INDIANA UNIVERSITY
TRANSPORTATION RESEARCH CENTER
School of Public and Environmental Affairs
222 West Second Street
Bloomington, Indiana 47403-1501
(812) 855-3908 Fax: (812) 855-3537

ON-SITE ADVANCED OCCUPANT PROTECTION SYSTEM INVESTIGATION

CASE NUMBER - IN-02-001
LOCATION - TEXAS
VEHICLE - 2000 CADILLAC DEVILLE TOURING SEDAN
CRASH DATE - December 2001

Submitted:

November 25, 2003

Contract Number: DTNH22-01-C-07002

Prepared for:

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

DISCLAIMERS

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

Technical Report Documentation Page

1. *Report No.* IN-02-001	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* On-Site Advanced Occupant Protection System Investigation Vehicle - 2000 Cadillac DeVille Touring Sedan Location - Texas		5. *Report Date:* November 26, 2003 6. *Performing Organization Code*	
7. *Author(s)* Special Crash Investigations Team #2		8. *Performing Organization Report No.*	
9. *Performing Organization Name and Address* Transportation Research Center Indiana University 222 West Second Street Bloomington, Indiana 47403-1501		10. *Work Unit No. (TRAIS)* 11. *Contract or Grant No.* DTNH22-01-C-07002	
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation (NRD-32) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003		13. *Type of Report and Period Covered* Technical Report Crash Date: December, 2001 14. *Sponsoring Agency Code*	
15. *Supplementary Notes* On-site AOPS air bag deployment investigation involving a 2000 Cadillac DeVille, four-door sedan, with manual safety belts and dual front air bags air bags, and a 1996 Mercury Mystique GS, four-door sedan			

16. *Abstract*

This report covers an on-site investigation of an air bag deployment crash that involved a 2000 Cadillac DeVille Touring Sedan (case vehicle) and a 1996 Mercury Mystique GS (other vehicle). This crash is of special interest because the case vehicle was equipped with multiple **A**dvanced **O**ccupant **P**rotection **S**ystem (AOPS) features, as well as an **E**vent **D**ata **R**ecorder (EDR) and both the case vehicle's driver (70-year-old male) **and** front right passenger (wife; 68-year-old female) sustained only minor injuries from their respective deploying air bags. The case vehicle was traveling northeastward in the northeastbound lane of a two-lane, undivided, city street. The Mercury had been traveling southwestward in the southwestbound lane of the same two-lane, undivided, city street but, for unknown reasons, crossed the roadway's centerline. Impact occurred in the northeastbound lane of the roadway. The front left of the case vehicle was impacted by the front left of the Mercury, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle's driver was seated with his seat track located between its middle and rearmost positions, and the tilt steering wheel was located in its middle position. He was restrained by his available, active, three-point, lap-and-shoulder, safety belt system which was equipped with a pretensioner. He sustained, according to his interview and medical records, minor injuries which included: a cervical strain and a chest contusion. The case vehicle's driver attributed the chest contusion to contact with his air bag. In this contractor's opinion, the cervical strain was most likely caused by his deploying air bag and the chest contusion by his seat belt system. The front right passenger was seated with her seat track located between its middle and rearmost positions and was restrained by her available, active, three-point, lap-and-shoulder, safety belt system which was equipped with a pretensioner. She sustained, according to her medical records and the driver's interview, minor injuries which included: a chest wall contusion and a lower abdominal contusion. The back left and back right passengers (daughters, 45-year-old and 48-year-old females) were seated but their seat track was not adjustable. Both were restrained by their available, active, three-point, lap-and-shoulder, safety belt systems. According to their medical records and the driver's interview, the back left passenger sustained minor contusions to her left forehead, left chest, left upper arm, and left leg. The back right passenger sustained a serious "blow-out" fracture of her left orbital rim, a minor nonanatomic brain injury, and contusions to the left eye, chest, and leg.

17. *Key Words* Air Bag Deployment Motor Vehicle Traffic Crash Injury Severity		18. *Distribution Statement* General Public		
19 *Security Classif. (of this report)* Unclassified	20. *Security Classif. (of this page)* Unclassified	21. *No. of Pages* 22	22. *Price* $10,500	

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

TABLE OF CONTENTS IN-02-001

Page No.

SELECTED PHOTOGRAPHS (Continued)

This on-site investigation was brought to NHTSA's attention on January 15, 2002, by NASS sampling activities. This crash involved a 2000 Cadillac DeVille Touring Sedan (case vehicle) and a 1996 Mercury Mystique GS (other vehicle). The crash occurred in December 2001, at 9:54 p.m., in Texas, and was investigated by the applicable city police department. This crash is of special interest because the case vehicle was equipped with multiple **A**dvanced **O**ccupant **P**rotection **S**ystem (AOPS) features, as well as an **E**vent **D**ata **R**ecorder (EDR) and both the case vehicle's driver [70-year-old, Black (non-Hispanic) male] **and** front right passenger [wife; 68-year-old, Black (non-Hispanic) female] sustained only minor injuries from their respective deploying air bags. This contractor inspected the scene and vehicles on 22-23 January, 2002. This contractor interviewed the case vehicle's driver on January 16, 2002. This summary is based on the Police Crash Report, an interview with the 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 northeastward in the northeastbound lane of a two-lane, undivided, city street and intended to continue its northeastbound travel path. The Mercury had been traveling southwestward in the southwestbound lane of the same two-lane, undivided, city street, intending to continue its southwestbound travel path but, for unknown reasons, crossed the roadway's centerline. The case vehicle's driver made no avoidance maneuvers prior to the crash. Impact occurred in the northeastbound lane of the roadway; see **CRASH DIAGRAM** at end.

The front left of the case vehicle was impacted by the front left of the Mercury, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. Although the case vehicle was equipped with side impact air bags for the outboard occupants in both front and back seats, none of these four side air bags deployed. Furthermore, the case vehicle's driver and front right passenger seating positions were equipped with seat belt pretensioners which were activated by the frontal impact. The case vehicle and the Mercury both rotated counterclockwise after impact. The case vehicle rotated approximately 180 degrees counterclockwise and came to rest on the southeast roadside, facing southwest. Likewise, the Mercury rotated approximately 170 degrees counterclockwise and came to rest straddling the centerline, facing east-northeast.

The 2000 Cadillac DeVille Touring Sedan was a front wheel drive, four-door sedan (VIN: IG6KF5799YU------). The case vehicle was equipped with four-wheel, anti-lock brakes and single-stage, redesigned air bags. In addition, the case vehicle was also equipped with an **E**vent **D**ata **R**ecorder (**EDR**). Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FLEE-6** (**0** degrees). The WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity impact because the vehicle's direct crash damage was outside-the-scope of the reconstruction program (i.e., the damage began as a sideswipe type impact prior to the left front wheel assembly being snagged by the Mercury). The Total, Longitudinal, and Lateral Delta Vs are, respectively: 21.4 km.p.h. (13.3 m.p.h.), -21.4 km.p.h. (-13.3 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). Based on the vehicle inspection and

the data from the **EDR**, this collision reconstruction should be considered borderline, and the results appear to be low. The case vehicle was towed due to damage.

The case vehicle's contact with the Mercury involved the extreme front left corner of the bumper. Direct damage began 76.5 centimeters (30.1 inches) left of the front bumper's center and extended, a measured distance of 8 centimeters (3.1 inches), leftward to the bumper corner. The direct contact to the case vehicle extended down its left side past the base of the windshield. The wheelbase on the case vehicle's left side was shortened 42 centimeters (16.5 inches), while the right side was shortened 3 centimeters (1.2 inches). The case vehicle's front left bumper, bumper fascia, left headlight and turn signal assemblies, left fender, and left front tire and wheel assembly were directly damaged and crushed rearward. The left front wheel separated from the front axle, the tie rod, and the steering arm, and the suspension system was damaged, as well. The case vehicle's left front tire was physically restricted and driven into the lower left "A"-pillar. The forward portion of the left rocker panel and the lower front left corner of the left front door sustained induced damage. Remote buckling was found at the left front door's upper window frame and, also, at the lower right corner of the door's rear seam where it meets the left "B"-pillar.

The data downloaded from the case vehicle's **EDR** showed the vehicle's SIR warning lamp status, driver's seat belt buckle status, brake switch status for the five recorded sample periods preceding the **ALGORITHM ENABLE**, ignition cycles at deployment, and velocity change (i.e., Delta V). Downloaded data of interest indicated the following. The case vehicle's driver seat belt status showed it was **"not buckled"**, and the Delta V reached a value of 27.0 km.p.h. (16.8 m.p.h.) at the 140 millisecond mark of recorded data; see **EVENT DATA RECORDER DATA** below. Although the case vehicle's **EDR** recorded an "**UNBUCKLED**" status, the physical evidence indicates that the driver was restrained. This contractor believes that the recorded Delta V is reasonable considering the amount of deformation to the case vehicle's front left wheel assembly and resultant intrusion into the driver's seating area.

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 the air bag's 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 four tethers, each 8 centimeters (3.1 inches) wide, and attached to the center circular stitching. The driver's air bag had two vent ports, approximately 3 centimeters (1.2 inches) in diameter, located at the 11 and 1 o'clock positions. The deployed driver's air bag was elliptical with a height of approximately 64 centimeters (25.2 inches) and a width of approximately 46 centimeters (18.1 inches). An inspection of the driver's air bag revealed that there was no contact evidence readily apparent on the air bag's fabric.

The front right passenger's air bag was located in the middle of the instrument panel. There was no module cover flap. Rather, as the deploying air bag expands, it forces the top, padded portion of the instrument panel upward, by an approximate 5 centimeters (2.0 inches), creating an opening between the horizontal top and the vertical front of the instrument panel. The air bag deployed through this opening. The automobile manufacturer refers to this design as an **ACTIVE**

INSTRUMENT PANEL. An inspection of the front right instrument panel and air bag's fabric revealed that the instrument panel opened at the designated points of attachment, and there was no evidence of damage during the deployment to the air bag or the instrument panel. The front right passenger's air bag was designed without any tethers, but it did have two vent ports, approximately 6 centimeters (2.4 inches) in diameter, located at the 3 and 9 o'clock positions. The deployed front right air bag was rectangular with a height of approximately 42 centimeters (16.5 inches) and a width of approximately 35 centimeters (13.8 inches). An inspection of the front right passenger's air bag revealed that there was no contact evidence readily apparent on the air bag's fabric.

Inspection of the case vehicle's interior revealed hair deposits on the roof over both the driver and front right passenger seating positions. Furthermore, there was a scrape on the roof area above the driver's seat and there was hair on the left corner of the front right passenger's sun visor; however, in this contractor's opinion, there is no evidence that the front right passenger moved forward and upward enough to contact the right sun visor. Furthermore, the roof deposits could have been spurious or they could have occurred as the front occupants were rebounding backward during the vehicle's post-impact trajectory, but there are no injuries, for either front seat occupant, associated with these deposits. The back left passenger contacted the left rear door glazing and the door panel, both above and below the armrest. Furthermore, the back left passenger imprinted lipstick on the back of the driver's seat and deposited blood on her own seat cushion, back rest, and the webbing of her safety belt. The back right passenger contacted the right rear door panel above the armrest and fractured the back panel of the front right passenger's seat back. There was extensive intrusion into the driver's seating area. The steering assembly was driven upwards while the floor pan, hood latch lever, side panel forward of the left "A"-pillar, and door side panel intruded laterally. The steering column was completely separated from its shear capsules and could be moved up and down.

The 1996 Mercury Mystique GS was a front wheel drive, four-door sedan (VIN: 1MELM6538TK------). Anti-lock brakes are an option for this vehicle, but it is unknown if the Mercury was so equipped. Based on the vehicle inspection, the CDC for the Mercury was determined to be: **12-FLEW-3** (**0** degrees).

The Mercury's contact with the case vehicle involved the front left one-third of the front bumper. Direct damage began 37 centimeters (14.6 inches) leftward from the center of the front bumper and extended, a measured distance of 42 centimeters (16.5 inches), along the front bumper to the front left bumper corner. Maximum crush was measured as 73 centimeters (28.7 inches) at C_1; however, residual crush was 65 centimeters (25.6 inches) at C_1. The wheelbase on the Mercury's left side was shortened 20 centimeters (7.9 inches), while the right side was extended 6 centimeters (2.4 inches). The Mercury's front left splash guard, front bumper, bumper fascia, grille, front left corner of the hood, left headlight and turn signal assemblies, and left fender were directly damaged and crushed rearward. The Mercury's left front tire was displaced rearward and physically restricted by the lower left "A"-pillar. The Mercury was towed due to damage.

Immediately prior to the crash the case vehicle's driver [183 centimeters and 107 kilograms (72 inches, 235 pounds)] was seated in an upright posture with his back against the seat back, his

left foot on the floor, his right foot on the accelerator, and both hands on the steering wheel. His seat track was located between its middle and rearmost positions, the seat back was slightly reclined, and the tilt steering wheel was located in its middle position. The case vehicle was also equipped with a telescopic steering wheel which was located in its middle position.

The case vehicle's driver was restrained by his available, active, three-point, lap-and-shoulder, safety belt system; the belt system was equipped with a pretensioner. Furthermore, the driver reported a belt pattern contusion to his chest that is most likely consistent with his use of the safety belt. In addition, the inspection of his seat belt webbing showed evidence of loading and revealed that the pretensioner had fired. The case vehicle had a seat integrated safety belt system and, thus, there was no "D"-ring. The latch plate showed evidence of recent usage, but no loading damage was noted. Although the driver's seat belt pretensioner had fired because of the intrusion into the driver's seating area, which resulted in the driver's seat being moved slightly toward the center console, the seat belt pretensioner's piston stroke could not be measured.

The case vehicle's driver made no known pre-crash avoidance maneuvers. As a result and independent of the use of his available safety belts, his position did not change just prior to impact. The case vehicle's impact with the 1996 Mercury enabled the case vehicle's driver to move forward and slightly upward, loading his safety belt system as he moved toward the case vehicle's **0** degree Direction of Principal Force as the case vehicle decelerated. The initial narrow end engagement and subsequent wheel interaction (i.e., similar to a sideswiping impact that starts on the side but results in pocketing) resulted in the air bag deploying late during the sequence of the impact. This delayed deployment occurred due to the prolonged change in time (Delta T) relative to the change in speed (magnitude of Delta V–i.e., ramp versus spike). Because of the driver's seat track position and his use of the available restraints, the driver's interaction with the deploying air bag was most likely minimized (i.e., he contacted the deploying air bag near the outermost portion of the air bag's excursion area). After contacting the deploying air bag the driver most likely rebounded backwards toward his seat back; however, it is possible that his backwards trajectory was such that the top of his scalp scraped the roof overlying his seating position. After the initial impact, the case vehicle rotated counterclockwise. During that counterclockwise rotation, the driver most likely moved to his left against the left front door panel. According to the driver's interview, when the case vehicle reached its final rest position he was sitting upright in his seat with his chin on his chest (i.e., the driver indicated that he had experienced a "brief loss of consciousness").

The driver was driven by a relative from the crash scene to a hospital. He sustained minor injuries and was treated and released. According to his interview and medical records, the injuries sustained by the case vehicle's driver included: a cervical strain, a chest contusion, and general body soreness. The case vehicle's driver attributed the chest contusion to contact with his air bag. In this contractor's opinion, the cervical strain was most likely caused by his deploying air bag and the chest contusion by his seat belt system.

The case vehicle's front right passenger [wife; 155 centimeters and 64 kilograms (61 inches, 140 pounds)] was seated in an upright posture with her back against the seat back and her feet on

the floor; however, the exact position of her hands is not known. Her seat track was located between its middle and rearmost positions, and her seat back was slightly reclined.

The case vehicle's front right passenger was restrained by her available, active, three-point, lap-and-shoulder, safety belt system; the belt system was also equipped with a pretensioner. Furthermore, according to the driver's interview, there was evidence of belt pattern bruising to the front right passenger's body, and the inspection of the front right passenger's seat belt webbing showed evidence of loading. The front right seat belt system was also seat integrated and, thus, there was no "D"-ring. The latch plate showed evidence of recent usage, but no loading damage was noted. The piston stroke for this seat position's seat belt pretensioner was measured at 3.5 centimeters (1.4 inches).

The front right passenger was taken by ambulance from the crash scene to a hospital. She sustained minor injuries and was treated and released. According to her medical records and the interview with the case vehicle's driver, her injuries included: a chest wall contusion and a lower abdominal contusion. In this contractor's opinion, the chest wall contusion was most likely caused by her deploying air bag and the abdominal contusion by the lap belt portion of her seat belt system.

The case vehicle's back left passenger [daughter of the driver; 45-year-old, Black (non-Hispanic) female; 170 centimeters and 64 kilograms (67 inches and 140 pounds)] was seated in an upright posture with her back against the seat back and her feet on the floor; however, the exact position of her hands is not known. Her seat track and seat back were not adjustable.

This back left passenger was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was no reported evidence of belt pattern bruising and/or abrasions to the back left passenger's body, and the inspection of the back left passenger's seat belt webbing showed evidence of usage. The back left seat belt system was also seat integrated and, thus, there was no "D"-ring. The latch plate showed evidence of recent usage, but no loading damage was noted.

The back left passenger accompanied her mother and sister (i.e., front right passenger and back right passenger, respectively) in an ambulance to a hospital. She sustained minor injuries and, while at the hospital, her injuries were examined and she was released. According to her medical records and the driver's interview, her injuries included: contusions to her left forehead, left chest, left upper arm, and left leg. Based on the interior inspection, the back left passenger most likely sustained her head injury when she contacted the driver's seat back. On the other hand, the remainder of her injuries most likely resulted during the case vehicle's counterclockwise rotation as she loaded the interior surface of the left rear door.

The case vehicle's back right passenger [daughter of the driver; 48-year-old, Black (non-Hispanic) female; 163 centimeters and 64 kilograms (64 inches and 140 pounds)] was seated in an upright posture with her back against the seat back and her feet on the floor. Once again, however, the exact position of her hands is not known. Her seat track and seat back were not adjustable.

The back right passenger was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was reported evidence of belt pattern bruising to the back right passenger's body (i.e., a chest contusion), and the inspection of the back right passenger's seat belt webbing showed evidence of usage. The back right seat belt system was also seat integrated and, thus, there was no "D"-ring. The latch plate showed evidence of recent usage, but no loading damage was noted

She was transported by ambulance to a hospital along with her mother and sister (i.e., back left passenger). She sustained minor injuries and was treated and released. According to her medical records and the driver's interview, her injuries included: a "blow-out" fracture of her left orbital rim, a minor nonanatomic brain injury, and contusions to the left eye, chest, and leg or legs (i.e., the driver could not recall if one or the other or both legs were injured). In this contractor's opinion, her eye fracture and contusion and her nonanatomic brain injury, as well as her leg contusion(s), were most likely caused by contacting the front right passenger's seat back. On the other hand, her chest contusion was most likely caused by her safety belt system.

There were three teenage occupants in the Mercury. There was a driver (16-year-old female), a front right passenger (16-year-old female), and a back right passenger (17-year-old female). According to the Police Crash Report, both front seat occupants were restrained by their available, active, three-point, lap-and-shoulder, safety belt systems. The Mercury was equipped with dual front supplemental restraint (air bags) systems that deployed during the crash. The back right passenger, according to the Police Crash Report, was not restrained. The Mercury's driver and back right passenger sustained non-incapacitating ("B") injuries and the front right passenger sustained possible ("C") injuries.

CRASH CIRCUMSTANCES

Figure 1: Case vehicle's northeastward travel path along roadway at approximate location of crash (case photo #01)

The case vehicle was traveling northeastward in the northeastbound lane of a two-lane, undivided, city street and intended to continue its northeastbound travel path (**Figure 1**). The Mercury had been traveling southwestward in the southwestbound lane of the same two-lane, undivided, city street, intending to continue its southwestbound travel path but, for unknown reasons, crossed the roadway's centerline. The case vehicle's driver made no avoidance maneuvers prior to the crash. Impact occurred in the northeastbound lane of the roadway; see **CRASH DIAGRAM** at end.

The city roadway was straight and had a 3.3% grade positive to the northeast (i.e., upgrade in the case vehicle's direction of travel) at the area of impact. The pavement was bituminous, but traveled and worn, and the width of the northeastbound lane was 4.4 meters (14.4 feet) and the southwestbound lane was 4.0 meters (13.1 feet). The shoulders were not improved (i.e., grass) and the roadway was not bordered by curbs. Pavement markings consisted of a double solid yellow centerline for both the northeast and southwestbound traffic. In addition, no edge lines

were present. The estimated coefficient of friction was 0.55 (0.70 when dry). There were no visible traffic controls. The statutory speed limit was 56 km.p.h. (35 m.p.h.). No regulatory speed limit sign was posted near the crash site. At the time of the crash the light condition was dark, the atmospheric condition was raining, and the road pavement was wet. Traffic density was light, and the site of the crash was urban undeveloped.

Figure 2: Case vehicle's front left damage viewed from left of front; Note: direct damage continues down left side and involves left outside rearview mirror and left front wheel was displaced rearward (case photo #08)

The front left of the case vehicle (**Figure 2**) was impacted by the front left of the Mercury (**Figure 3**), causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. Although the case vehicle was equipped with side impact air bags for the outboard occupants in both front and back seats, none of these four side air bags deployed. Furthermore, the case vehicle's driver and front right passenger seating positions were equipped with seat belt pretensioners which were activated by the frontal impact. The case vehicle and the Mercury both rotated counterclockwise after impact. The case vehicle rotated approximately 180 degrees counterclockwise and came to rest on the southeast roadside, facing southwest. Likewise, the Mercury rotated approximately 170 degrees counterclockwise and came to rest straddling the centerline, facing east-northeast.

Figure 3: Mercury's front left damage, viewed from left of front, from impact with case vehicle (case photo #60)

CASE VEHICLE

The 2000 Cadillac DeVille Touring Sedan was a front wheel drive, five-passenger, four-door sedan (VIN: 1G6KF5799YU------) equipped with a 4.6L, V-8 engine and a four-speed automatic transmission. Braking was achieved by a power-assisted, front and rear disc, four-wheel, anti-lock system. The case vehicle's wheelbase was 293 centimeters (115.4 inches), and the odometer reading at inspection is unknown because the case vehicle was equipped with an electronic odometer. The case vehicle was equipped with advanced occupant protection system features including single-stage, redesigned air bags, pretensioners, and an **E**vent **D**ata **R**ecorder (**EDR**).

Inspection of the vehicle's interior revealed adjustable front bucket seats with adjustable head restraints; a non-adjustable back bench seat with integral head restraints for all three back seating positions; and integral, continuous loop, three-point, lap-and-shoulder, safety belt systems at all front and back positions. The exact position adjustment for either of the two front adjustable head restraints was not determined. As a result, there were no "D"-rings or upper anchorage adjusters on any of the five seating positions. The vehicle was equipped with knee bolsters for both the

driver and front right passenger, neither of which were deformed. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a frontal air bag for the driver and front right passenger seating positions. In addition, the vehicle was equipped with front and back, seat back-mounted, side impact air bags. Both frontal air bags deployed as a result of the case vehicle's very narrow frontal impact with the Mercury. None of the case vehicle's seat back-mounted side impact air bags deployed as a result of the case vehicle's frontal impact.

CASE VEHICLE DAMAGE

Figure 4: Elevated view of case vehicle's frontal damage with contour gauge present at bumper level; Note: yellow tape (arrow) marks width of direct damage on bumper (case photo #06)

The case vehicle's contact with the Mercury involved the extreme front left corner of the bumper (**Figure 4**). Direct damage began 76.5 centimeters (30.1 inches) left of the front bumper's center and extended, a measured distance of 8 centimeters (3.1 inches), leftward to the bumper corner. The direct contact to the case vehicle extended down its left side past the base of the windshield. The wheelbase on the case vehicle's left side was shortened 42 centimeters (16.5 inches), while the right side was shortened 3 centimeters (1.2 inches). The case vehicle's front left bumper, bumper fascia, left headlight and turn signal assemblies, left fender, and left front tire and wheel assembly were directly damaged and crushed rearward. The left front wheel separated from the front axle, the tie rod, and the steering arm, and the suspension system was damaged, as well (**Figure 5**). The case vehicle's left front tire was physically restricted and driven into the lower left "A"-pillar. The forward portion of the left rocker panel and the lower front left corner of the left front door sustained induced damage. Remote buckling was found at the left front door's upper window frame and, also, at the lower right corner of the door's rear seam where it meets the left "B"-pillar.

Figure 5: Case vehicle's front left damage viewed from left; Note: left front tire and wheel assembly were crushed rearward and separated from front axle, tire rod, steering arm, and suspension (case photo #11)

Figure 6: Case vehicle's roof and windshield header areas showing hair deposits on roof over both front passenger positions, hair deposit on front right sun visor, and a scrape over driver's position (case photo #28)

Inspection of the case vehicle's interior revealed hair deposits on the roof over both the driver and front right passenger seating positions. Furthermore, there was a scrape on the roof area above the driver's seat and there was hair on the left corner of the front right passenger's sun visor (**Figure 6** above); however, in this contractor's opinion, there is no evidence that the front right passenger moved forward and upward enough to contact the right sun visor. Furthermore, the roof deposits could have been spurious or they could have occurred as the front occupants were rebounding backward during the vehicle's post-impact trajectory, but there are no injuries, for either front seat occupant, associated with these deposits. The back left passenger contacted the left rear door glazing and the door panel, both above and below the armrest. Furthermore, the back left passenger imprinted lipstick on the back of the driver's seat (**Figure 7**) and deposited blood on her own seat cushion, back rest, and the webbing of her safety belt. The back right passenger contacted the right rear door panel above the armrest and fractured the back panel of the front right passenger's seat back (**Figure 8**). There was extensive intrusion into the driver's seating area. The steering assembly was driven upwards while the floor pan, hood latch lever, side panel forward of the left "A"-pillar, and door side panel intruded laterally (**Figure 9**). The steering column was completely separated from its shear capsules and could be moved up and down.

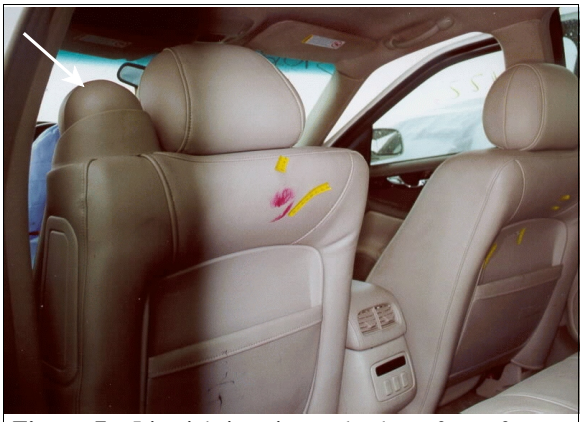


Figure 7: Lipstick imprint on back surface of case vehicle's driver seat back from contact by back left passenger; Note: driver's seat integrated restraint system (case photo #49)

Figure 8: Fracture and contact evidence on back surface of case vehicle's front right passenger seat back from contact by back right passenger; Note: front right passenger's seat integrated restraint system (case photo #51)

Figure 9: Overhead view of case vehicle's driver seating area showing lateral intrusion into area (case photo #33)

Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FLEE-6** (**0** degrees). The WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity impact because the vehicle's direct crash damage was outside-the-scope of the reconstruction program (i.e., the damage began as a sideswipe type impact prior to the left front wheel assembly being snagged by the Mercury). The Total, Longitudinal, and Lateral Delta Vs are, respectively: 21.4 km.p.h. (13.3 m.p.h.), -21.4

km.p.h. (-13.3 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). Based on the vehicle inspection and the data from the **EDR**, this collision reconstruction should be considered borderline, and the results appear to be low. The case vehicle was towed due to damage.

EVENT DATA RECORDER

The data downloaded from the case vehicle's **EDR** showed the vehicle's SIR warning lamp status, driver's seat belt buckle status, brake switch status for the five recorded sample periods preceding the **ALGORITHM ENABLE**, ignition cycles at deployment, and velocity change (i.e., Delta V). Downloaded data of interest indicated the following. The case vehicle's driver seat belt status showed it was **"not buckled"**, and the Delta V reached a value of 27.0 km.p.h. (16.8 m.p.h.) at the 140 millisecond mark of recorded data; see **EVENT DATA RECORDER DATA** (**Figures 20** through **22**) below. Although the case vehicle's **EDR** recorded an "**UNBUCKLED**" status, the physical evidence indicates that the driver was restrained. This contractor believes that the recorded Delta V is reasonable considering the amount of deformation to the case vehicle's front left wheel assembly and resultant intrusion into the driver's seating area.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a Supplemental Restraint System (SRS) that contained single-stage, redesigned frontal air bags at the driver and front right passenger positions. In addition, the vehicle was equipped with front and back, seat back-mounted, side impact air bags. Both frontal air bags deployed as a result of the frontal impact with the Mercury. None of the case vehicle's four seat back-mounted side air bags deployed as a result of the case vehicle's frontal impact with the Mercury. 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 the air bag's 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 module cover consisted of symmetrical "I"-configuration cover flaps made of thick vinyl with overall dimensions of 8 centimeters (3.1 inches) at the left and right horizontal seams and 12 centimeters (4.7 inches) vertically. The driver's air bag was designed with four tethers, each 8 centimeters (3.1 inches) wide, and attached to the center circular stitching. The driver's air bag had two vent ports, approximately 3 centimeters (1.2 inches) in diameter, located at the 11 and 1 o'clock positions. The deployed driver's air bag was elliptical with a height of approximately 64 centimeters (25.2 inches) and a width of approximately 46 centimeters (18.1 inches). An inspection of the driver's air bag revealed that there was no contact evidence readily apparent on the air bag's fabric (**Figure 10**).

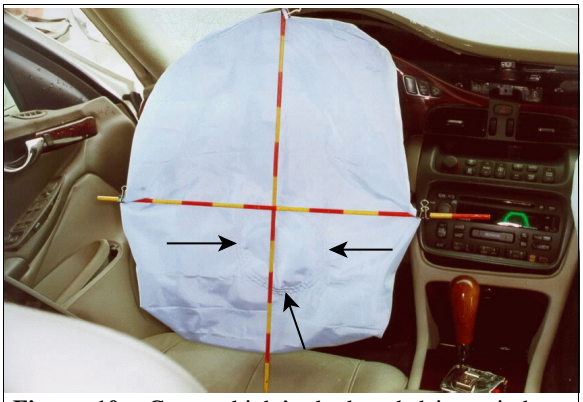


Figure 10: Case vehicle's deployed driver air bag showing no obvious occupant contact evidence; Note: below center location of circular stitched area (case photo #37)

The front right passenger's air bag was located in the middle of the instrument panel. There was no module cover flap. Rather, as the deploying air bag expands, it forces the top, padded portion of the instrument panel upward, by an approximate 5 centimeters (2.0 inches), creating an opening between the horizontal top and the vertical front of the instrument panel. The air bag deployed through this opening. The automobile manufacturer refers to this design as an **ACTIVE INSTRUMENT PANEL**. An inspection of the front right instrument panel and air bag's fabric revealed that the instrument panel opened at the designated points of attachment, and there was no evidence of damage during the deployment to the air bag or the instrument panel. The front right passenger's air bag was designed without any tethers, but it did have two vent ports, approximately 6 centimeters (2.4 inches) in diameter, located at the 3 and 9 o'clock positions. The deployed front right air bag was rectangular with a height of approximately 42 centimeters (16.5 inches) and a width of approximately 35 centimeters (13.8 inches). An inspection of the front right passenger's air bag revealed that there was no contact evidence readily apparent on the air bag's fabric (**Figure 11**).

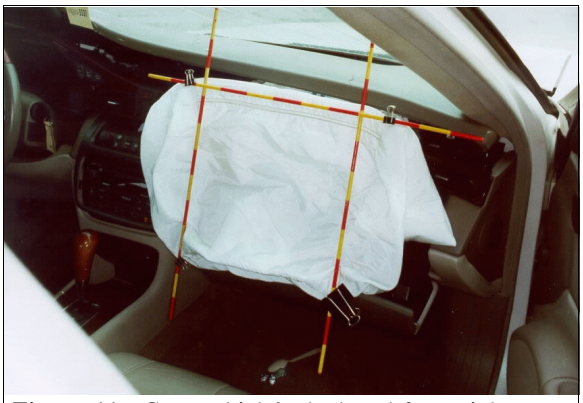


Figure 11: Case vehicle's deployed front right passenger air bag showing no obvious evidence of occupant contact (case photo #38)

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [183 centimeters and 107 kilograms (72 inches, 235 pounds)] was seated in an upright posture with his back against the seat back, his left foot on the floor, his right foot on the accelerator, and both hands on the steering wheel. His seat track was located between its middle and rearmost positions, the seat back was slightly reclined, and the tilt steering wheel was located in its middle position. The case vehicle was also equipped with a telescopic steering wheel which was located in its middle position.

The case vehicle's driver was restrained by his available, active, three-point, lap-and-shoulder, safety belt system; the belt system was equipped with a pretensioner. Furthermore, the driver reported a belt pattern contusion to his chest that is most likely consistent with his use of the safety belt. In addition, the inspection of his seat belt webbing showed evidence of loading (**Figure 12**) and revealed that the pretensioner had fired. The case vehicle had a seat integrated safety belt system and, thus, there was no "D"-ring (**Figure 7** above). The latch plate showed evidence of recent usage, but no loading damage was noted. Although the driver's seat belt pretensioner had fired, because of the intrusion into the driver's seating area which resulted in the

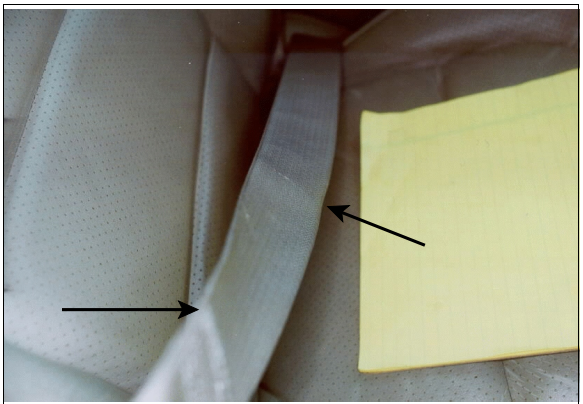


Figure 12: Close-up of seat belt webbing for case vehicle's driver showing evidence of loading (case photo #39)

driver's seat being moved slightly toward the center console, the seat belt pretensioner's piston stroke could not be measured (**Figure 13**).

Figure 13: Close-up of buckle from case vehicle's driver seat belt system showing actuated seat belt pretensioner; Note: driver's seat jammed against center console as a result of lateral intrusion into driver' seating area (case photo #40)

The case vehicle's driver made no known pre-crash avoidance maneuvers. As a result and independent of the use of his available safety belts, his position did not change just prior to impact. The case vehicle's impact with the 1996 Mercury enabled the case vehicle's driver to move forward and slightly upward, loading his safety belt system as he moved toward the case vehicle's **0** degree Direction of Principal Force as the case vehicle decelerated. The initial narrow end engagement and subsequent wheel interaction (i.e., similar to a sideswiping impact that starts on the side but results in pocketing) resulted in the air bag deploying late during the sequence of the impact. This delayed deployment occurred due to the prolonged change in time (Delta T) relative to the change in speed (magnitude of Delta V–i.e., ramp versus spike). Because of the driver's seat track position and his use of the available restraints, the driver's interaction with the deploying air bag was most likely minimized (i.e., he contacted the deploying air bag near the outermost portion of the air bag's excursion area). After contacting the deploying air bag the driver most likely rebounded backwards toward his seat back; however, it is possible that his backwards trajectory was such that the top of his scalp scraped the roof overlying his seating position. After the initial impact, the case vehicle rotated counterclockwise. During that counterclockwise rotation, the driver most likely moved to his left against the left front door panel. According to the driver's interview, when the case vehicle reached its final rest position he was sitting upright in his seat with his chin on his chest (i.e., the driver indicated that he had experienced a "brief loss of consciousness").

CASE VEHICLE DRIVER INJURIES

The driver was driven by a relative from the crash scene to a hospital. He sustained minor injuries and was treated and released. According to his interview and medical records, the injuries sustained by the case vehicle's driver included: a cervical strain, a chest contusion, and general body soreness. The case vehicle's driver attributed the chest contusion to contact with his air bag. In this contractor's opinion, the cervical strain was most likely caused by his deploying air bag and the chest contusion by his seat belt system.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Strain, acute cervical	640278.1 minor	Air bag, driver's	Possible	Emergency room records

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
2	Contusion chest, not further specified	490402.1 minor	Torso portion of safety belt system	Probable	Interviewee (same person)

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

The case vehicle's front right passenger [wife; 155 centimeters and 64 kilograms (61 inches, 140 pounds)] was seated in an upright posture with her back against the seat back and her feet on the floor; however, the exact position of her hands is not known. Her seat track was located between its middle and rearmost positions, and her seat back was slightly reclined.

The case vehicle's front right passenger was restrained by her available, active, three-point, lap-and-shoulder, safety belt system; the belt system was also equipped with a pretensioner. Furthermore, according to the driver's interview, there was evidence of belt pattern bruising to the front right passenger's body, and the inspection of the front right passenger's seat belt webbing showed evidence of loading (**Figure 14**). The front right seat belt system was also seat integrated and, thus, there was no "D"-ring (**Figure 8** above). The latch plate showed evidence of recent usage, but no loading damage was noted. The piston stroke for this seat position's seat belt pretensioner (**Figure 15** below) was measured at 3.5 centimeters (1.4 inches).

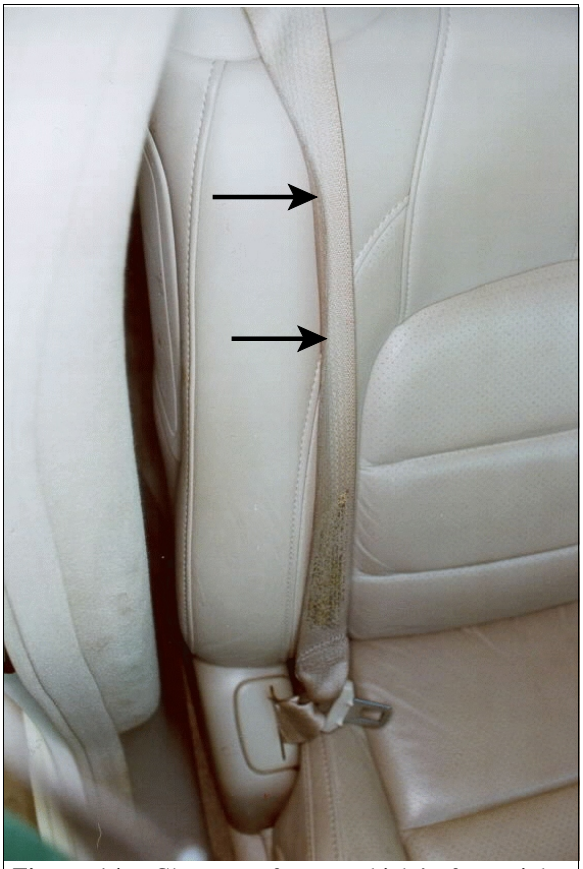


Figure 14: Close-up of case vehicle's front right passenger seat belt system showing evidence of loading on belt's webbing (case photo #55)

The case vehicle's driver made no known pre-crash avoidance maneuvers. As a result and independent of the use of her available safety belts, the front right passenger's position did not change just prior to impact. The case vehicle's impact with the 1996 Mercury enabled the case vehicle's front right passenger to move forward and slightly upward, loading her safety belt system as she moved toward the case vehicle's **0** degree Direction of Principal Force as the case vehicle decelerated. The initial narrow end engagement and subsequent wheel interaction (i.e., similar to a sideswiping impact that starts on the side but results in pocketing) resulted in the air bag deploying late during the sequence of the impact. This delayed deployment occurred due to the prolonged change in time (Delta T) relative to the change in speed (magnitude of Delta V–i.e., ramp versus spike). Because of the front right passenger's seat track position and her use of the

Figure 15: Close-up of buckle for case vehicle's front right passenger seat belt system showing actuated pretensioner (case photo #42)

available restraints, the front right passenger's interaction with the deploying air bag was most likely minimized (i.e., she contacted the deploying air bag near the outermost portion of the air bag's excursion area). After contacting the deploying air bag the front right passenger most likely rebounded backwards toward her seat back; however, it is possible that her backwards trajectory was such that the top of her scalp came in contact with the roof overlying her seating position. After the initial impact, the case vehicle rotated counterclockwise. During that counterclockwise rotation, the front right passenger most likely moved to her left against the right side of the driver's seat back and/or center console. According to the driver's interview, he had no specific knowledge of this occupant's posture at final rest. Based on the available information, this occupant was most likely seated near her original pre-crash travel position at final rest. She exited the vehicle without assistance.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger was taken by ambulance from the crash scene to a hospital. She sustained minor injuries and was treated and released. According to her medical records and the interview with the case vehicle's driver, her injuries included: a chest wall contusion and a lower abdominal contusion. In this contractor's opinion, the chest wall contusion was most likely caused by her deploying air bag and the abdominal contusion by the lap belt portion of her seat belt system.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion chest wall, not further specified	490402.1 minor	Air bag, front right passenger's	Possible	Emergency room records
2	Contusion lower abdomen {along lap belt area}	590402.1 minor	Lap portion of safety belt system	Probable	Interviewee (driver)

CASE VEHICLE BACK LEFT PASSENGER KINEMATICS

The case vehicle's back left passenger [daughter of the driver; 45-year-old, Black (non-Hispanic) female; 170 centimeters and 64 kilograms (67 inches and 140 pounds)] was seated in an upright posture with her back against the seat back and her feet on the floor; however, the exact position of her hands is not known. Her seat track and seat back were not adjustable.

This back left passenger was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was no reported evidence of belt pattern bruising and/or abrasions to the back left passenger's body, and the inspection of the back left passenger's seat belt webbing showed evidence of usage (**Figure 16**). The back left seat belt system was also seat integrated and, thus, there was no "D"-ring. The latch plate showed evidence of recent usage, but no loading damage was noted.

Figure 16: Close-up of case vehicle's back left seat belt system showing loading evidence on belt webbing (i.e., yellow tape) and blood evidence on seat back's cushion (case photo #47)

The case vehicle's driver made no known pre-crash avoidance maneuvers. As a result and independent of the use of her available safety belts, the back left passenger's position did not change just prior to impact. The case vehicle's impact with the 1996 Mercury enabled the case vehicle's back left passenger to move forward and slightly upward, loading her safety belt system as she moved toward the case vehicle's **0** degree Direction of Principal Force as the case vehicle decelerated. The case vehicle's driver did not know whether this occupant's safety belts were positioned properly but, based on the vehicle inspection, the back left passenger contacted the back surface of the driver's seat back with her forehead as a result of the impact with the Mercury. After contacting the driver's seat back, the back left passenger most likely rebounded backwards toward her own seat back. After the initial impact, the case vehicle rotated counterclockwise. During that counterclockwise rotation, the back left passenger most likely moved to her left against the interior surface of the left rear door panel and left rear window glazing. According to the driver's interview, he had no specific knowledge of this occupant's posture at final rest. Based on the available information, this occupant was most likely seated near her original pre-crash travel position at final rest. She exited the vehicle without assistance.

CASE VEHICLE BACK LEFT PASSENGER INJURIES

The back left passenger accompanied her mother and sister (i.e., front right passenger and back right passenger, respectively) in an ambulance to a hospital. She sustained minor injuries and, while at the hospital, her injuries were examined and she was released. According to her medical records and the driver's interview, her injuries included: contusions to her left forehead, left chest, left upper arm, and left leg. Based on the interior inspection, the back left passenger most likely sustained her head injury when she contacted the driver's seat back. On the other hand, the remainder of her injuries most likely resulted during the case vehicle's counterclockwise rotation as she loaded the interior surface of the left rear door.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion {hematoma}, large left forehead	290402.1 minor	Seat back, driver's	Probable	Emergency room records
2	Contusion left chest {in rib area}, not further specified	490402.1 minor	Left side interior surface, excluding hardware and/or armrest	Probable	Interviewee (driver)
3	Contused left upper arm, not further specified	790402.1 minor	Left side interior surface, excluding hardware and/or armrest	Probable	Interviewee (driver)
4	Contusion left leg, involving both upper and lower left leg areas	890402.1 minor	Left side interior surface, excluding hardware and/or armrest	Probable	Interviewee (driver)

CASE VEHICLE BACK RIGHT PASSENGER KINEMATICS

The case vehicle's back right passenger [daughter of the driver; 48-year-old, Black (non-Hispanic) female; 163 centimeters and 64 kilograms (64 inches and 140 pounds)] was seated in an upright posture with her back against the seat back and her feet on the floor. Once again, however, the exact position of her hands is not known. Her seat track and seat back were not adjustable.

The back right passenger was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was reported evidence of belt pattern bruising to the back right passenger's body (i.e., a chest contusion), and the inspection of the back right passenger's seat belt webbing showed evidence of usage (**Figure 17**). The back right seat belt system was also seat integrated and, thus, there was no "D"-ring. The latch plate showed evidence of recent usage, but no loading damage was noted.

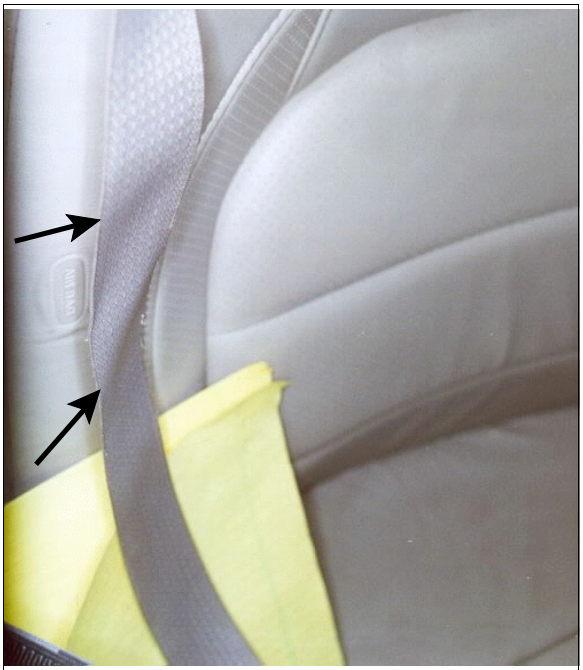


Figure 17: Close-up of seat belt webbing for case vehicle's back right passenger showing evidence of loading on webbing (case photo #52)

The case vehicle's driver made no known pre-crash avoidance maneuvers. As a result and independent of the use of her available safety belts, the back right passenger's position did not

change just prior to impact. The case vehicle's impact with the 1996 Mercury enabled the case vehicle's back right passenger to move forward and slightly upward, loading her safety belt system as she moved toward the case vehicle's **0** degree Direction of Principal Force as the case vehicle decelerated. The case vehicle's driver did not know whether this occupant's safety belts were positioned properly but, based on the vehicle inspection, the back right passenger contacted the back surface of the front right passenger's seat back with her face and most likely her knees as a result of the impact with the Mercury. After contacting the front right passenger's seat back, the back right passenger most likely rebounded backwards toward her own seat back. After the initial impact, the case vehicle rotated counterclockwise. During that counterclockwise rotation, the back right passenger most likely moved to her left toward the back left passenger's seating position. It is possible that the two back passengers contacted one another during the rotation, but the case vehicle's driver was not aware of any inter-occupant interaction. This occupant also loaded the interior surface of the back right door panel during the rotation. According to the driver's interview, he had no specific knowledge of this occupant's posture at final rest. Based on the available information, this occupant was most likely seated near her original pre-crash travel position at final rest. She exited the vehicle without assistance.

CASE VEHICLE BACK RIGHT PASSENGER INJURIES

She was transported by ambulance to a hospital along with her mother and sister (i.e., back left passenger). She sustained minor injuries and was treated and released. According to her medical records and the driver's interview, her injuries included: a "blow-out" fracture of her left orbital rim, a minor nonanatomic brain injury, and contusions to the left eye, chest, and leg or legs (i.e., the driver could not recall if one or the other or both legs were injured). In this contractor's opinion, her eye fracture and contusion and her nonanatomic brain injury, as well as her leg contusion(s), were most likely caused by contacting the front right passenger's seat back. On the other hand, her chest contusion was most likely caused by her safety belt system.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Fracture, blow-out, left inferior orbital rim with opacified left maxillary sinus	251204.3 serious	Seat back, front right passenger's	Probable	Emergency room records
2	Nonanatomic brain injury: awake, no prior unconsciousness but with vomiting	160402.1 minor	Seat back, front right passenger's	Probable	Emergency room records
3	Contusion {ecchymosis} left eye {periorbital}	297402.1 minor	Seat back, front right passenger's	Probable	Emergency room records
4	Contusion chest with diffuse chest wall tenderness, not further specified [Aspect = Unknown]	490402.1 minor	Torso portion of safety belt system	Probable	Interviewee (driver)

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
5	Contusion leg(s), not further specified anatomically; does not recall if left, right, or both [Aspect = Unknown]	890402.1 minor	Seat back, front right passenger's	Certain	Interviewee (driver)

OTHER VEHICLE

The 1996 Mercury Mystique GS was a front wheel drive, five-passenger, four-door sedan (VIN: 1MELM6538TK------) equipped with a 2.0L, I-4 engine and a four-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum system. The Mercury's wheelbase was 271 centimeters (106.5 inches), and the odometer reading is unknown because the interior of the Mercury was not inspected.

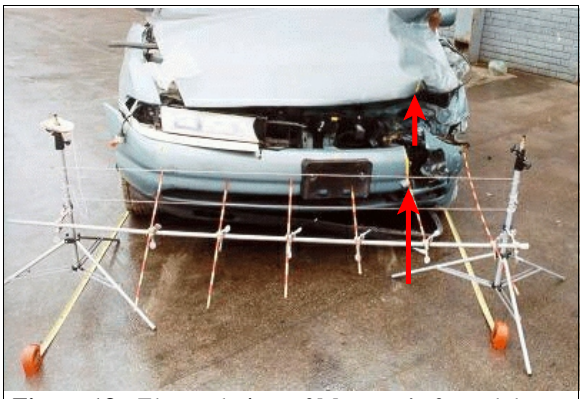


Figure 18: Elevated view of Mercury's frontal damage with contour gauge present at bumper level; Note: yellow tape (arrows) shows width of direct damage on bumper and hood (case photo #57)

The Mercury's contact with the case vehicle involved the front left one-third of the front bumper (**Figure 3** above). Direct damage began 37 centimeters (14.6 inches) leftward from the center of the front bumper and extended, a measured distance of 42 centimeters (16.5 inches), along the front bumper to the front left bumper corner (**Figure 18**). Maximum crush was measured as 73 centimeters (28.7 inches) at C_1; however, residual crush was 65 centimeters (25.6 inches) at C_1 (**Figure 19**). The wheelbase on the Mercury's left side was shortened 20 centimeters (7.9 inches), while the right side was extended 6 centimeters (2.4 inches). The Mercury's front left splash guard, front bumper, bumper fascia, grille, front left corner of the hood, left headlight and turn signal assemblies, and left fender were directly damaged and crushed rearward. The Mercury's left front tire was displaced rearward and physically restricted by the lower left "A"-pillar.

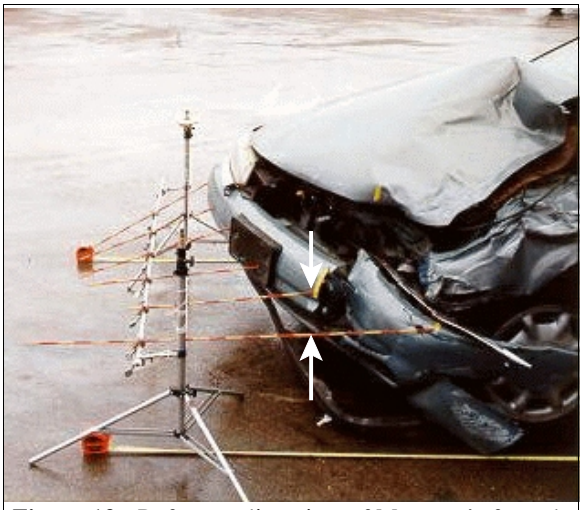
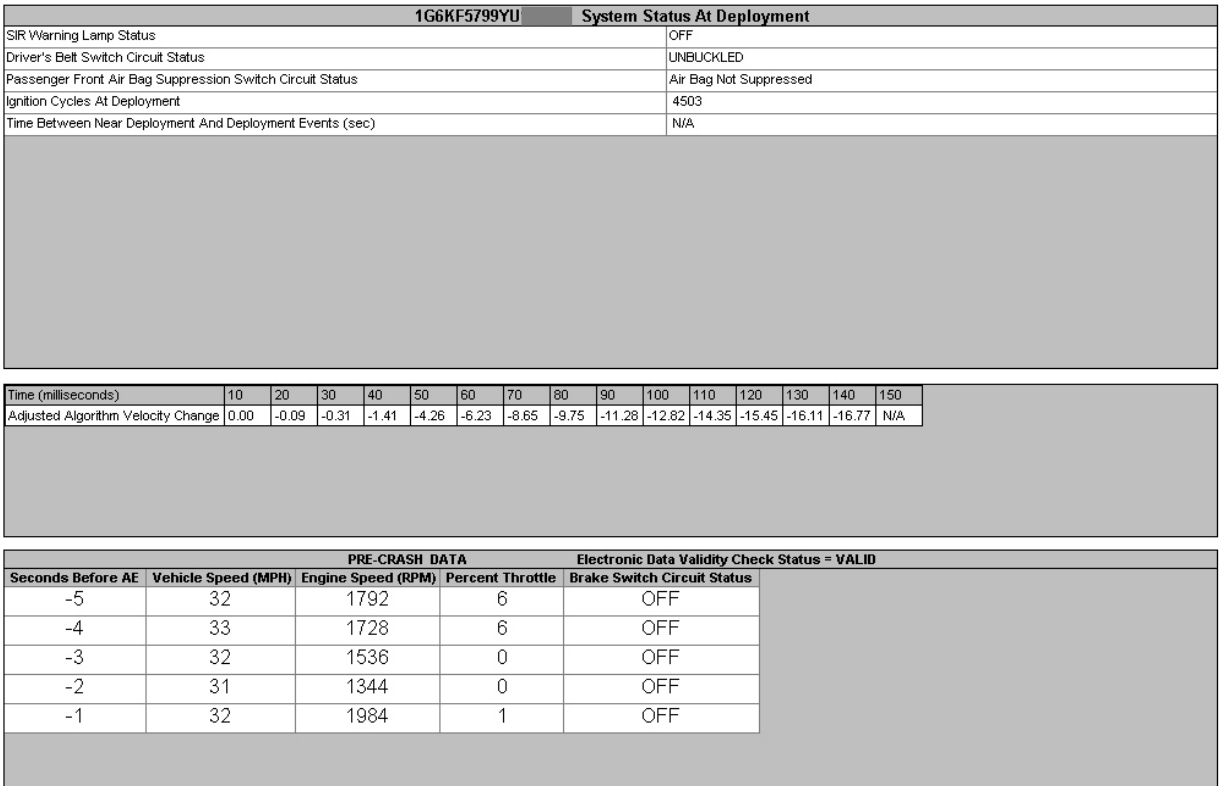


Figure 19: Reference line view of Mercury's frontal damage viewed from left with contour gauge present at bumper level; Note: arrows show width of direct damage on bumper (case photo #62)

Based on the vehicle inspection, the CDC for the Mercury was determined to be: **12-FLEW-3** (**0** degrees). The WinSMASH

reconstruction program, missing vehicle algorithm, was used on the Mercury's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 31.1 km.p.h. (19.3 m.p.h.), -31.1 km.p.h. (-19.3 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The Mercury was towed due to damage.

There were three teenage occupants in the Mercury. There was a driver (16-year-old female), a front right passenger (16-year-old female), and a back right passenger (17-year-old female). According to the Police Crash Report, both front seat occupants were restrained by their available, active, three-point, lap-and-shoulder, safety belt systems. The Mercury was equipped with dual front supplemental restraint (air bags) systems that deployed during the crash. The back right passenger, according to the Police Crash Report, was not restrained. The Mercury's driver and back right passenger sustained non-incapacitating ("B") injuries and the front right passenger sustained possible ("C") injuries.



1G6KF5799YU	System Status At Deployment
SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	UNBUCKLED
Passenger Front Air Bag Suppression Switch Circuit Status	Air Bag Not Suppressed
Ignition Cycles At Deployment	4503
Time Between Near Deployment And Deployment Events (sec)	N/A

Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Adjusted Algorithm Velocity Change	0.00	-0.09	-0.31	-1.41	-4.26	-6.23	-8.65	-9.75	-11.28	-12.82	-14.35	-15.45	-16.11	-16.77	N/A

PRE-CRASH DATA — Electronic Data Validity Check Status = VALID

Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	32	1792	6	OFF
-4	33	1728	6	OFF
-3	32	1536	0	OFF
-2	31	1344	0	OFF
-1	32	1984	1	OFF

Figure 20: Case vehicle's pre-crash speed, brake switch status, and restraint system status at deployment, and the case vehicle's change in velocity (Delta V) over the first 140 milliseconds post deployment

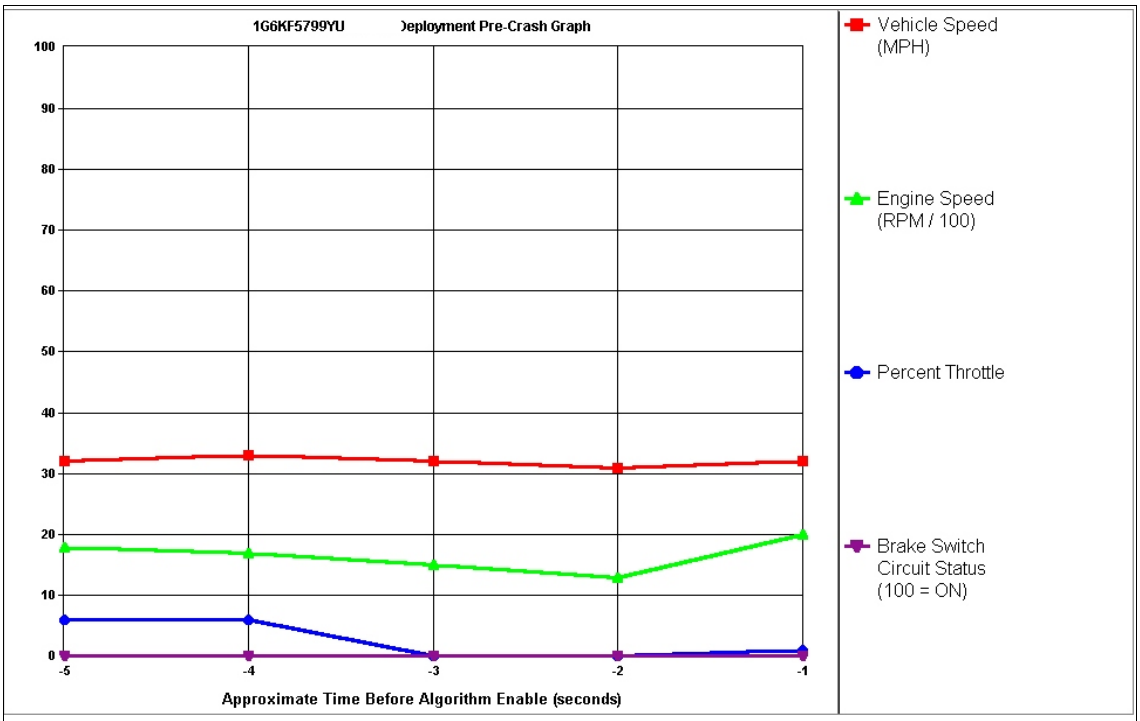


Figure 21: Case vehicle's pre-crash speed and brake switch circuit status showing that the vehicle had been traveling at approximately 50 km.p.h. (31 m.p.h.) and that the brake switch had not been activated.

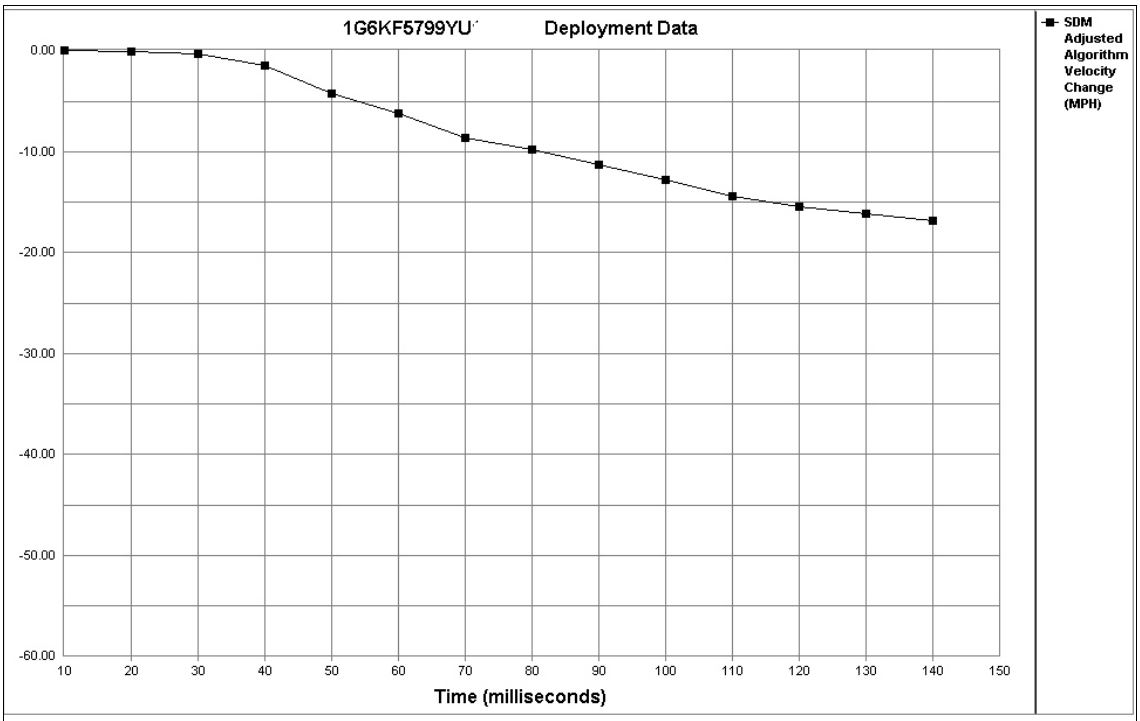
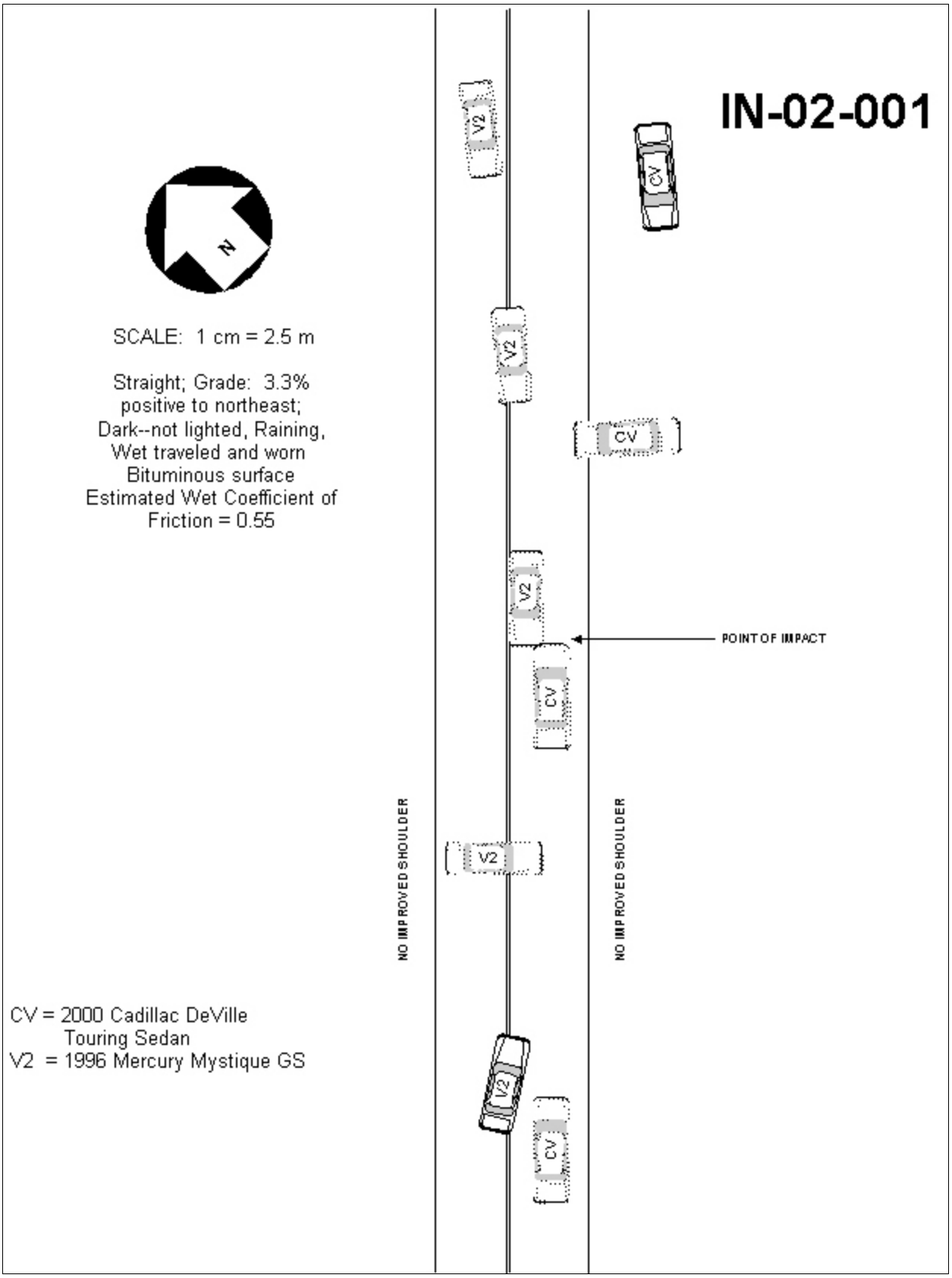


Figure 22: The case vehicle sustained a velocity change of approximately 27.0 km.p.h. (16.8 m.p.h.) during the first 140 milliseconds after the crash was detected


IN-02-001
N
SCALE: 1 cm = 2.5 m
Straight; Grade: 3.3%
positive to northeast;
Dark--not lighted, Raining,
Wet traveled and worn
Bituminous surface
Estimated Wet Coefficient of
Friction = 0.55
V2
CV
V2
CV
V2
POINT OF IMPACT
CV
NO IMPROVED SHOULDER
NO IMPROVED SHOULDER
V2
V2
CV
CV = 2000 Cadillac DeVille
Touring Sedan
V2 = 1996 Mercury Mystique GS