (case photo #53)

The CDCs for the other events were: event #1, with the Oldsmobile, **12-FLES-7 (350)**; event #3, with the front of the Ford, **02-RBEW-3 (070)**; event #4, sideslap with the Ford, **03-RYEW-2 (090)**. Because the other impacts did not involve the case vehicle, the WinSMASH reconstruction program was not used. For the impact with the Oldsmobile, the severity for the Nissan is estimated as moderate (24 - 40 km.p.h. [15 - 25 m.p.h.]). For the two impacts with the Ford, event #3 with the front of the Ford is estimated as being of low severity (14 - 23 km.p.h. [9 - 14 m.p.h.]) and the sideslap is estimated as minor severity (1 - 13 km.p.h. {1 - 8 m.p.h.]).

The Nissan was equipped with driver and front right passenger air bags that did deploy, probably as a result of the first impact with the Oldsmobile. There were two occupants, the driver and an adult front right passenger. Both were transported via helicopter to a trauma center with police-reported "A" (incapacitating) injuries.

2ND OTHER VEHICLE: 1995 OLDSMOBILE SILHOUETTE

The second other vehicle was a front wheel drive 1995 Oldsmobile Silhouette three-door minivan (VIN: 1GHDU06LXST------), equipped with a 3.8 liter V6 engine and an automatic transmission with a column-mounted selector lever. The Oldsmobile was equipped with four-wheel anti-lock brakes. Its wheelbase was 279 centimeters [109.8 inches]. The odometer reading is not known. The Oldsmobile was towed from the scene due to disabling damage.

The Oldsmobile was involved in the first event only and did not make contact with the case vehicle. The CDC was determined to be: **12-LDEW-1 (350)**. This was a swiping-type impact, but included snagging and tearing off the left rear wheel and tire assembly (**Figure 11**). This contractor estimates that this was an impact of moderate severity (9 - 16 km.p.h. [15 - 25 m.p.h.]) for the Oldsmobile.

Figure 11: Oldsmobile at final rest, left side damage and left rear wheel torn off (case photo #63a)

The Oldsmobile was equipped with driver and front right passenger air bags that did deploy. There were six occupants. The driver and the second row left passenger were transported via ground ambulance with police-reported "B" (evident, non-incapacitating) injuries and the other four occupants were reported as not injured and not transported.

3RD OTHER VEHICLE: 1994 FORD ESCORT

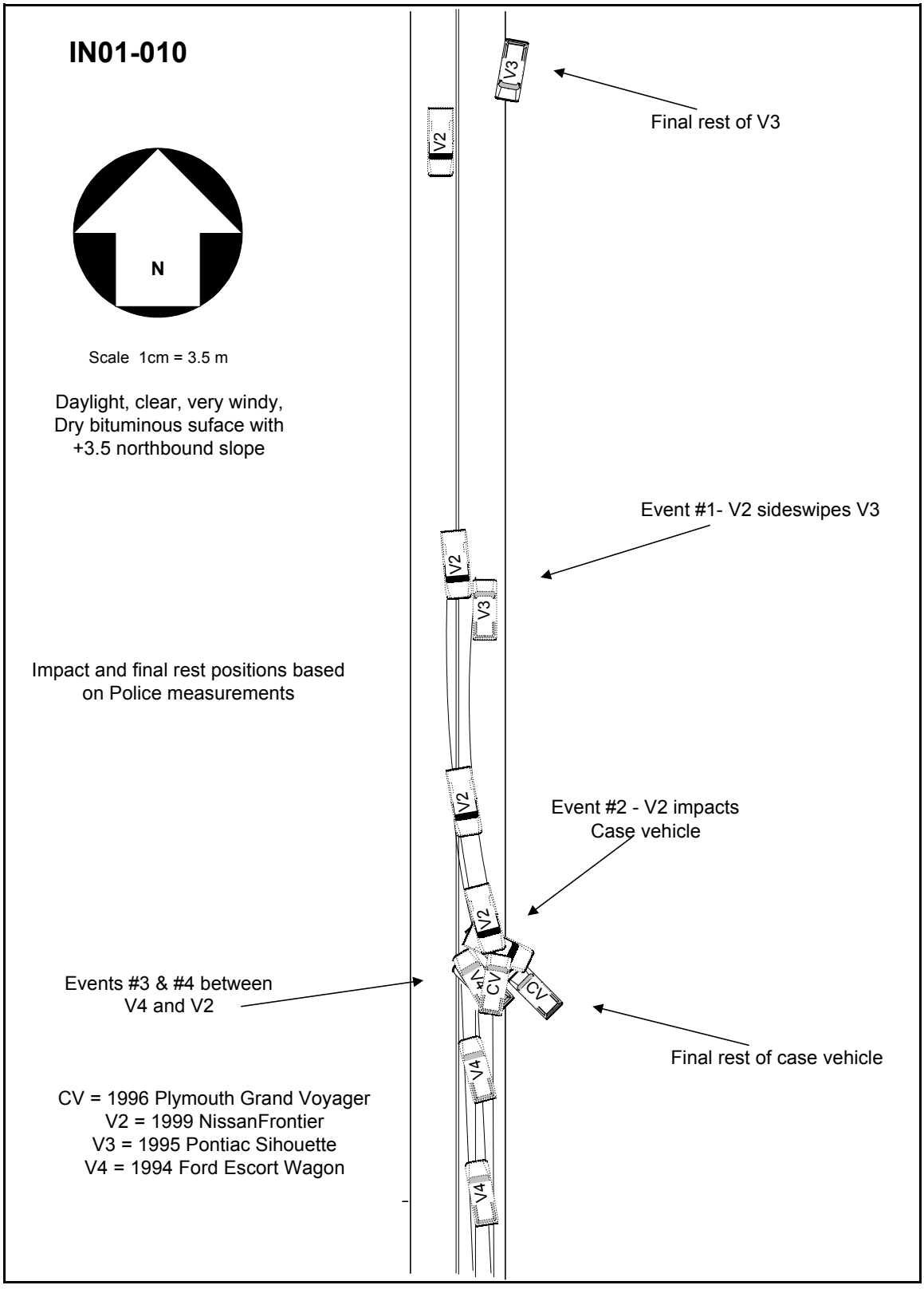
The third other vehicle was a front wheel drive 1994 Ford Escort four-door, five-passenger station wagon (VIN: 1FARP15J2RW------), equipped with a 1.9 liter I4 engine and a manual transmission with a console-mounted shift lever. The Ford was not equipped with anti-lock brakes. Its wheelbase was 250 centimeters [98.4 inches]. The odometer reading is not known. The Ford as towed from the scene due to disabling damage.

Figure 12: Front and right side of Ford, sideslap damage at right rear corner (case photo # 77)

The Ford was involved in two impacts with the Nissan (events 3 and 4) and did not make contact with the case vehicle. The CDCs were determined to be: **01-FDEW-1 (020)** and **03-RBEW-2 (090)**. Because the Ford's impacts did not

involve the case vehicle, the WinSMASH reconstruction program was not used. The Ford's frontal impact is estimated as low severity (14 - 23 km..p.h. [9 - 14 m.p.h.]) and the sideslap as minor severity (1 - 13 km.p.h. [1 - 8 m.p.h.]).

The Ford was not equipped with any air bags. The driver was the lone occupant and was transported via ground ambulance with police-reported "B" (evident, non-incapacitating) injuries.


IN01-010
N
Scale 1cm = 3.5 m
Daylight, clear, very windy,
Dry bituminous suface with
+3.5 northbound slope
Impact and final rest positions based
on Police measurements
Events #3 & #4 between
V4 and V2
CV = 1996 Plymouth Grand Voyager
V2 = 1999 NissanFrontier
V3 = 1995 Pontiac Sihouette
V4 = 1994 Ford Escort Wagon
Final rest of V3
Event #1- V2 sideswipes V3
Event #2 - V2 impacts
Case vehicle
Final rest of case vehicle
V3
V2
V2
V3
V2
V2
V1
CV
CV
V4
V4