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ON-SITE ADVANCED OCCUPANT PROTECTION SYSTEM INVESTIGATION

CASE NUMBER - IN-03-003
LOCATION - Texas
VEHICLE - 2002 FORD WINDSTAR
CRASH DATE - November 2002

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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.

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15. <i>Supplementary Notes</i> On-site investigation of an air bag deployment crash involving a 2002 Ford Windstar minivan equipped with multiple advanced occupant protection system features, that hit a 2002 Chevrolet Avalanche pickup					
16. <i>Abstract</i> This report covers an on-site investigation of an air bag deployment crash involving a 2002 Ford Windstar LX (case vehicle), a 2002 Chevrolet Avalanche (1st other vehicle), a 1997 Dodge Caravan (2nd other vehicle), and a 1986 Chevrolet Blazer (3rd other vehicle). This crash is of special interest because the case vehicle was equipped with multiple advanced occupant protection system (AOPS) features and an Event Data Recorder (EDR) that was harvested in the field and downloaded by the manufacturer. The case vehicle was traveling south in the inside southbound lane of a two-lane, one-way roadway that was part of a divided trafficway and intended to continue straight ahead. The Chevrolet Avalanche, the Dodge and the Chevrolet Blazer were all stopped due to congested traffic, heading south in the same lane of the same roadway. The case vehicle's driver made no avoidance maneuvers prior to the crash. The front of the case vehicle impacted the back of the Avalanche, causing the case vehicle's driver and front right passenger air bags to deploy. The first impact pushed the Avalanche forward and the front of the Avalanche impacted the back of the Dodge Caravan and, subsequently, the front of the Dodge impacted the back of the Chevrolet Blazer in a chain-reaction, rear-end collision sequence. All four vehicles came to rest in the southbound lanes headed south, near their respective points of impact. The case vehicle was towed, the other three vehicles were all driven from the scene. The case vehicle's driver (35-year-old female), front right passenger (10-year-old male), and three other child passengers, were all restrained by the manual safety belt systems and all sustained minor injuries. None were transported via ambulance from the scene, but all five presented themselves at a hospital emergency department later the same day, where all five were treated and released.					
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This on-site investigation was brought to the NHTSA's attention on January 23, 2003 by NASS/GES sampling activities. This crash involved a 2002 Ford Windstar LX (case vehicle), a 2002 Chevrolet Avalanche (1st other vehicle), a 1997 Dodge Caravan (2nd other vehicle), and a 1986 Chevrolet Blazer (3rd other vehicle). The crash occurred in November 2002 in Texas, at 6:10 p.m., and was investigated by the applicable municipal police department. This crash is of special interest because the case vehicle was equipped with multiple advanced occupant protection system (AOPS) features and an Event Data Recorder (EDR) that was harvested. The case vehicle's driver (35-year-old female, white, non-Hispanic) and front right passenger (10-year-old male, white, non-Hispanic) both sustained minor injuries. This contractor inspected the case vehicle on 29 January, 2003, and interviewed the case vehicle driver and inspected the crash scene on 30 January, 2003. This report is based on the police crash report, the interview with the case vehicle driver, scene and vehicle inspections, the EDR download, medical records, occupant kinematic principles, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling south in the inside southbound lane of a two-lane, one-way roadway that was part of a divided trafficway and intended to continue straight ahead (i.e., both the north and southbound roadways had two through lanes, separated by a curbed, grass median). The Chevrolet Avalanche, the Dodge and the Chevrolet Blazer were all stopped due to congested traffic, heading south in the same lane of the same roadway. There were no adverse weather conditions and it was dark and not lighted. The speed limit was 80 km.p.h. [50 m.p.h.] and there were no roadway defects. The case vehicle's driver made no avoidance maneuvers prior to the crash. The crash occurred in the inside southbound through lane of the roadway.

The front of the case vehicle impacted the back of the Avalanche, causing the case vehicle's driver and front right passenger air bags to deploy. The first impact pushed the Avalanche forward and the front of the Avalanche impacted the back of the Dodge Caravan and, subsequently, the front of the Dodge impacted the back of the Chevrolet Blazer in a chain-reaction, rear-end collision sequence. All four vehicles came to rest in the southbound lanes headed south, near their respective points of impact.

The case vehicle was a 2002 Ford Windstar LX front wheel drive, four-door, seven-passenger minivan (VIN: 2FMZA51442B-----). The case vehicle was equipped with four-wheel anti-lock brakes, frontal air bags with dual-stage inflators and safety belt pretensioners for the two front seats, and driver seat position sensing. The exact odometer reading is not known due to the non-functional electronic instrument panel, but the driver estimated that there were 9,656 kilometers [6,000 miles] on the case vehicle. Its wheelbase was 307 centimeters [120.7 inches]. The case vehicle was towed due to disabling damage. Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FDEW-3 (0)**. The WinSMASH reconstruction program, missing vehicle algorithm based on the case vehicle's crush profile, was used. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 31.0 km.p.h. [19.3 m.p.h.], -31.0 km.p.h. [-19.3 m.p.h.], and 0 km.p.h. [0 m.p.h.]. The crash severity for the case vehicle's single impact was moderate (24-40 km.p.h. [15-25 m.p.h.]).

The case vehicle's contact with the Avalanche involved the front plane, mostly above the front bumper, resulting in a classic front underride damage configuration. Direct damage extended across the entire front plane except the rightmost portion of the right fender, above the bumper, a measured distance of 153 centimeters [60.2 inches]. Crush measurements were taken on the front bumper and on the upper radiator support. Maximum crush was measured as 49 centimeters [19.3 inches] at C4, near the center on the leading edge of the hood. The wheelbase on the case vehicle's left side was shortened 2 centimeters [0.8 inches] while the right side was lengthened 1 centimeter [0.4 inches]. The case vehicle's front bumper and bumper fascia were only slightly contacted but the grille, hood, radiator, and other engine components were directly damaged and crushed rearward. None of the case vehicle's tires were physically restricted or deflated. There was minor cracking along the lower edge of the windshield and no other glazing damage. The leading edge of the left fender was crushed rearward, but the right fender was intact.

The case vehicle's EDR was harvested and forwarded to the NHTSA to be downloaded. The Restraints Control Module (RCM) reports indicate that there were no faults in the automatic restraint circuitry and the air bags were a dual stage system. The driver and front right passenger seat belts are reported as buckled, with the driver's seat reported in the forward position. The driver and front right passenger pretensioners were commanded to actuate at 12.8 milliseconds [0.0128 seconds] after algorithm enable. First stage deployment of the driver's air bag was commanded at 12.8 milliseconds [0.0128 seconds] and first stage deployment of the passenger's air bag was commanded at 18.4 milliseconds [0.0184 seconds]. The second stage deployment was not commanded for either air bag and the second stage charges were disposed at 112.8 milliseconds [0.1128 seconds] (driver) and 118.4 milliseconds [0.1184 seconds] (passenger). The maximum recorded longitudinal delta V was -16.3 km.p.h. [-10.12 m.p.h.] at 63.2 milliseconds [0.0632 seconds] after algorithm enable. The recording stopped at this data point, but this probably reflects a power interruption and the crash pulse recording is probably incomplete.

The case vehicle's driver air bag was located in the steering wheel hub. The air bag module's cover flaps opened at the designated tear points and there was no evidence of damage to the air bag or the cover flaps. The deployed driver's air bag was round with a diameter of 57 centimeters [22.4 inches]. There were routine deployment scuffs but no contact evidence readily apparent on the driver's air bag.

The front right passenger's air bag was located in the top of the instrument panel. The front right air bag module's cover flap opened at the designated tear points and there was no evidence of damage to the air bag or the cover flap. The deployed front right air bag was rectangular with a height of approximately 58 centimeters [22.8 inches] and a width of approximately 48 centimeters [18.9 inches]. There was no contact evidence readily apparent on the front right air bag.

Inspection of the case vehicle's interior revealed a scuff on the driver's knee bolster and a scuff on the back of the driver's head restraint. In addition, there was evidence of safety belt use on the system components at the seat positions corresponding to the five occupants' locations.

Immediately prior to the crash the case vehicle's driver (35-year-old female, white, non-

Hispanic; 163 centimeters and 77 kilograms [64 inches, 170 pounds]) was seated in an upright posture with her back against the seat back. She was restrained by her available, active, three-point, lap-and-shoulder safety belt system. Her seat track was located between its middle and forward-most positions, the seat back was slightly reclined, and the tilt steering wheel was located in its middle position. According to her interview, she had been looking into the back seat. When she looked forward she recognized the impending impact and attempted to cover her face with her arms. At impact, her left foot was on the floor, her right foot was on the foot controls, and both her arms were covering her face in anticipation of the impact.

The case vehicle's driver made no known pre-crash avoidance maneuvers and her posture did not change, except she attempted to cover her face with her arms just prior to impact. The case vehicle's impact with the Avalanche caused the driver's air bag and safety belt pretensioner to deploy and caused the driver to move forward, toward the 12:00 o'clock direction of force as the case vehicle decelerated. She loaded the safety belt webbing and sustained a chest wall contusion, bruising on her left shoulder and abrasions on her abdomen. Her left foot loaded against the floor and she sustained a fracture of the left fourth metatarsal. The driver was not transported by ambulance, but presented herself at a hospital emergency room later the same day, where she was treated and released.

The case vehicle's front right passenger (10-year-old male, white, non-Hispanic; 147 centimeters and 42 kilograms [58 inches, 92 pounds]) was seated in an upright posture with his back against the seat back, his feet on the floor, and had both hands/arms on the armrests. His seat track was located between its middle and rearmost positions, and the seat back was upright. The case vehicle's front right passenger was restrained by his available active, three-point, lap-and-shoulder safety belt system.

The case vehicle's driver made no known pre-crash avoidance maneuvers and the front right passenger's posture did not change. The case vehicle's impact with the Avalanche caused the passenger's air bag and safety belt pretensioner to deploy and caused him to move forward, toward the 12 o'clock direction of force as the case vehicle decelerated. He loaded the safety belt webbing and sustained an abrasion on his right shoulder and contusions and abrasions on his hips. The front right passenger was not transported by ambulance, but was taken to a hospital emergency room later the same day, where he was treated and released.

The case vehicle's second row right passenger (10-year-old male, white, non-Hispanic; 147 centimeters and 54 kilograms [58 inches and 120 pounds]) was seated in an upright posture with his back against the seat, his feet on the floor, and was holding playing cards in his hands. Neither his seat track nor seat back were adjustable. He was restrained by his available active, three-point, lap-and-shoulder safety belt system. The safety belt latch plate was damaged and the belt webbing was twisted and creased where it passes through the latch plate. At impact, he moved forward in response to the deceleration, loading the safety belt webbing, and he sustained contusions on his chest and abdomen. His face struck the back of the front right seat back and he sustained contusions on his forehead and nose. He was not transported by ambulance but was taken to a hospital emergency room later the same day, where he was treated and released.

The case vehicle's back center passenger (7-year-old female, white, non-Hispanic; 134 centimeters and 23.6 kilograms [53 inches and 52 pounds]) was seated in an upright posture with her back against the seat, her feet dangling over the front edge of the seat cushion, and her hands/arms in an unknown position. She was restrained by her available, lap-only safety belt, but the belt was buckled in a very loose fashion (i.e., the belt was not snug around her hips). At impact, she moved forward in response to the deceleration, loading the lap belt and sustaining contusions over both hips and an abrasion on her right hip. The rapid deceleration caused her to bite her lower lip, causing edema. She also sustained an abrasion on her right small finger. She was not transported by ambulance but was taken to a hospital emergency room later the same day, where she was treated and released.

The case vehicle's back right passenger (7-year-old female, white, non-Hispanic; 132 centimeters and 25 kilograms (52 inches and 55 pounds]) was seated in an upright posture with her back against the seat, her feet dangling over the front edge of the seat cushion, and her hands/arms in an unknown position. She was incorrectly restrained by her available, active, three-point, lap-and-shoulder safety belt system, with the lap portion across her hips and the shoulder portion behind her back. At impact, she moved forward in response to the deceleration, loading the lap portion of her safety belt. She sustained abrasions over both hips and a contusion across her lower abdomen. She was not transported by ambulance but was taken to a hospital emergency room later the same day, where she was treated and released.

The first other vehicle was a 2002 Chevrolet Avalanche rear wheel drive, four-door pickup/SUV hybrid (VIN: 3GNEC13TX2G-----). The Avalanche could not be located for inspection and, with no available vehicle photographs, the CDCs for the Avalanche cannot be estimated. According to the police crash report, the Avalanche was impacted on the rear plane by the case vehicle and was pushed forward such that its front contacted the back of the Dodge. The WinSMASH reconstruction program, missing vehicle algorithm based on the case vehicle's crush profile, was used on the Avalanche's rear impact. The Total, Longitudinal, and Lateral Delta Vs for the Avalanche are, respectively: 26 km.p.h. [16.2 m.p.h.], + 26 km.p.h. [+ 16.2 m.p.h.], and 0 km.p.h. [0 m.p.h.]. This is a borderline reconstruction but the results appear reasonable. The crash severity for the Avalanche's rear impact was moderate (24-40 km.p.h. [15 to 25 m.p.h.]). The Avalanche was driven from the scene.

The second other vehicle was a 1997 Dodge Caravan (VIN: 2B4GP44R4VR-----). It did not have any contact with the case vehicle and was not inspected. The Dodge was driven from the scene.

The third other vehicle was a 1986 Chevrolet Blazer SUV (VIN: 1G8EK18H0GF-----). It did not have any contact with the case vehicle and was not inspected. The Blazer was driven from the scene.

The case vehicle was traveling south in the inside southbound lane of a two-lane, one-way roadway that was part of a divided trafficway and intended to continue straight ahead (i.e., both the north and southbound roadways had two through lanes, separated by a curbed, grass median). The Chevrolet Avalanche, the Dodge and the Chevrolet Blazer were all stopped due to congested traffic, heading south in the same lane of the same roadway. There were no adverse weather conditions and it was dark and not lighted. The speed limit was 80 km.p.h. [50 m.p.h.], the concrete road surface was straight, level, dry and there were no roadway defects. The case vehicle's driver made no avoidance maneuvers prior to the crash. The crash occurred in the inside southbound through lane of the roadway (**Figure 1**).

The front of the case vehicle impacted the back of the Avalanche, causing the case vehicle's driver and front right passenger air bags and safety belt pretensioners to deploy. The first impact pushed the Avalanche forward and the front of the Avalanche impacted the back of the Dodge Caravan. Subsequently, the front of the Dodge impacted the back of the Chevrolet Blazer in a chain-reaction, rear-end collision sequence. All four vehicles came to rest near their respective points of impact, in the southbound lane headed south.

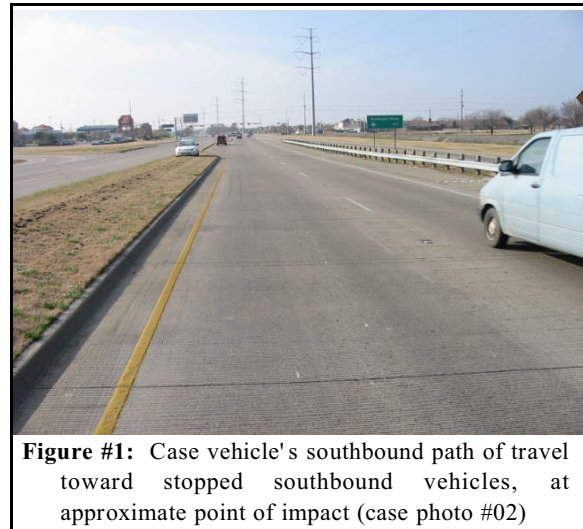


Figure #1: Case vehicle's southbound path of travel toward stopped southbound vehicles, at approximate point of impact (case photo #02)

CASE VEHICLE

The case vehicle was a 2002 Ford Windstar LX front wheel drive, four-door, seven-passenger minivan (VIN: 2FMZA51442B-----), equipped with a 3.8 liter V6 gasoline engine and an automatic transmission with a column-mounted selector lever. The case vehicle was equipped four-wheel anti-lock brakes, frontal air bags with dual-stage inflators and safety belt pretensioners for the two front seats, and driver seat position sensing. The odometer reading is not known due to the non-functional electronic instrument panel, but the driver estimated that there were 9,656 kilometers [6,000 miles] on the case vehicle. Its specification wheelbase was 307 centimeters [120.7 inches]. The case vehicle was towed due to disabling damage.

CASE VEHICLE'S DAMAGE

The case vehicle's contact with the Avalanche involved the front plane, mostly above the front bumper, resulting in a classic front underride damage configuration (**Figures 2 and 3**). Direct damage extended across the entire front plane except the rightmost portion of the right fender, above the bumper, a measured distance of 153 centimeters [60.2 inches]. Crush measurements were taken on the front bumper and on the upper radiator support. Maximum crush was measured as 49 centimeters [19.3 inches] at C4, near the center on the leading edge of the hood. The wheelbase on the case vehicle's left side was shortened 2 centimeters [0.8 inches] while the right side was lengthened 1 centimeter [0.4 inches]. The case vehicle's front bumper and

bumper fascia were only slightly contacted but the grille, hood, radiator, and other engine components were directly damaged and crushed rearward. None of the case vehicle's tires were physically restricted or deflated. There was minor cracking along the base of the windshield and no other glazing damage. Both the right and left headlight and turn signal assemblies were shattered and crushed rearward. The leading edge of the left fender was crushed rearward, but the right fender had only very minor deformation.

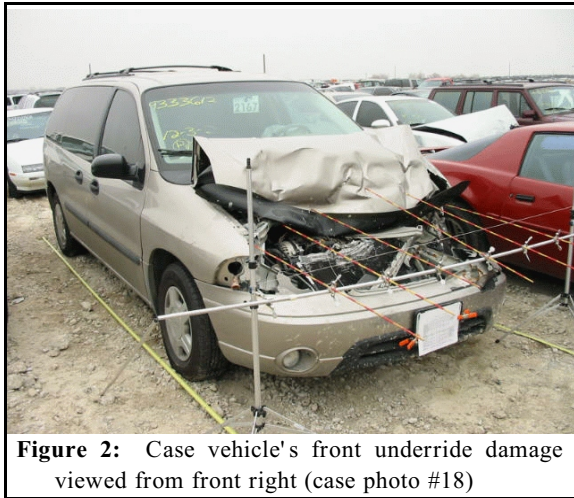


Figure 2: Case vehicle's front underride damage viewed from front right (case photo #18)



Figure 3: Case vehicle's front underride damage viewed from front left (case photo #15)

Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FDEW-3 (0)**. The WinSMASH reconstruction program, missing vehicle algorithm based on the case vehicle's crush profile, was used. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 31.0 km.p.h. [19.3 m.p.h.], -31.0 km.p.h. [-19.3 m.p.h.], and 0 km.p.h. [0 m.p.h.]. This is a borderline reconstruction, but the results appear reasonable. The crash severity for the case vehicle was moderate (24-40 km.p.h. [15-25 m.p.h.]).

Data concerning the case vehicle's tires are presented in the following table.

Tire	Measured Pressure		Recommend Pressure		Tread Depth		Damage	Restricted	Deflated
	kPa	psi	kPa	psi	mm	32 nd			
LF	165	24	241	35	7	9	None	No	No
RF	186	27	241	35	7	9	None	No	No
LR	172	25	241	35	8	10	None	No	No
RR	186	27	241	35	8	10	None	No	No

Inspection of the case vehicle's interior revealed a scuff on the driver's knee bolster and a scuff on the back of the driver's head restraint. In addition, there was evidence of safety belt use on the system components at the seat positions corresponding to the five occupants' locations.

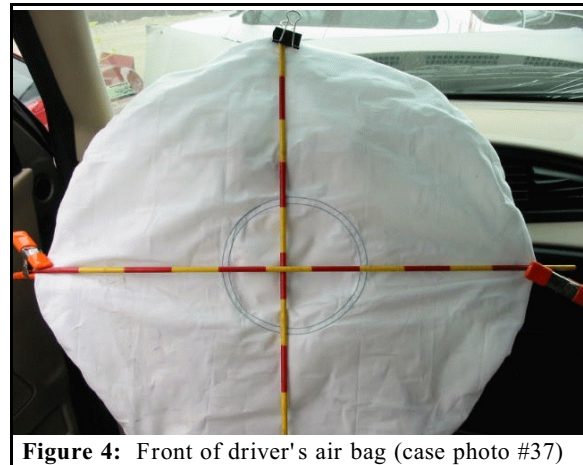
The case vehicle's EDR was harvested and forwarded to the NHTSA to be downloaded. The Restraints Control Module (RCM) reports are included as **Figures 8** and **9**. The System Status at Deployment report (**Figure 8**) indicates that there were no faults in the automatic restraint circuitry and the air bags were a dual stage system. The driver and front right passenger seat belts are reported as buckled, with the driver's seat reported in the forward position. The driver and front right passenger pretensioners were commanded to actuate at 12.8 milliseconds [0.0128 seconds] after algorithm enable. First stage deployment of the driver's air bag was commanded at 12.8 milliseconds [0.0128 seconds] and first stage deployment of the passenger's air bag was commanded at 18.4 milliseconds [0.0184 seconds]. The second stage deployment was not commanded for either air bag and the second stage charges were disposed at 112.8 milliseconds [0.1128 seconds] (driver) and 118.4 milliseconds [0.1184 seconds] (passenger).

The Longitudinal Crash Pulse Graph (**Figure 9**) shows longitudinal delta V as a gradual slope (rather than a spike), with the maximum recorded value -16.3 km.p.h. [-10.12 m.p.h.] at 63.2 milliseconds after algorithm enable. The recording stopped at this data point, but this probably reflects a power interruption and the crash pulse recording is probably incomplete.

AUTOMATIC RESTRAINT SYSTEM

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 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 deployed driver's air bag was round with a diameter of 57 centimeters [22.4 inches] (**Figure 4**). The driver's air bag was designed with two tethers, each 12 centimeters [4.7 inches] wide, and had two vent ports, approximately 3.5 centimeters [1.4 inches] in diameter, located at the 11 and 1 o'clock positions. There were routine deployment scuffs but no contact evidence.

The front right passenger's air bag was located in the top of the instrument panel. An inspection of the module's cover flap and air bag 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 deployed front right air bag was rectangular with a height of approximately 58 centimeters [22.8 inches] and a width of approximately 48 centimeters [18.9 inches] (**Figure 5**). The front right passenger's air bag was



designed without any tethers and had one vent port, approximately 3 centimeters [1.2 inches] in diameter, located at the 9:30 o'clock position. There was no contact evidence on the air bag.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver (35-year-old female, white, non-Hispanic; 163 centimeters and 77 kilograms [64 inches, 170 pounds]) was seated in an upright posture with her back against the seat back. She was restrained by her available, active, three-point, lap-and-shoulder safety belt system. There was evidence of belt pattern bruising and abrasions on her body and the inspection of the driver's seat belt webbing, D-ring, and latch plate showed evidence of loading. Her seat track was located between its middle and forward-most positions, the seat back was slightly reclined, and the tilt steering wheel was located in its middle position. According to her interview, she had been looking into the back seat. When she looked forward she recognized the impending impact and attempted to cover her face with her arms. At impact, her left foot was on the floor, her right foot was on the foot controls, and both her arms were covering her face in anticipation of the impact.

The case vehicle's driver made no known pre-crash avoidance maneuvers and her posture did not change, except she attempted to cover her face with her arms just prior to impact. The case vehicle's impact with the Avalanche caused the driver's air bag and safety belt pretensioner to deploy and caused the driver to move forward, toward the 12:00 o'clock direction of force as the case vehicle decelerated. She loaded the safety belt webbing and sustained a chest wall contusion, bruising on her left shoulder and abrasions on her abdomen. Her left foot loaded against the floor and she sustained a fracture of the left fourth metatarsal. She rebounded from the impact into her seat at final rest.

CASE VEHICLE DRIVER INJURIES

The driver was not transported by ambulance, but presented herself at a hospital emergency room later the same day, where she was treated and released.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Fracture left 4th metatarsal	moderate 852200.2,1	Floor/toe pan	Probable	Emergency room records
2	Contusion chest wall, not further specified	minor 490402.1,4	Torso portion of safety belt system	Probable	Emergency room records
3 4	Abrasions on right and left abdomen, not further specified	minor 590202.1,1 590202.1,2	Lap portion of safety belt system	Probable	Emergency room records
5	Contusion, deep, over left shoulder, not further specified	minor 790402.1,2	Torso portion of safety belt system	Probable	Interviewee (same person)

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

IN-03-003

The case vehicle's front right passenger (10-year-old male, white, non-Hispanic; 147 centimeters and 42 kilograms [58 inches, 92 pounds]) was seated in an upright posture with his back against the seat back, his feet on the floor, and both hands/arms on the armrests. He was restrained by his available active, three-point, lap-and-shoulder safety belt system. His seat track was located between its middle and rearmost positions, and the seat back was upright.

The case vehicle's driver made no known pre-crash avoidance maneuvers and the front right passenger's posture did not change. The case vehicle's impact with the Avalanche caused the passenger's air bag and safety belt pretensioner to deploy and caused him to move forward, toward the 12:00 o'clock direction of force as the case vehicle decelerated. He loaded the safety belt webbing and sustained an abrasion on his right shoulder and contusions and abrasions on his hips. He rebounded into his seat at final rest.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger was not transported by ambulance, but was taken to a hospital emergency room later the same day, where he was treated and released.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion, 12.7 x 7.6 cm (5 x 3 in) right neck—caused bleeding	minor 390202.1,1	Torso portion of safety belt system	Probable	Emergency room records
2 3	Abrasions over right and left abdomen, at iliac crests	minor 590202.1,1 590202.1,2	Lap portion of safety belt system	Probable	Emergency room records
4 5	Contusions {bruises}, 10.2 cm (4 in) over right and left hips, at iliac crests	minor 590402.1,1 590402.1,2	Lap portion of safety belt system	Probable	Interviewee (driver)

CASE VEHICLE SECOND ROW RIGHT PASSENGER KINEMATICS

The case vehicle's second row right passenger (10-year-old male, white, non-Hispanic; 147 centimeters and 54 kilograms [58 inches and 120 pounds]) was seated in an upright posture with his back against the seat back, his feet on the floor, and was holding playing cards in his hands. Neither his seat track nor seat back were adjustable. He was restrained by his available active, three-point, lap-and-shoulder safety belt system.

The second row right safety belt latch plate showed evidence of damage beyond basic loading stress. The safety belt system was fitted with a light weight locking/cinching latch plate. The guide bar was visibly deformed and the plastic casing was stressed. The cinch bar was manufactured with a convex profile, but one end of the cinch bar was partially torn from its

housing and had been deformed into a concave profile. At the time of the inspection, the belt webbing was found folded and creased where it passed through the latch plate (**Figures 6 and 7**).



Figure 6: Top of second row right safety belt latch plate; note, guide bar deformed (right) and cinch bar torn and deformed (left) (case photo #44)



Figure 7: Bottom of second row right safety belt latch plate (case photo #45)

The case vehicle's driver made no known pre-crash avoidance maneuvers and the second row right passenger's posture did not change. At impact, he moved forward in response to the deceleration, loading the safety belt webbing, and he sustained contusions on his chest and abdomen. His face struck the back of the front right seat back and he sustained contusions on his forehead and nose. He rebounded into his seat at final rest.

CASE VEHICLE SECOND SEAT RIGHT PASSENGER INJURIES

This passenger was not transported by ambulance but was taken to a hospital emergency room later the same day, where he was treated and released.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion {bruise} forehead, not further specified	minor 290402.1,7	Seat back, front right passenger's	Probable	Emergency room records
2	Contusion {bruise} nose, not further specified	minor 290402.1,4	Seat back, front right passenger's	Probable	Emergency room records
3	Contusion left chest, not further specified	minor 490402.1,2	Unknown contact mechanism	Unknown	Emergency room records
4	Contusion {bruise} abdomen, not further specified	minor 590402.1,8	Lap portion of safety belt system	Certain	Emergency room records

The case vehicle's back center passenger (7-year-old female, white, non-Hispanic; 134 centimeters and 23.6 kilograms [53 inches and 52 pounds]) was seated in an upright posture with her back against the seat back, her feet dangling over the front edge of the seat cushion, and her hands/arms in an unknown position. She was restrained by her lap-only safety belt, but the belt was buckled in a very loose fashion (i.e., the belt was not snug around her hips).

The case vehicle's driver made no known pre-crash avoidance maneuvers and the third row center passenger's posture did not change. At impact, she moved forward in response to the deceleration, loading the lap belt and sustaining contusions over both hips and an abrasion on her right hip. The rapid deceleration caused her to bite her lower lip, causing edema. She also sustained an abrasion on her right small finger. She rebounded into her seat at final rest.

CASE VEHICLE BACK CENTER PASSENGER INJURIES

The back center passenger not transported by ambulance but was taken to a hospital emergency room later the same day, where she was treated and released.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion lower lip with edema	minor 290402.1,8	Noncontact injury: bit lip with teeth	Probable	Emergency room records
2	Abrasion right pelvis	minor 590202.1,1	Lap portion of safety belt system	Probable	Emergency room records
3 4	Contusions {bruises} over bilateral hips	minor 590402.1,1 590402.1,2	Lap portion of safety belt system	Probable	Emergency room records
5	Abrasion right small finger, not further specified	minor 790202.1,1	Unknown contact mechanism	Unknown	Emergency room records

CASE VEHICLE BACK RIGHT PASSENGER KINEMATICS

The case vehicle's third row right passenger (7-year-old female, white, non-Hispanic; 132 centimeters and 25 kilograms (52 inches and 55 pounds]) was seated in an upright posture with her back against the seat back, her feet dangling over the front edge of the seat cushion, and her hands/arms were in an unknown position. This passenger was incorrectly restrained by her available, active, three-point, lap-and-shoulder safety belt system, with the lap portion across her hips and the shoulder portion behind her back. There was no evidence of usage on the webbing or D-ring. She rebounded into her seat at final rest.

The back right passenger was not transported by ambulance but was taken to a hospital emergency room later the same day, where she was treated and released.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1 2	Abrasions over right and left hips, not further specified	minor 590202.1,1 590202.1,2	Lap portion of safety belt system	Probable	Emergency room records
3	Contusions {bruising}, 15.2 x 2.5 cm (6 x 1 in) across lower abdomen	minor 590402.1,8	Lap portion of safety belt system	Probable	Interviewee (driver)

First Other Vehicle

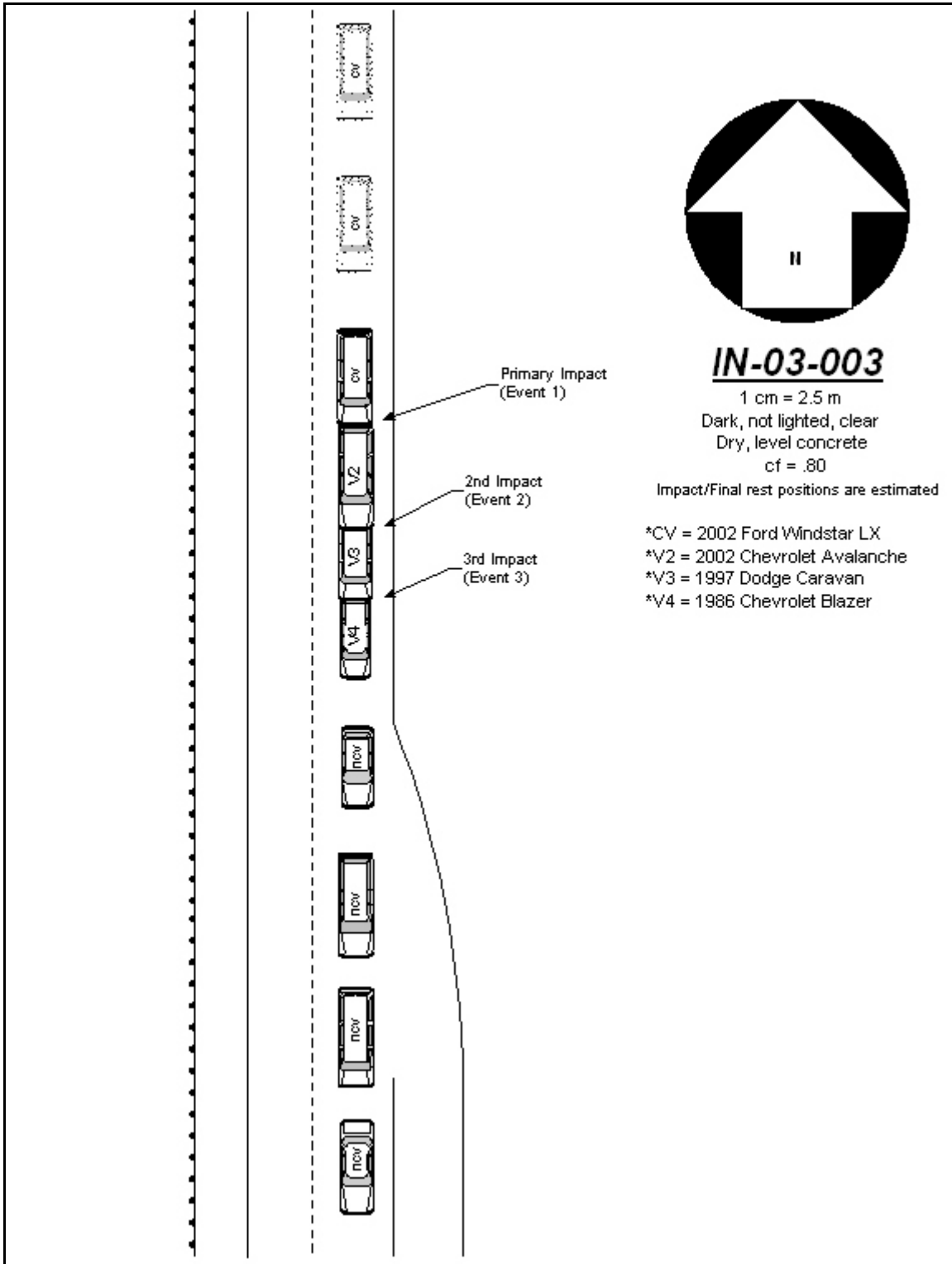
The first other vehicle was a 2002 Chevrolet Avalanche rear wheel drive, four-door pickup/SUV hybrid (VIN: 3GNEC13TX2G-----). The Avalanche could not be located for inspection and, with no available vehicle photographs, the CDCs for the Avalanche cannot be estimated. According to the police crash report, the Avalanche was impacted on the rear plane by the case vehicle and was pushed forward such that its front contacted the back of the Dodge. The WinSMASH reconstruction program, missing vehicle algorithm based on the case vehicle's crush profile, was used on the Avalanche's rear (first) impact. The Total, Longitudinal, and Lateral Delta Vs for the Avalanche are, respectively: 26 km.p.h. [16.2 m.p.h.], + 26 km.p.h. [+ 16.2 m.p.h.], and 0 km.p.h. [0 m.p.h.]. This is a borderline reconstruction but the results appear reasonable. The crash severity for the Avalanche was moderate (24-40 km.p.h. [15 to 25 m.p.h.]). The Avalanche was driven from the scene.

SECOND OTHER VEHICLE

The second other vehicle was a 1997 Dodge Caravan (VIN: 2B4GP44R4VR-----), did not have any contact with the case vehicle and was not inspected. The Dodge was driven from the scene.

THIRD OTHER VEHICLE

The third other vehicle was a 1986 Chevrolet Blazer SUV (VIN: 1G8EK18H0GF-----), did not have any contact with the case vehicle and was not inspected. The Blazer was driven from the scene.



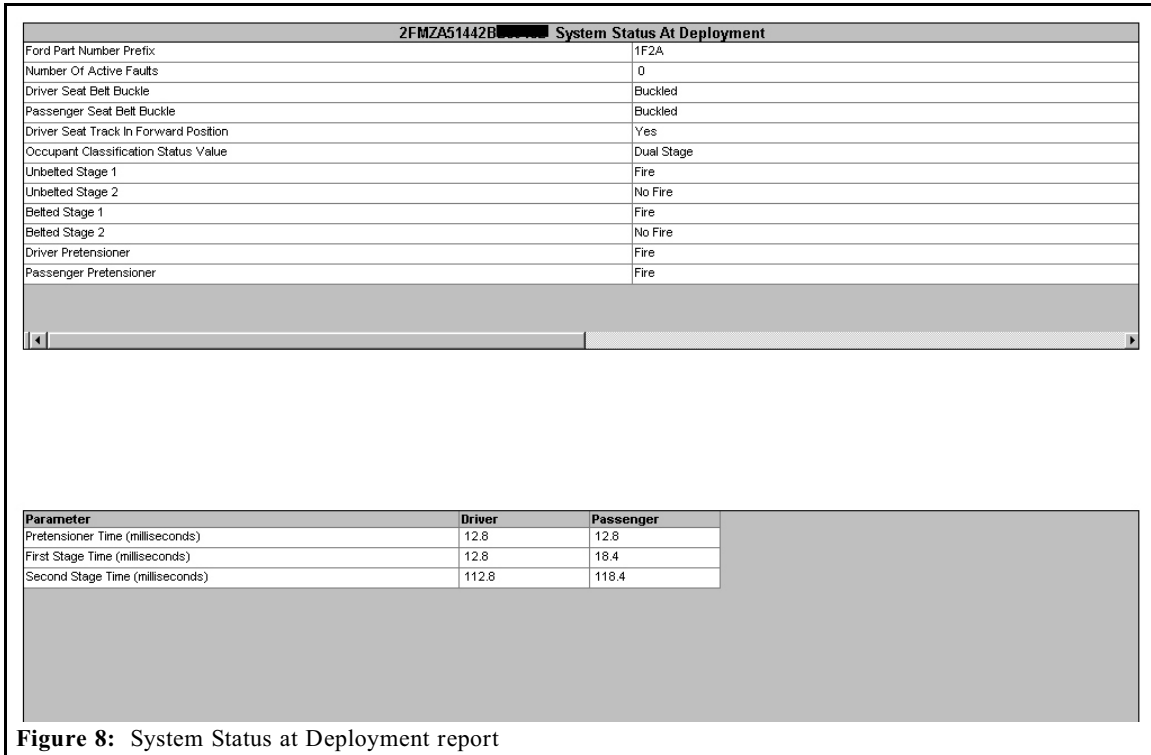


Figure 8: System Status at Deployment report

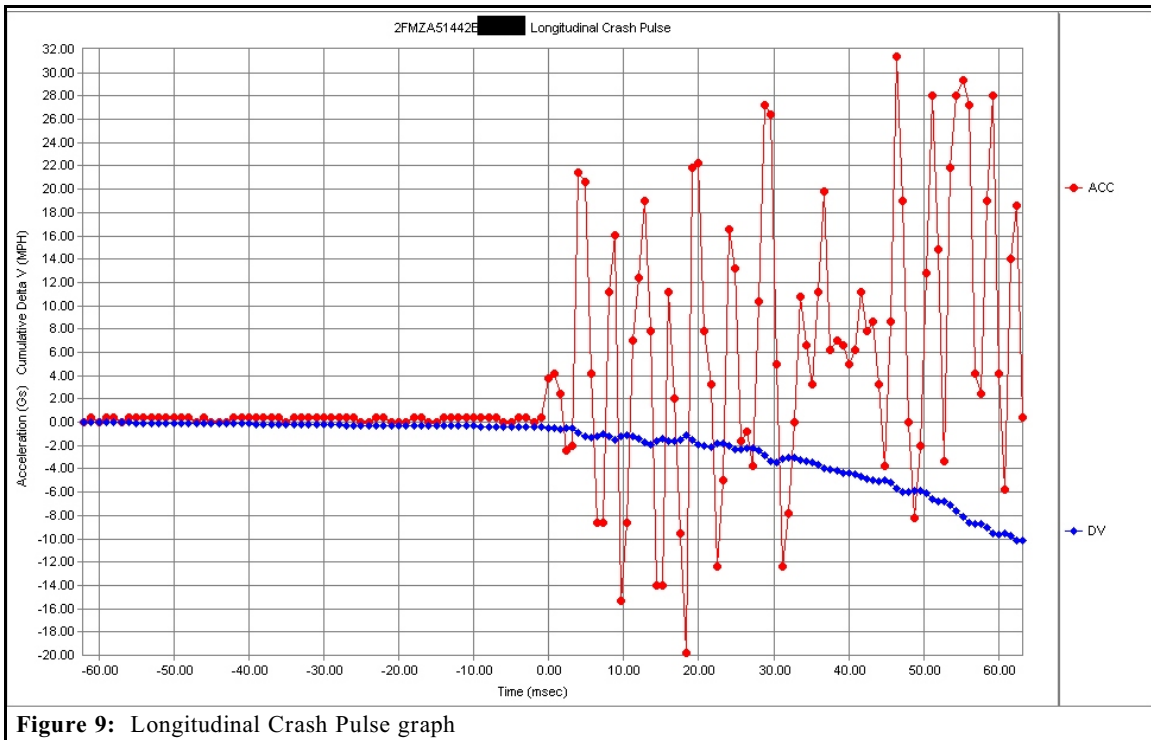


Figure 9: Longitudinal Crash Pulse graph