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### ON-SITE ADULT AIR BAG-RELATED FATALITY INVESTIGATION

CASE NUMBER - IN97-044  
LOCATION - TEXAS  
VEHICLE - 1996 FORD CONTOUR GL  
CRASH DATE - May, 1997

Submitted:

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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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16. <i>Abstract</i> This report covers an on-site investigation of an air bag deployment crash that involved a 1996 Ford Contour GL (Case Vehicle) and a concrete median barrier. This crash is of special interest because the case vehicle's driver (63-year-old male) sustained serious brain injuries from contacting the deploying front right air bag module's cover flap and air bag, resulting in his death. The case vehicle was traveling south in the outside lane of a six-lane, divided, U.S. Freeway and intended to continue traveling southward (i.e., both the north and southbound roadways had three through lanes). The case vehicle drifted off the west (right) edge of the roadway. The crash occurred on the west (right) roadside of the southbound roadway. The case vehicle's right quarter panel, just above the wheel well, impacted a concrete barrier. As a result of the impact, the case vehicle's driver over steered back to the left, causing the case vehicle to veer across all three southbound lanes and go into a counterclockwise yaw. The primary impact occurred when the case vehicle struck, in an end swiping fashion, a concrete median barrier. The case vehicle's frontal end swipe impact with the concrete barrier caused the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle continued to rotate counterclockwise and came to rest straddling the edge line that separates the inside southbound through lane from the median. The case vehicle's driver was seated with his seat track located between its middle and rearmost positions, and the vehicle was not equipped with a tilt steering wheel. He was not wearing his available, active, three-point, lap-and-shoulder, safety belt system, and sustained, according to his medical records, serious injuries which included: a nonanatomic brain injury; diffuse subarachnoid hemorrhages over his entire brain, including both cerebral lobes and his cerebellum and brain stem; an unspecified fracture of C <sub>5</sub> ; comminuted fractures of his nose and right maxilla; fractures of his left 5th and 6th ribs; a subgaleal hemorrhage over his entire right skull, and facial lacerations that involved a laceration running downward from the medial right eye along the right side of his nose, a laceration under his right eye, and lacerations to the right corner of his mouth and lip. The autopsy records indicated that the driver had a blood alcohol concentration (BAC) of .19%.			
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This on-site investigation was brought to NHTSA's attention on November 21, 1997 by an attorney representing the family of the deceased case vehicle's driver. This crash involved a 1996 Ford Contour GL (case vehicle) and a concrete median barrier. The crash occurred in May, 1997, at 1:00 a.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's driver [63-year-old, Black (unknown if Hispanic) male] sustained serious brain injuries from contacting the deploying front right air bag module's cover flap and air bag, resulting in his death. This contractor inspected the scene and case vehicle on December 11-12, 1997. This report is based on the Police Crash Report, interviews with the investigating officer, a conversation with the attorney representing the family of 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 south in the outside lane of a six-lane, divided, U.S. Freeway and intended to continue traveling southward (i.e., both the north and southbound roadways had three through lanes). The case vehicle drifted off the west (right) edge of the roadway, apparently because the driver fell asleep. Based on the available evidence, the case vehicle's driver made no pre-crash avoidance maneuvers prior to the crash. The crash occurred on the west (right) roadside of the southbound roadway (see **CRASH DIAGRAM** below).

The case vehicle's right quarter panel, just above the wheel well, impacted a concrete barrier. As a result of the impact, the case vehicle's driver over steered back to the left, causing the case vehicle to veer across all three southbound lanes and go into a counterclockwise yaw. Besides the case vehicle's driver over correcting to the left, it is unknown whether the driver made any other avoidance maneuvers prior to departing the east (left) edge of the southbound roadway. The primary impact occurred when the case vehicle struck, in an end swiping fashion, a concrete median barrier. The case vehicle's frontal end swipe impact with the concrete barrier caused the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle continued to rotate counterclockwise and came to rest straddling the edge line that separates the inside southbound through lane from the median.

The case vehicle's driver [168 centimeters and 71 kilograms (66 inches, 156 pounds)] was not wearing his available, active, three-point, lap-and-shoulder, safety belt system. In addition, there was no evidence of belt pattern bruising and/or abrasions to the driver's body, and the inspection of the driver's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

The case vehicle's driver made no known pre-crash avoidance maneuvers prior to the initial impact. As a result and independent of the nonuse of his available safety belts, his pre-impact body position did not change just prior to impact. The case vehicle's minor impact with the first concrete longitudinal barrier enabled the driver to continue slightly forward, if at all, most likely toward the case vehicle's steering wheel. This initial impact set in motion (i.e., most likely by alerting the driver) an improper steering maneuver (i.e., he over corrected leftwards, back onto

the roadway and, in effect, induced a counterclockwise rotation), which because of his nonuse of the available safety belts, resulted in him moving to the right and forward just prior to the primary impact. Based on the damage to the case vehicle's front and the injuries to the case vehicle's driver, the case vehicle's primary impact with the cement barrier in the median did not immediately deploy either of the front air bags, but the impact allowed the driver to move further forward and to his right with the top of his head leading and angled, approximately, perpendicular to the interior surface of the right front door. This delay enabled the right side of the driver's face to be directly on top of the front right air bag module when the module deployed. The deploying air bag module's cover flap struck the right side of the driver's face, lacerating and fracturing his face, and the expanding air bag lifted the driver's head upwards into the front right sun visor. Meanwhile, the lower portion of his torso and pelvis continued toward the right as a result of the case vehicle's continued counterclockwise rotation. The driver's head subsequently struck the right front door glazing and interior surface of the right door's side panel prior to his body coming to rest. The case vehicle came to rest heading north-northeastward. At final rest the driver was laying across the front right passenger seat with his face on the seat cushion and the top of his head touching the door panel.

The driver was transported by ambulance to the hospital. He sustained serious injuries and was pronounced dead three minutes after arriving in the hospital's emergency room (i.e., one hour and 10 minutes post-crash). Based on his medical records, the injuries sustained by the case vehicle's driver included: a nonanatomic brain injury; diffuse subarachnoid hemorrhages over his entire brain, including both cerebral lobes and his cerebellum and brain stem; an unspecified fracture of C<sub>5</sub>; comminuted fractures of his nose and right maxilla; fractures of his left 5th and 6th ribs; a subgaleal hemorrhage over his entire right skull, and facial lacerations that involved a laceration running downward from the medial right eye along the right side of his nose, a laceration under his right eye, and lacerations to the right corner of his mouth and lip. The autopsy records indicated that the driver had a blood alcohol concentration (BAC) of .19%.

The case vehicle was a front wheel drive 1996 Ford Contour GL, four-door sedan (VIN: 1FALP6531TK-----). The case vehicle was equipped with anti-lock brakes. The case vehicle was towed but not due to damage. Based on the vehicle inspection, the CDC was determined to be: **02-FDEW-1 (50)**, for the case vehicle [maximum crush was 1 centimeter (0.4 inches)]. The WinSMASH reconstruction program, barrier algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 7.3 km.p.h. (4.5 m.p.h.), -4.7 km.p.h. (-2.9 m.p.h.), and -5.6 km.p.h. (-3.5 m.p.h.). This contractor believes that while this collision fits the model, the Delta Vs are low. The low Delta Vs are a result of the minimal deformation to the case vehicle's front bumper, which sustained nothing more than scrapes with some slight shifting to the left, and the counterclockwise rotational trajectory of the case vehicle just prior to its impact with the barrier.

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 driver's air bag was designed with four tethers, each 6 centimeters (2.4 inches) in width. The driver's air bag had two vent ports, approximately 2 centimeters (0.8 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 57 centimeters (22.4 inches) and a width of approximately 59 centimeters (23.2 inches). There was 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. An inspection of the front right air bag module's cover flaps and air bag revealed that the cover flaps opened at the designated tear points, and there was a snag on the underneath surface towards the driver's side of the air bag. Furthermore, there was deformation, teeth marks, and skin on the front right air bag module's cover flap. The front right passenger's air bag was designed with two tethers, each 7.5 centimeters (3.0 inches) in width. The front right air bag had one vent port, approximately 7 centimeters (2.8 inches) in diameter, located at the 10 o'clock position. The deployed front right air bag was rectangular with a height of approximately 55 centimeters (21.7 inches) and a width of approximately 65 centimeters (25.6 inches). There was contact evidence readily apparent (i.e., an area of oil/skin transfer) on the underneath side of the front right air bag, toward the driver's side, and an area of blood and skin primarily over the lower right quadrant of the front right air bag's front surface.

The inspection of the case vehicle's interior revealed a broken windshield wiper lever on the steering column, an area of blood and hair on the front right sun visor, an area of spray on the right windshield, a small blood smear on the roof over the front right seating position, a blood spot on the interior surface of the right front door, and an area of blood and smear on the right front door's glazing.

Immediately prior to the initial impact the exact posture of the case vehicle's driver is unknown, but presumably he was seated with his back against the seat back, his left foot on the floor, his right foot on the accelerator, his left hand on the steering wheel, and his right hand on the arm rest. Based on the vehicle inspection, his seat track was located between its middle and rearmost positions, the seat back was slightly reclined, and the vehicle was not equipped with a tilt steering wheel.

### CRASH CIRCUMSTANCES

Based on the available evidence, at the time of the crash the southbound roadway had three through lanes; however, at the time of this contractor's inspection (i.e., approximately seven months later), the roadway was under construction and the number of southbound travel lanes was at least four in the approximate area of the impact. The following trafficway description are based on a combination of the Police Crash Report and this contractor's inspection.



**Figure 1:** Case vehicle's southward travel path viewed from center lane of southbound roadway; Note: neither the farthest right (west) lane nor the road construction were present at the time of the crash (case photo #51)

The case vehicle was traveling south in the outside lane of a six-lane, divided, U.S. Freeway (**Figure 1**) and intended to continue traveling southward (i.e., both the north and southbound



roadways had three through lanes). The case vehicle drifted off the west (right) edge of the roadway, apparently because the driver fell asleep. Based on the available evidence, the case vehicle's driver made no pre-crash avoidance maneuvers prior to the crash. The crash occurred on the west (right) roadside (**Figure 2**) of the southbound roadway (see **CRASH DIAGRAM** below).

The U.S. freeway was curved slightly to the right (unknown radius) for southbound traffic and level (i.e., actual slope was  $< 2\%$ , positive to the south) near the area of impact. The pavement was concrete, and the width of the travel lanes for the case vehicle appear to be approximately 3-4 meters (approximately 10-13 feet) each. The shoulders were improved (i.e., concrete) with varying widths of approximately 1-2 meters (3.3-6.6 feet) on each side. During some stretches the southbound roadway is skirted by concrete barriers on each side of the roadway. In other locations the roadway is skirted by a concrete barrier on the left (east) and impact attenuators along the right (west) side. Depending on the exact point of impact<sup>1</sup>, the travel lanes were separated by either a single broken or a solid white line. The roadway was bordered by a solid yellow edge line on the left (east) side and a solid white edge line on right (west) side. The estimated coefficient of friction was 0.70. There were no visible traffic controls. The posted speed limit is 89 km.p.h. (55 m.p.h.). At the time of the crash the light condition was dark, but illuminated by overhead street lamps at the area of impact, the atmospheric condition was either clear or cloudy, and the road pavement was dry. Traffic density was light the site of the crash was primarily urban commercial.

The case vehicle's right quarter panel, just above the wheel well (**Figure 3**), impacted a concrete barrier. As a result of the impact, the case vehicle's driver over steered back to the left, causing the case vehicle to veer across all three southbound lanes and go into a counterclockwise yaw. Besides the case vehicle's driver over correcting to the left, it is unknown whether the driver made any other avoidance maneuvers prior to departing the east (left) edge of the southbound roadway. The primary impact occurred when the case vehicle struck, in an end swiping fashion (**Figure 4** below), a concrete median barrier. The case vehicle's frontal end swipe impact (**Figures 5 and 6** below) with the concrete barrier caused



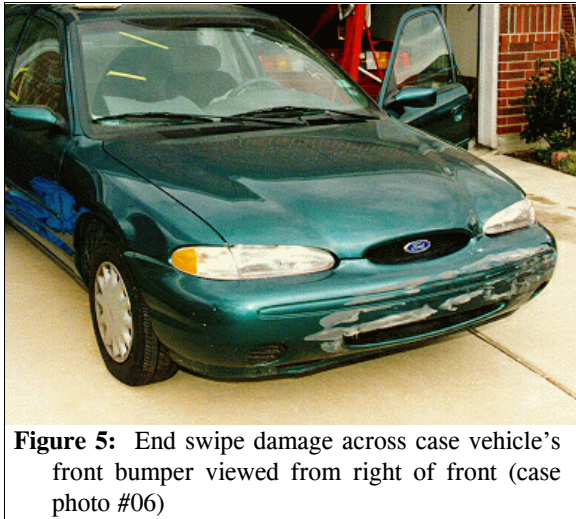
**Figure 2:** Approximate area of case vehicle's crash viewed from center lane of southbound roadway; Note: impacted concrete longitudinal barriers were located off both east (left) and west (right) sides of road and the farthest right (west) lane did not exist at the time of the crash (case photo #03)



**Figure 3:** Sideswipe damage to case vehicle's right quarter panel above the right rear wheel well; Note: contact resulted from initial impact with concrete longitudinal barrier (case photo #16)

<sup>1</sup> The exact point of impact cannot be determined because the right (west) side of the highway has been changed (i.e., expanded westward) since the crash occurred, and at least one new southbound through lane has been added where the contacted longitudinal barrier along the west roadside once stood.

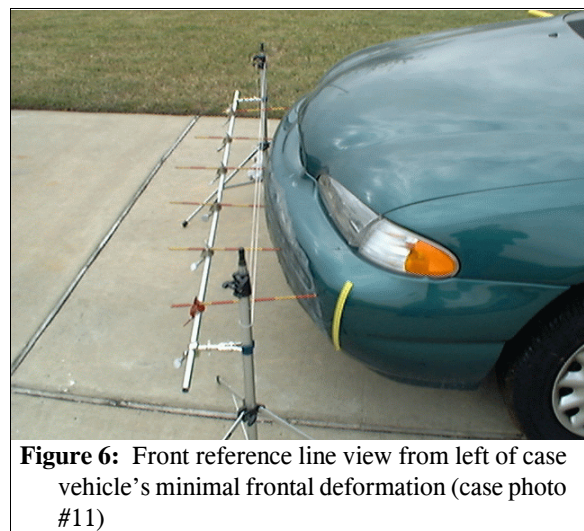
the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle continued to rotate counterclockwise and came to rest straddling the edge line that separates the inside southbound through lane from the median.



**Figure 5:** End swipe damage across case vehicle's front bumper viewed from right of front (case photo #06)



**Figure 4:** End swipe damage to case vehicle's front bumper fascia from concrete median barrier viewed from left of front (case photo #05)



**Figure 6:** Front reference line view from left of case vehicle's minimal frontal deformation (case photo #11)

## **CASE VEHICLE**

The case vehicle was a front wheel drive 1996 Ford Contour GL, five-passenger, four-door sedan (VIN: 1FALP6531TK-----) equipped with power-assisted rack-and-pinion steering, a 2.0L, DOHC SMPEFI, I-4 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 271 centimeters (106.5 inches), and the odometer reading at inspection was 26,866 kilometers (16,694 miles).

Inspection of the vehicle's interior revealed adjustable front bucket seats with adjustable head restraints; a non-adjustable back bench seat without head restraints for the seating positions; and continuous loop, three-point, lap-and-shoulder, safety belt systems at the front and back outboard positions; and a two-point, lap belt system at the back center position. The front seat belt systems were equipped with manually operated height adjusters for the "D"-rings; the driver's was set in the full-up position. There was a center console between the two front seats with an emergency brake handle and floor mounted transmission selector lever. In addition, there was an arm rest with small storage compartment. The vehicle was equipped with knee bolsters for both the driver and front right passenger. Neither knee bolster showed any visible evidence of contact or deformation. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a frontal air bag for the driver and front right passenger seating positions. Both front seat air bags deployed as a result of the case vehicle's impact with the concrete longitudinal barrier located in the median. The left rear door glazing was disintegrated by rescue personnel attempting

to aid the case vehicle's driver in the locked vehicle.



**Figure 7:** Case vehicle's steering column showing deployed driver air bag and broken windshield wiper lever (case photo #25)



**Figure 8:** Case vehicle's front seating area showing deployed front air bags and driver's travel path within interior; Note: sequentially driver struck and deposited evidence on the front right passenger air bag module's cover flap, air bag, front right sun visor, and right front glazing (case photo #28)



**Figure 9:** Vertical view of case vehicle's deployed front right passenger air bag showing evidence of driver contact to front surface of air bag, front right sun visor; and spray on the right windshield (case photo #40)



**Figure 10:** Case vehicle's front right sun visor showing blood smear and indentation on sun visor (case photo #41)

The inspection of the case vehicle's interior revealed the windshield wiper lever on the steering column to be broken and hanging down (**Figure 7** above). The energy absorbing steering column showed no evidence of compression. The glove compartment door directly in front of the front right seating area showed no evidence of direct contact (**Figure 8** above). There was an area of unknown body fluid sprayed on the right windshield (**Figure 9** above) above the passenger side air bag module's cover flap. There was contact (i.e., hair with blood smear) on the front right sun visor (**Figure 10** above), a small blood smear on the roof over the front right seating position, and a head sized grease smear with blood on the base of the right front door's glazing (**Figures 11 and 12**). In addition, there was a blood trail on the right front door panel with a large area of blood on the lateral (outside) portion of the front right passenger seat cushion (**Figures 11 and 13**).



**Figure 11:** Interior surface of case vehicle's right front door and deployed front right passenger's air bag showing occupant contact on air bag, right front glazing, and lateral surface of front right seat (case photo #43)



**Figure 12:** Case vehicle's right front door glazing showing oil and blood smear from contact by driver's head (case photo #50)



**Figure 13:** Case vehicle's front seating area showing deployed driver and front right passenger air bags and blood evidence on lateral side of front right seat (case photo #46)

## CASE VEHICLE DAMAGE

The case vehicle's initial contact with the concrete longitudinal barrier located off the right (west) side of the road involved a sideswipe type impact to the right quarter panel, just above the right rear wheel well area. The direct damage can be described as scuffing with minor deformation. The direct damage was 77 centimeters (30.3 inches) long and started 25 centimeters (9.8 inches) forward of the right rear axle and extended rearwards (**Figure 3** above). Maximum crush was only 0.5 centimeters (0.2 inches). The case vehicle's frontal impact with the concrete barrier caused minimal deformation (**Figure 6** above) and was primarily heavy abrasions across the case vehicle's front bumper fascia from right to left (passenger side to driver side–**Figure 5** above). There was heavier abrading on the front left bumper corner (**Figure 4** above). The direct damage was 125 centimeters (49.2 inches) in width and started 51 centimeters (20.1 inches) right

of center. The contact extended across the entire front bumper fascia to the front left bumper corner of the case vehicle. The field L went from bumper corner to bumper corner, a distance of 137 centimeters (53.9 inches). The maximum residual crush to the front bumper was measured at 1 centimeter (0.4 inches). Neither of the front tires were physically restricted from the front end damage, and the wheelbase was unaltered from the crash. The left fender and the right front surface of the front bumper showed visible induced damage from the frontal impact. Both headlight assemblies and grille remained undamaged. The metal gas tank sustained no damage in the crash.

Based on the vehicle inspection, the CDC was determined to be: **02-FDEW-1 (50)**, for the case vehicle. The WinSMASH reconstruction program, barrier algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 7.3 km.p.h. (4.5 m.p.h.), -4.7 km.p.h. (-2.9 m.p.h.), and -5.6 km.p.h. (-3.5 m.p.h.). This contractor believes that while this collision fits the model, the Delta Vs are low. The low Delta Vs are a result of the minimal deformation to the case vehicle's front bumper, which sustained nothing more than scrapes with some slight shifting to the left, and the counterclockwise rotational trajectory of the case vehicle just prior to its impact with the barrier. The case vehicle was towed but not due to damage.

#### **AUTOMATIC RESTRAINT SYSTEM**

The case vehicle was equipped with a Supplemental Restraint System (SRS) that contained frontal air bags at the driver and front right passenger positions. Both air bags deployed as a result of the case vehicle's frontal end swipe with concrete median barrier. The case vehicle's driver air bag was located in the steering wheel hub. The module cover consisted of asymmetrical "H"-configuration cover flaps made of thick vinyl. The overall dimensions of the top flap were 26 centimeters (10.2 inches) at the top, 20 centimeters (7.9 inches) across the center seam and 8 centimeters (3.1 inches) vertically. The overall dimensions of the bottom flap were 21 centimeters (8.3 inches) at the bottom, 19 centimeters (7.5 inches) across the center seam, and 8 centimeters (3.1 inches) vertically. 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 driver's air bag was designed with four tethers, sewn interiorly to the center of the air bag, each 6 centimeters (2.4 inches) in width. The driver's air bag had two vent ports, approximately 2 centimeters (0.8 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 57 centimeters (22.4 inches) and a width of approximately 59 centimeters (23.2 inches). There was no contact evidence readily apparent on the driver's air bag (**Figure 14**).



**Figure 14:** Case vehicle's deployed driver air bag showing no visible evidence of contact (case photo #22)

The front right passenger's air bag was located in the top of the instrument panel. There was a single quadrilateral shaped modular cover flap. The cover flap was made of a thick vinyl over a thick cardboard type frame. The flap's dimensions were: 37 centimeters (14.6 inches) at the forward horizontal seam (i.e., toward the front right seating position), 49 centimeters (19.3 inches) at the rear (i.e., toward the windshield) horizontal seam, 18 centimeters (7.1 inches) along the right vertical seam, and 35 centimeters (13.8 inches) along the angled left vertical seam. There was an angled crease that ran laterally across the cover flap. The crease began 15 centimeters (5.9 inches) up from the right (toward the right front door) forward horizontal seam and ended 23 centimeters (9.1 inches) up from the left (toward the driver) forward horizontal seam. The profile of the case vehicle's instrument panel resulted in a 14 centimeter (5.5 inch) setback of the leading edge of the cover flap relative to the protruding right instrument panel.

An inspection of the front right air bag module's cover flaps and air bag revealed that the cover flaps opened at the designated tear points, and there was a snag on the underneath surface towards the driver's side of the air bag (**Figures 15 and 16**). A 2 centimeter (0.8 inch) snag resulted during the air bag's altered deployment path as it caught on the metal frame of the cover flap. Furthermore, there was deformation, teeth marks, and skin on the front right air bag module's cover flap (**Figure 17 and Figure 18** below). The deformation was located 9 centimeters (3.5 inches) in from the left side edge of the cover flap and 13 centimeters (5.1 inches) in from the right edge. The skin transfer was approximately 15 centimeters (5.9 inches) wide and was 7 centimeters (2.8 inches) high starting from the forward-most edge of the cover flap. The teeth scratches started 14 centimeters (5.5 inches) in from the left side edge and extended 2 centimeters (0.8 inches) up from the forward-most edge of the cover flap downward. The cover flap did not contact the windshield.



**Figure 15:** Underneath surface of case vehicle's deployed front right passenger air bag showing driver contact area near snag which occurred during air bag's deployment (case photo #33)



**Figure 16:** Close-up of snag on underneath surface of case vehicle's deployed front right passenger air bag; Note: snag (arrows) near area of skin, oil, and fluid stains from contact by driver (case photo #34)



**Figure 17:** Case vehicle's front right seating area showing driver's direction of movement and contacts to air bag module's cover flap, sun visor, and right front door glazing; Note: spray on right windshield (case photo #30)

The front right passenger's air bag was designed with two tethers, each 7.5 centimeters (3.0 inches) in width. Both tethers were sewn to the interior face of the air bag at a point that was approximately 25 centimeters (9.8 inches) below the top edge. The front right air bag had one vent port, approximately 7 centimeters (2.8 inches) in diameter, located at the 10 o'clock position. The deployed front right air bag was rectangular with a height of approximately 55 centimeters (21.7 inches) and a width of approximately 65 centimeters (25.6 inches). There was contact evidence readily apparent on the underneath side of the front right air bag, toward the driver's side. A large 24 x 30 centimeter (9.4 x 11.8 inch) area of oil and skin transfers along with blood smears was detected. In addition, an area of blood and skin primarily over the lower right quadrant of the front right air bag's front surface (Figure 19) was found, and a 2 x 4 centimeter (0.8 x 1.6 inch) blood spot towards the upper center of the air bag's front surface. There was no skin transfers found on the top or front portion of the front right passenger's air bag.

#### CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the initial impact the exact posture of the case vehicle's driver [63-year-old, Black (unknown if Hispanic) male; 168 centimeters and 71 kilograms (66 inches, 156 pounds)] is unknown, but presumably he was seated with his back against the seat back, his left foot on the floor, his right foot on the accelerator, his left hand on the steering wheel, and his right hand on the arm rest. Based on the vehicle inspection, his seat track was located between its middle and rearmost positions, the seat back was slightly reclined, and the vehicle was not equipped with a tilt steering wheel.

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

The case vehicle's driver made no known pre-crash avoidance maneuvers prior to the initial impact. As a result and independent of the nonuse of his available safety belts, his pre-impact body position did not change just prior to impact. The case vehicle's minor impact with the first concrete longitudinal barrier enabled the driver to continue slightly forward, if at all, most likely



**Figure 18:** Close-up of deformation and teeth marks (arrow) on case vehicle front right passenger air bag module's cover flap from contact with face of case vehicle's driver (case photo #37)



**Figure 19:** Case vehicle's deployed front right air bag showing evidence of occupant contact to lower right quadrant (case photo #39)

toward the case vehicle's steering wheel. This initial impact set in motion (i.e., most likely by alerting the driver) an improper steering maneuver (i.e., he over corrected leftwards, back onto the roadway and, in effect, induced a counterclockwise rotation), which because of his nonuse of the available safety belts, resulted in him moving to the right and forward just prior to the primary impact. The driver's pre-crash condition (see **INJURIES** section below) combined with the impact force from the median barrier caused the driver's hands to slip off the steering wheel and enable his torso to travel over the center floor-mounted console, with his right side leading, putting himself near the right instrument panel just prior to impact. The driver hit and broke the windshield wiper lever on the right side of the steering column with his leg or foot (**Figure 7** above). This could have occurred while the driver was moving forward and to his right toward the front right air bag module. Alternatively, as the driver was being lifted upwards towards the sun visor by the deploying front right air bag, a reflex leg movement may have broken the windshield wiper lever. Based on the damage to the case vehicle's front and the injuries to the case vehicle's driver, the case vehicle's primary impact with the cement barrier in the median did not immediately deploy either of the front air bags. In this contractor's opinion, this delay occurred because of the case vehicle's impact angle with the concrete barrier (approximate 50 degree Direction of Principal Force) was such that the discriminating sensor for the vehicle's air bags did not immediately fire. However, the impact allowed the driver to move further forward and to his right with the top of his head leading and angled, approximately, perpendicular to the interior surface of the right front door. This delay enabled the right side of the driver's face to be directly on top of the front right air bag module when the module deployed (**Figure 17** above). The deploying air bag module's cover flap (**Figure 18** above) struck the right side of the driver's face, lacerating and fracturing his face, and the expanding air bag lifted the driver's head upwards into the front right sun visor (**Figures 9 and 10** above). Meanwhile, the lower portion of his torso and pelvis continued toward the right as a result of the case vehicle's continued counterclockwise rotation. The driver's head subsequently struck the right front door glazing (**Figures 11 and 12** above) and dropped downward toward the front right seat, where a blood spot was deposited on the interior surface of the right door's side panel, prior to his body coming to rest. The case vehicle came to rest heading north-northeastward. At final rest the driver was laying across the front right passenger seat with his face on the seat cushion (**Figures 11 and 13** above) and the top of his head touching the door panel. The driver remained in the vehicle prior to rescue personnel arriving and gaining access to the locked vehicle.

#### **CASE VEHICLE DRIVER INJURIES**

The driver was transported by ambulance from the scene to the hospital. He sustained serious injuries and was pronounced dead three minutes after arriving in the hospital's emergency room (i.e., one hour and 10 minutes post-crash). Based on his medical records, the injuries sustained by the case vehicle's driver included: a nonanatomic brain injury; diffuse subarachnoid hemorrhages over his entire brain, including both cerebral lobes and his cerebellum and brain stem; an unspecified fracture of C<sub>5</sub>; comminuted fractures of his nose and right maxilla; fractures of his left 5th and 6th ribs; a subgaleal hemorrhage over his entire right skull, and facial lacerations that involved a laceration running downward from the medial right eye along the right side of his nose, a laceration under his right eye, and lacerations to the right corner of his mouth



and lip. The autopsy records indicated that the driver had a blood alcohol concentration (BAC) of .19%.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury with loss of consciousness <sup>2</sup> and cardiopulmonary <sup>3</sup> arrest	160802.3 serious	Air bag, front right passenger's	Probable	Emergency room records
2 3	Hemorrhage, subarachnoid, diffuse over entire brain	140684.3 140684.3 serious	Air bag, front right passenger's	Probable	Autopsy
4	Hemorrhage, subarachnoid, diffuse over cerebellum, including brain stem	140466.3 serious	Front right sun visor	Probable	Autopsy
5	Fracture C <sub>5</sub> -vertebral <sup>4</sup> component not specified	650216.2 moderate	Front right module's cover flap	Probable	Autopsy
6	Fracture, comminuted, nose	251004.2 moderate	Front right module's cover flap	Certain	Autopsy
7	Fracture, comminuted, right maxilla	250802.2 moderate	Front right module's cover flap	Certain	Autopsy
8	Fracture left 5 <sup>th</sup> and 6 <sup>th</sup> ribs, adjacent to sternum	450220.2 moderate	Right side window sill	Possible	Autopsy
9	Hemorrhage, subgaleal, over entire right skull	190402.1 minor	Front right sun visor	Probable	Autopsy
10	Laceration, 10.2 cm (4 in), from medial right eye down along right side of nose	290602.1 minor	Front right module's cover flap	Certain	Autopsy
11	Laceration, 2.5 cm (1 in), underneath right eye	290602.1 minor	Front right module's cover flap	Certain	Autopsy
12	Lacerations, 1.9 cm (0.75 in)-at right corner of mouth, and 3.2 cm (1.25 in)-in lower lip	290602.1 minor	Front right module's cover flap	Certain	Autopsy

<sup>2</sup> This patient was unconscious upon arrival of emergency medical services (EMS) at the scene. He was diagnosed in the emergency room (ER) as sustaining blunt head trauma, including facial fractures. He was asystolic at the scene and never regained a cardiac rhythm. This patient had agonal respirations upon arrival of EMS and went into respiratory arrest shortly thereafter. The EMS indicated a Glasgow Coma Scale (GCS) score of 3; however, no GCS score was reported in the ER. This patient was in the ER only three minutes before being pronounced dead; in essence, this patient was dead-on-arrival. Unfortunately, no recorded assessment was made of this patient's neurologic status (e.g., response to stimuli).

<sup>3</sup> The emergency medical technicians initially suspected a possible tracheal collapse because they were unsuccessful (in several attempts) intubating him because they could not get the endotracheal tube past his vocal cords.

<sup>4</sup> The cervical spinal cord was not examined during the autopsy; therefore, it is unknown if there was spinal cord injury. In addition, the specific fractured component of the fifth cervical vertebra was not identified.

