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ON-SITE CHILD AIR BAG-RELATED FATALITY INVESTIGATION

CASE NUMBER - IN01-021
LOCATION - TEXAS
VEHICLE - 1996 GEO METRO LSI
CRASH DATE - August, 2001

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 Geo Metro LSi (case vehicle) and a 1992 Pontiac Grand Am SE (other vehicle). This crash is of special interest because the case vehicle's "out-of-position" front right passenger (15-month-old female), who was sitting on the lap of an adult front right passenger, sustained a fatal brain stem laceration from the deploying front right passenger air bag. The case vehicle was traveling south in the inside lane of a four-lane, undivided, city street and was approaching a four-leg intersection (i.e., there were two through lanes in both the north and southbound directions). The Pontiac had been traveling north in inside lane of the same city street and was turning left across the case vehicle's path of travel. The crash occurred in the inside southbound lane, within the four-leg intersection of the two roadways. The front of the case vehicle impacted the front right half of the Pontiac, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle's "out-of-position" front right passenger was seated "on the lap" of an adult front right passenger, and the front right seat track was located between its middle and rearmost positions. She was not using the available, active, three-point, lap-and-shoulder, safety belt system. According to a conversation with the medical examiner, she sustained fatal injuries which included: a transection of the brain stem; a fracture at C ₅ -C ₆ with transection of the spinal cord; a tracheal transection; diffuse subarachnoid hemorrhage; lung contusions; a liver contusion; bilateral kidney contusions; and a large abrasion covering the entire face, anterior neck, upper chest, and both shoulders. This occupant's brain stem and cervical spinal injuries were caused by the deploying front right passenger air bag. The driver (54-year-old male) 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 using his available, active, three-point, lap-and-shoulder, safety belt system and sustained, according to the adult front right passenger, minor lacerations to the top of his head and upper left arm. The adult, front right passenger (40-year-old female) was seated and was not using her available, active, three-point, lap-and-shoulder, safety belt system. According to her interview, she sustained a moderate injury (i.e., a fractured right collarbone) and contusions to her upper right chest and left knee, and a sprained left ankle. The back right passenger (9-year-old female) was seated, but her seat track was not adjustable. She was not using her available, active, three-point, lap-and-shoulder, safety belt system and sustained, according to her mother (i.e., the adult, front right passenger), a minor lip laceration and complained of head pain.					
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This on-site investigation was brought to NHTSA's attention on August 13, 2001 by the NASS Western Zone Center. This crash involved a 1996 Geo Metro LSi (case vehicle) and a 1992 Pontiac Grand Am SE (other vehicle). The crash occurred in August, 2001, at 2:12 p.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's "out-of-position" front right passenger [15-month-old, White (Hispanic) female], who was sitting on the lap of an adult front right passenger, sustained a fatal brain stem laceration from the deploying front right passenger air bag. This contractor inspected the scene and vehicles on 15-16 August, 2001. This contractor obtained a partial interview with the case vehicle's adult front right passenger on August 29, 2001. The mother of the child (i.e., not an occupant) declined to cooperate in this research. Likewise, the adult front occupants declined to cooperate any further as well. This report is based on the Police Crash Report, a partial interview with the case vehicle's adult front right passenger, conversations with the investigating police officer and the medical examiner, scene and vehicle inspections, occupant kinematic principles, an occupant medical record, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling south in the inside lane of a four-lane, undivided, city street and was approaching a partially controlled four-leg intersection, intending to continue traveling southward (i.e., there were two through lanes in both the north and southbound directions with regulatory **STOP** signs for the east and westbound traffic). The Pontiac had been traveling north in inside lane of the same, two-lane, undivided, city street and was turning left across the case vehicle's path of travel, intending to travel westward. The case vehicle's driver braked just prior to impact, attempting to avoid the crash. The crash occurred in the inside southbound lane, within the four-leg intersection of the two roadways; see **CRASH DIAGRAM** at end.

The front of the case vehicle impacted the front right half of the Pontiac, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. As a result of the impact, the case vehicle rotated approximately 45 degrees clockwise prior to coming to rest straddling both southbound lanes, heading southwestward. The Pontiac, which had attempted to beat the case vehicle through the intersection by starting its left turn prior to the physical beginning of the intersection, was deflected westward and rotated approximately 30 degrees counterclockwise. The Pontiac came to rest heading primarily westward with its left front tire on the west sidewalk and the rear portion of the vehicle in the outside southbound lane.

The 1996 Geo Metro LSI was a front wheel drive, four-door sedan (VIN: 2C1MR5290T6-----). The case vehicle was not equipped with anti-lock brakes. Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **11-FDEW-2 (340)**. The WinSMASH reconstruction program, damage only algorithm, was used on the case vehicle's highest severity impact. The preliminary Total, Longitudinal, and Lateral Delta Vs are, respectively: 28.1 km.p.h. (17.5 m.p.h.), -26.4 km.p.h. (-16.4 m.p.h.), and + 9.6 km.p.h. (+ 6.0 m.p.h.). The case vehicle was towed due to damage.

The case vehicle's contact with the Pontiac involved almost its entire front. Direct damage began at the front left bumper corner and extended, a measured distance of 108 centimeters (42.5 inches), along the front bumper towards the right—ending 42 centimeters (16.5 inches) right of center. Residual maximum crush was measured as 36 centimeters (14.2 inches) at C₄. The wheelbase on the case vehicle's left side was extended approximately 1 centimeter (0.4 inches) while the right side was shortened approximately 1 centimeter (0.4 inches). The case vehicle's front bumper, bumper fascia, grille, hood, left headlight and turn signal assemblies, and radiator were directly damaged and crushed rearward. None of the case vehicle's tires were damaged, deflated, or physically restricted. The right headlight and turn signal assemblies sustained induced damage as well as the hood, right outside rearview mirror, and both the right and left fenders. No obvious induced damage or remote buckling was noted to the remainder of the case vehicle's exterior.

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 revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers, each 11.5 centimeters (4.5 inches) in width. The driver's air bag had two vent ports, approximately 4 centimeters (1.6 inches) in diameter, located at the 10:30 and 1:30 o'clock positions. The deployed driver's air bag was round with a diameter of 64 centimeters (25.2 inches). An inspection of the driver's air bag fabric did not reveal any skin evidence readily apparent on the air bag's fabric, but there was a copious amount of blood on the air bag's front surface and a few drops on blood on its back surface near the air bag's vent ports. According to the adult front right passenger, this blood resulted from the driver's scalp laceration.

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 flap and the air bag's fabric revealed that the cover flap opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flap. The front right passenger's air bag was designed without any tethers or vent ports. The deployed front right air bag was rectangular with a height of approximately 44 centimeters (17.3 inches) and a width of approximately 46 centimeters (18.1 inches).

An inspection of the front right air bag's fabric revealed a large area of skin transfer located 15 centimeters (5.9 inches) inward from the air bag's left seam. The area of skin transfer was approximately 7 centimeters (2.8 inches) in width and involved both the front portion of the top surface and the top portion of the front surface. From the seam that separates the top and front surfaces, the transfer area extended a measured distance 12 centimeters (4.7 inches) onto the top surface and 24 centimeters (9.4 inches) downward onto the front surface. There was a blood spot on the front surface underneath the area of skin transfer. To the right of this blood spot, there was a 7 centimeter (2.8 inch) hole that had been cut by the applicable police department (i.e., for evidentiary purposes). Furthermore, there were purple/red streaks vertically oriented on the front surface of the air bag that paralleled and outlined the area of skin transfer. In addition, there were two obliquely oriented red streaks located near the front surface's 5 o'clock position. Finally,

there was a 3 centimeter (1.2 inch) area of stitching separation along the front surface's right seam that was located 14 centimeters (5.5 inches) down from the aforementioned top horizontal seam.

Inspection of the case vehicle's interior revealed that the windshield's glazing was cracked on the driver's side from contact by the driver's left hand and there was a hair deposit on the driver's sun visor stem from the driver's scalp. Furthermore, there was contact to the left instrument panel (i.e., vent cracked) and a scuff on the left side of the driver's knee bolster. There was a small area of blood and possibly skin noted to the right windshield's header just below the sun visor. In addition, the upper right corner of the glove box and/or passenger's knee bolster was scuffed from occupant contact and the front right passenger's seat back was bent forward after being impacted by the back right passenger. Intrusion to the top of the seat back was visually estimated as 15 to 30 centimeters (between 5.9 and 11.8 inches). There were no other intrusions to the case vehicle's interior. Finally, there was no evidence of compression to the energy absorbing shear capsules in the steering column and no deformation to the steering wheel rim.

The 1992 Pontiac Grand Am SE was a front wheel drive, two-door coupe (VIN: 1G2NE1433NC-----). The Pontiac was equipped with four-wheel, anti-lock brakes. Based on the vehicle inspection, the CDC for the Pontiac was determined to be: **01-FZEW-2 (30)** [residual maximum crush was 38 centimeters (15.0 inches) at C₆]. The WinSMASH reconstruction program, damage only algorithm, was used on the Pontiac's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 24.1 km.p.h. (15.0 m.p.h.), -20.8 km.p.h. (-12.9 m.p.h.), and -12.0 km.p.h. (-7.5 m.p.h.). The Pontiac was towed due to damage.

Immediately prior to the crash, the case vehicle's "out-of-position" front right passenger [81 centimeters and 14 kilograms (32 inches, 31 pounds)] was seated "on the lap" of an adult front right passenger with her back against the adult passenger's chest, her feet sticking out forward from atop the seated front right passenger's thighs, and her hands on her lap. The front right seat track was located between its middle and rearmost positions, and the seat back was upright.

The case vehicle's "on-lap" front right passenger was not using the 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 "on-lap" passenger's body.

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse of either a child safety seat or the available safety belts, the "on-lap" front right passenger moved forward and slightly upward just prior to impact. Her forward movement was most likely restricted by the hands of the adult front right passenger. The case vehicle's impact with the Pontiac enabled the case vehicle's "on-lap" passenger to continue forward, slightly leftward, and upward toward the case vehicle's **340** degree Direction of Principal Force as the case vehicle decelerated. As a result, the "on-lap" passenger contacted the deploying air bag while simultaneously being compressed into the air bag's fabric and possibly the instrument panel by the unrestrained, adult, front right passenger. As the air bag reached maximum expansion, the "on-lap" front right passenger was most likely pushed backwards into the adult front right passenger. As the case vehicle reached maximum engagement, the case vehicle rotated clockwise. Based on occupant kinematic principals, the "on-lap" front right passenger most likely

moved toward the right front door as the vehicle moved to final rest. According to the interview with the adult front right passenger, she has no recollection of whether or not the “on-lap” child passenger came loose from her grasp during the crash. Furthermore, the front right passenger has no recollection of the exact posture of the child at final rest, most likely as a result of the traumatic nature of this event.

The “on-lap” front right occupant was transported by ambulance to the hospital. She sustained a fatal injury and was pronounced dead thirty minutes post-crash. According to a conversation with the medical examiner, the injuries sustained by the case vehicle's “on-lap” front right passenger included: a nearly complete transection of the brain stem; a “complete” fracture at C₅-C₆ with transection of the spinal cord; a tracheal transection; diffuse subarachnoid hemorrhage; lung contusions; a liver contusion; bilateral kidney contusions; and a large abrasion covering the entire face, anterior neck, upper chest, and both shoulders. This occupant's brain stem and cervical spinal injuries were caused by her contact with the case vehicle's deploying front right passenger air bag.

According to the adult front right passenger, the case vehicle's driver [54-year-old, White Hispanic) male; of unknown height and weight] was seated in an upright posture with his back against the seat back, his left foot on the floor, his right foot on the brake, and both hands on the steering wheel. His seat track was located between its middle and rearmost positions, the seat back was upright, and the vehicle was not equipped with a tilt steering wheel.

The case vehicle's driver was not using his available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, 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 driver was transported by ambulance to the hospital. He sustained minor injuries and was treated and released. According to the case vehicle's, adult, front right passenger, the driver's injuries included: lacerations to the top of his head and upper left arm. In addition, the driver complained of a sore neck.

The case vehicle's adult, front right passenger [40-year-old, White (Hispanic) female; 165 centimeters and 109 kilograms (65 inches, 240 pounds)] was seated in an upright posture with her back against the seat back, both feet on the floor, and her right arm around the “on-lap” passenger's waist. The exact location of her left arm is unknown. Her seat track was located between its middle and rearmost positions, and the seat back was upright. It should be noted that her seat back was deformed forward—approximately 10 degrees forward of 90 degrees.

In the opinion of this contractor, the case vehicle's adult, front right passenger was not using her available, active, three-point, lap-and-shoulder, safety belt system. It should be noted that an inspection of the front right passenger's, three-point, seat belt system did show evidence of loading but only on the “D”-ring. Furthermore, this occupant's self-reported injuries **are consistent** with safety belt usage. However, an inspection of the seat belt webbing showed no evidence of rippling (i.e., loading from the hefty front right passenger) **and** only one spot of blood, which most likely

occurred while it was in its storage position against the “B”-pillar. In addition, assuming that the “on-lap” passenger came to rest on the seated front right passenger’s lap, this investigator would have expected to find blood evidence on the shoulder portion of the front right belt webbing; however, little blood was found on any portion of the seat belt’s webbing. Finally, according to the Police Crash Report, the investigating officer noted that there was a lot of blood on the front right passenger’s “shirt” which was “... coming from the infant’s head, nose, and mouth.” If the adult front right passenger had been belted, then copious amounts of blood would have been expected on the seat belt’s webbing. Based on the vehicle inspection, the case vehicle had previously been in another crash (i.e., the case vehicle has been sold at least two times). The loading evidence on the “D”-ring was deemed most likely to have occurred prior to this crash.

The front right passenger was transported by ambulance to the hospital. She sustained moderate injuries and was treated and released. According to her interview, she sustained a fractured right collarbone, contusions to her upper right chest and left knee, and a sprained left ankle. In addition, the adult front right passenger had a history of polio in her right arm and indicated that her right arm was also weak.

The exact posture of the case vehicle's back right passenger [9-year-old, White (Hispanic) female; 122 centimeters and 18 kilograms (48 inches, 40 pounds)] is unknown but presumably she was seated, most likely in an upright posture with her back against the seat back and her feet on the floor. The back right passenger’s hands were most likely outstretched in front of her just prior to the crash. Her seat track and seat back were not adjustable.

Based on the interior inspection, the case vehicle's back right passenger was not using her available, active, three-point, lap-and-shoulder, safety belt system. The inspection of the back right passenger's seat belt webbing and latch plate showed no evidence of usage during this crash.

The back right passenger was transported by ambulance to the hospital. According to the interview with her mother (i.e., the adult, front right passenger), she sustained minor injuries and was treated and released. The back right passenger sustained a lip laceration and complained of head pain.

CRASH CIRCUMSTANCES

The case vehicle was traveling south in the inside lane of a four-lane, undivided, city street (**Figure 1**) and was approaching a partially controlled four-leg intersection, intending to continue traveling southward (i.e., there were two through lanes in both the north and southbound directions with regulatory **STOP** signs (Manual on Uniform Traffic Control Devices, R1-1) for the east and westbound traffic). The Pontiac had been traveling north in inside lane of the same, two-lane, undivided, city street and was turning left



Figure 1: Case vehicle’s southward travel path in inside southbound lane; Note: arrow shows approximate point of impact with Pontiac which was making a left-hand turn from inside northbound lane (case photo #01)

across the case vehicle's path of travel, intending to travel westward. The case vehicle's driver braked just prior to impact, attempting to avoid the crash. The crash occurred in the inside southbound lane, within the four-leg intersection of the two roadways; see **CRASH DIAGRAM** at end.

The city roadway was straight and level at the area of impact. The pavement was bituminous, but traveled, and the width of both inside travel lanes (i.e., north and southbound) was 3.4 meters (11 feet). The roadway was bordered by barrier curbs. Pavement markings consisted of a double solid yellow centerline for both north and southbound traffic, and the lanes were divided by a dashed white line. In addition, no edge lines were present. The estimated coefficient of friction was 0.70. Traffic controls consisted of a regulatory **SPEED LIMIT** sign (MUTCD, R2-1) combined with a **SCHOOL** sign (MUTCD, S4-3) and a **TIMES** plaque (MUTCD, S4-1) that was located on the south leg of the intersection on the southwest quadrant. The statutory speed limit was 48 km.p.h. (30 m.p.h.). At the time of the crash the light condition was daylight, the atmospheric condition was cloudy, and the road pavement was dry. Traffic density is unknown, and the site of the crash was urban commercial.



Figure 2: Case vehicle's damaged front viewed from left of front with bumper fascia placed on bumper; Note: tape indicates width of direct damage (case photo #11)



Figure 3: Case vehicle's frontal damaged viewed from right of front with contour gauge present (case photo #20)

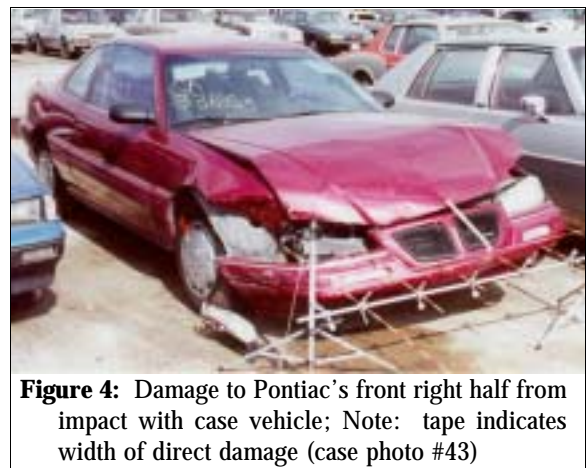


Figure 4: Damage to Pontiac's front right half from impact with case vehicle; Note: tape indicates width of direct damage (case photo #43)

The front (**Figures 2 and 3**) of the case vehicle impacted the front right half of the Pontiac (**Figure 4**), causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. As a result of the impact, the case vehicle rotated approximately 45 degrees clockwise prior to coming to rest straddling both southbound lanes, heading southwestward. The Pontiac, which had attempted to beat the case vehicle through the intersection by starting its left turn prior to the physical beginning of the intersection, was deflected westward and rotated approximately 30 degrees counterclockwise. The Pontiac came to rest heading primarily westward

with its left front tire on the west sidewalk and the rear portion of the vehicle in the outside southbound lane (**Figure 5**).



Figure 5: On-scene northerly view of final rest positions of case vehicle (background) and Pontiac (foreground) toward southwest quadrant of inter-section (case photo #45)

CASE VEHICLE

The 1996 Geo Metro LSi was a front wheel drive, four-passenger, four-door sedan (VIN: 2C1MR5290T6-----) equipped with a 1.3L, I-4 engine and a three-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum system. The case vehicle was not equipped with four-wheel, anti-lock brakes. The case vehicle’s wheelbase was 237 centimeters (93.1 inches), and the odometer reading at inspection was 159,964 kilometers (99,397 miles).

Inspection of the vehicle’s interior revealed adjustable front bucket seats with integral head restraints; a non-adjustable back bench seat without head restraints for the back seating positions; continuous loop, and three-point, lap-and-shoulder, safety belt systems at the front and back outboard positions. The front seat belt systems were not equipped with manually operated, upper anchorage adjusters for the “D”-rings. 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. Both frontal air bags deployed as a result of the case vehicle’s frontal impact with the Pontiac.

CASE VEHICLE DAMAGE

The case vehicle’s contact with the Pontiac involved almost its entire front (**Figure 2** above and **Figure 6**). Direct damage began at the front left bumper corner and extended, a measured distance of 108 centimeters (42.5 inches), along the front bumper towards the right—ending 42 centimeters (16.5 inches) right of center. Residual maximum crush was measured as 36 centimeters (14.2 inches) at C₄. The wheelbase on the case vehicle’s left side was extended approximately 1 centimeter (0.4 inches) while the right side was shortened approximately 1 centimeter (0.4 inches). The case vehicle’s front bumper, bumper fascia, grille, hood, left headlight and turn signal assemblies, and radiator were directly damaged and crushed rearward. None of the case vehicle’s tires were damaged, deflated, or physically restricted. The right headlight and turn signal assemblies sustained induced damage as well as the hood, right outside rearview mirror, and both



Figure 6: Overhead view of case vehicle’s frontal damage with contour gauge present; Note: bumper fascia lying on ground (case photo #12)

the right and left fenders. No obvious induced damage or remote buckling was noted to the remainder of the case vehicle's exterior.



Figure 7: Vertical view of case vehicle's driver air bag and header area showing contact (arrow) to sun visor post (case photo #25)



Figure 8: Case vehicle's driver sun visor showing hair clump on sun visor's stem from contact with driver's scalp (case photo #23)



Figure 9: Case vehicle's front right passenger seating area showing right knee contact to glove box and right instrument panel; Note: center floor mounted console also ajar (case photo #32)

Inspection of the case vehicle's interior revealed that the windshield's glazing was cracked on the driver's side from contact by the driver's left hand and there was a hair deposit on the driver's sun visor stem from the driver's scalp (**Figures 7 and 8**). Furthermore, there was contact to the left instrument panel (i.e., vent cracked) and a scuff on the left side of the driver's knee bolster. There was a small area of blood and possibly skin noted to the right windshield's header just below the sun visor. In addition, the upper right corner of the glove box and/or passenger's knee bolster was scuffed from occupant contact (**Figure 9**) and the front right passenger's seat back was bent forward after being impacted by the back right passenger (**Figure 10 and Figure 11** below). Intrusion to the top of the seat back was visually estimated as 15 to 30 centimeters (between 5.9 and 11.8 inches). There



Figure 10: Case vehicle's deformed front right seat back from contact by back right passenger; Note: blood (arrows) on window sill and door panel (case photo #35)

were no other intrusions to the case vehicle's interior. Finally, there was no evidence of compression to the energy absorbing shear capsules in the steering column and no deformation to the steering wheel rim.

Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **11-FDEW-2 (340)**. The WinSMASH reconstruction program, damage only algorithm, was used on the case vehicle's highest severity impact. The preliminary Total, Longitudinal, and Lateral Delta Vs are, respectively: 28.1 km.p.h. (17.5 m.p.h.), -26.4 km.p.h. (-16.4 m.p.h.), and + 9.6 km.p.h. (+ 6.0 m.p.h.). The case vehicle was towed due to damage.



Figure 11 Case vehicle's front seating area showing deformation to front right seat back from contact by back right passenger and deployed frontal air bags (case photo #26)

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 frontal air bags deployed as a result of the frontal impact with the Pontiac. 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 with overall dimensions of 15.5 centimeters (6.1 inches) at the horizontal seam and 6.5 centimeters (2.6 inches) vertically for the upper flap and 8 centimeters (3.1 inches) vertically for the lower flap. An inspection of the air bag module's cover flaps and the air bag's revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers, each 11.5 centimeters (4.5 inches) in width. The driver's air bag had two vent ports, approximately 4 centimeters (1.6 inches) in diameter, located at the 10:30 and 1:30 o'clock positions. The deployed driver's air bag was round with a diameter of 64 centimeters (25.2 inches). An inspection of the driver's air bag fabric did not revealed any skin evidence readily apparent on the air bag's fabric, but there was a copious amount of blood on the air bag's front surface (**Figure 7** above and **Figure 12**) and a few drops on blood on its back surface near the air bag's vent ports. According to the adult front right passenger, this blood resulted from the driver's scalp laceration.



Figure 12: Case vehicle's driver air bag showing copious blood smears from driver's scalp injuries (case photo #24)

The front right passenger's air bag was located in the top of the instrument panel. There was a single, essentially rectangular, modular cover flap. The cover flap was made of a thick vinyl over a thick cardboard type frame. The flap's dimensions were 35 centimeters (13.8 inches) at the lower horizontal seam and 16 centimeters (6.3 inches) along both vertical seams. The profile of the case vehicle's instrument panel resulted in a 3 centimeter (1.2 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 flap and the air bag's fabric revealed that the cover flap opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flap. The front right passenger's air bag was designed without any tethers or vent ports. The deployed front right air bag was rectangular with a height of approximately 44 centimeters (17.3 inches) and a width of approximately 46 centimeters (18.1 inches).



Figure 14: Close-up of skin transfer area on front portion of top surface of case vehicle's front right passenger air bag (case photo #30)

An inspection of the front right air bag's fabric revealed a large area of skin transfer located 15 centimeters (5.9 inches) inward from the air bag's left seam. The area of skin transfer was approximately 7 centimeters (2.8 inches) in width and involved both the front portion of the top surface and the top portion of the front surface. From the seam that separates the top and front surfaces, the transfer area extended a measured distance 12 centimeters (4.7 inches) onto the top surface (Figures 13 and 14) and 24 centimeters



Figure 13: Skin transfer area on front portion of top surface of case vehicle's deployed front right passenger air bag (case photo #29)

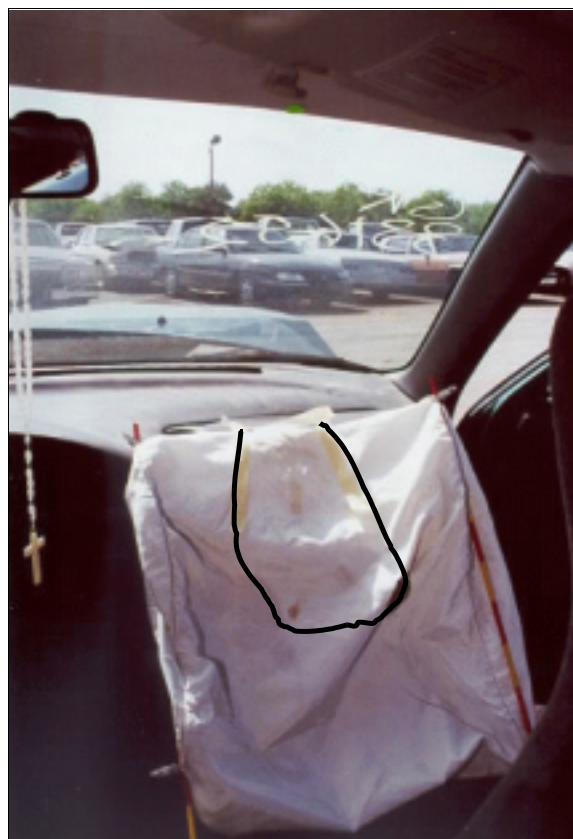


Figure 15: Vertical view showing area of skin transfer on top portion of front surface of case vehicle's front right passenger air bag (case photo #28)

(9.4 inches) downward onto the front surface (**Figure 15** above and **Figure 16**). There was a blood spot on the front surface underneath the area of skin transfer. To the right of this blood spot, there was a 7 centimeter (2.8 inch) hole that had been cut by the applicable police department (i.e., for evidentiary purposes). Furthermore, there were purple/red streaks vertically oriented on the front surface of the air bag that paralleled and outlined the area of skin transfer. In addition, there were two obliquely oriented red streaks located near the front surface's 5 o'clock position. Finally, there was a 3 centimeter (1.2 inch) area of stitching separation along the front surface's right seam that was located 14 centimeters (5.5 inches) down from the aforementioned top horizontal seam.

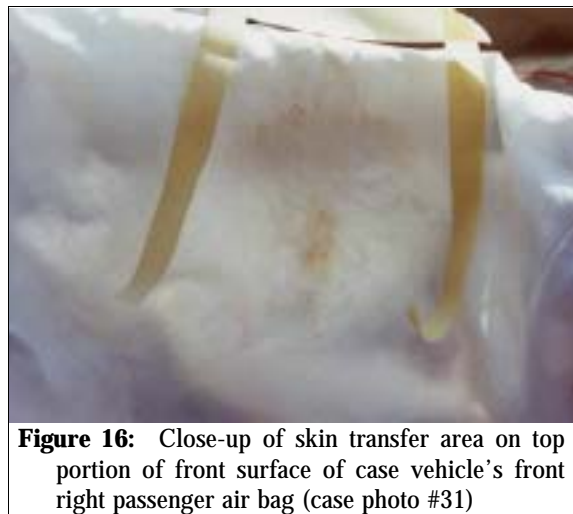


Figure 16: Close-up of skin transfer area on top portion of front surface of case vehicle's front right passenger air bag (case photo #31)

CASE VEHICLE "ON-LAP" FRONT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash, the case vehicle's "out-of-position" front right passenger [[15-month-old, White (Hispanic) female; 81 centimeters and 14 kilograms (32 inches, 31 pounds)] was seated "on the lap" of an adult front right passenger with her back against the adult passenger's chest, her feet sticking out forward from atop the seated front right passenger's thighs, and her hands on her lap. The front right seat track was located between its middle and rearmost positions, and the seat back was upright.

The case vehicle's "on-lap" front right passenger was not using the 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 "on-lap" passenger's body.

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse of either a child safety seat or the available safety belts, the "on-lap" front right passenger moved forward and slightly upward just prior to impact. Her forward movement was most likely restricted by the hands of the adult front right passenger. The case vehicle's impact with the Pontiac enabled the case vehicle's "on-lap" passenger to continue forward, slightly leftward, and upward toward the case vehicle's **340** degree Direction of Principal Force as the case vehicle decelerated. As a result, the "on-lap" passenger contacted the deploying air bag while simultaneously being compressed into the air bag's fabric and possibly the instrument panel by the unrestrained, adult, front right passenger. As the air bag reached maximum expansion, the "on-lap" front right passenger was most likely pushed backwards into the adult front right passenger. As the case vehicle reached maximum engagement, the case vehicle rotated clockwise. Based on occupant kinematic principals, the "on-lap" front right passenger most likely moved toward the right front door as the vehicle moved to final rest. According to the interview with the adult front right passenger, she has no recollection of whether or not the "on-lap" child passenger came loose from her grasp during the crash. Furthermore, the front right passenger has

no recollection of the exact posture of the child at final rest, most likely as a result of the traumatic nature of this event.

CASE VEHICLE “ON-LAP” FRONT RIGHT PASSENGER INJURIES

The “on-lap” front right occupant was transported by ambulance to the hospital. She sustained a fatal injury and was pronounced dead thirty minutes post-crash. According to a conversation with the medical examiner, the injuries sustained by the case vehicle's “on-lap” front right passenger included: a nearly complete transection of the brain stem; a “complete” fracture at C₅-C₆ with transection of the spinal cord; a tracheal transection; diffuse subarachnoid hemorrhage; lung contusions; a liver contusion; bilateral kidney contusions; and a large abrasion covering the entire face, anterior neck, upper chest, and both shoulders. This occupant's brain stem and cervical spinal injuries were caused by her contact with the case vehicle's deploying front right passenger air bag.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Fracture neck, not further specified	615999.7 unknown	Air bag, front right passenger's	Certain	Autopsy ¹
2	Laceration {complete transection} of the cervical spinal cord at the C ₅ -C ₆ level with cervical fracture	640264.5 ² critical	Air bag, front right passenger's	Certain	Other: conversation ³
3	Laceration, almost complete, brain stem, not further specified	140212.6 untreatable	Air bag, front right passenger's	Certain	Other: conversation ³
4	Laceration {transection} trachea, not further specified	442610.5 critical	Air bag, front right passenger's	Certain	Other: conversation ³
5	Hemorrhage, diffuse subarachnoid, not further specified [Aspect = Unknown]	140684.3 serious	Air bag, front right passenger's	Probable	Other: conversation ³
6	Contusion lungs, not further specified [Aspect = Unknown]	441402.3 serious	Air bag, front right passenger's	Probable	Other: conversation ³
	Hemorrhage, petechia, in thymus	Not coded	Air bag, front right passenger's	Probable	Other: conversation ³

¹ The only medical record the Medical Examiner would allow this contractor to obtain without a signed medical release was a copy of page entitled: “Cause and Manner of Death”. The cause of death was listed as a neck fracture (without further elaboration).

² The choice of injury code is difficult because the NASS CDS Injury Coding manual presumes that one knows whether there was a complete or an incomplete cord syndrome. Because the only available medical information is based upon an autopsy, the syndrome issue is not discernable (i.e., you cannot determine the difference in a dead person). In the absence of protocol, this contractor chooses to assume that the syndrome was complete.

³ These lesions were reported to this contractor by means of a telephone conversation with the physician who performed the autopsy on this occupant, and there is no documentation to support these lesions.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
7	Contusion liver, not further specified	541810.2 moderate	Other occupant: adult front right passenger	Possible	Other: con- versation ³
8 9	Contusion kidneys, not further specified	541610.2 541610.2 moderate	Other occupant: adult front right passenger	Probable	Other: con- versation ³
10	Abrasions entire face, not further specified [Aspect = Whole]	290202.1 minor	Air bag, front right passenger's	Certain	Other: con- versation ³
11	Abrasions neck, not further specified [Aspect = Whole]	390202.1 minor	Air bag, front right passenger's	Certain	Other: con- versation ³
12	Abrasions shoulders, not further specified [Aspect = Bilateral]	790202.1 minor	Air bag, front right passenger's	Certain	Other: con- versation ³
13	Abrasions upper chest, not further specified	490202.1 minor	Air bag, front right passenger's	Certain	Other: con- versation ³

CASE VEHICLE DRIVER KINEMATICS

According to the adult front right passenger, the case vehicle's driver [54-year-old, White Hispanic) male; of unknown height and weight] was seated in an upright posture with his back against the seat back, his left foot on the floor, his right foot on the brake, and both hands on the steering wheel. His seat track was located between its middle and rearmost positions, the seat back was upright, and the vehicle was not equipped with a tilt steering wheel.

The case vehicle's driver was not using his available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, 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 braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse his available safety belts, he moved forward and slightly upward just prior to impact. The case vehicle's impact with the Pontiac enabled the case vehicle's driver to continue forward, slightly leftward, and upward toward the case vehicle's **340** degree Direction of Principal Force as the case vehicle decelerated. As a result, he glanced off the deploying driver air bag and struck the sun visor with the top of his head, lacerating his scalp. Although this contractor has no knowledge of the driver's height, the driver most likely contacted the deploying air bag in his chest and abdomen. The driver also most likely contacted the driver's knee bolster (i.e., scuff) and the left instrument panel (i.e., a left instrument panel vent was cracked) with his knees and/or thighs, and he is believed to have cracked the windshield's glazing with his left hand. As the case vehicle reached maximum engagement, the case vehicle rotated clockwise to final rest. Based on occupant kinematic principals, the driver rebounded backwards,

most likely toward the right side of his seat back and/or center console. According to the adult front right passenger, she has no recollection of the exact posture of the driver at final rest.

CASE VEHICLE DRIVER INJURIES

The driver was transported by ambulance to the hospital. He sustained minor injuries and was treated and released. According to the case vehicle’s, adult, front right passenger, the driver’s injuries included: lacerations to the top of his head and upper left arm. In addition, the driver complained of a sore neck.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Laceration {stitches} to top of head	190600.1 minor	Sun visor, driver’s	Certain	Interviewee (other occupant)
2	Laceration {cut} left upper arm, not further specified	790600.1 minor	Unknown contact mechanism	Unknown	Interviewee (other occupant)

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

The case vehicle's adult, front right passenger [40-year-old, White (Hispanic) female; 165 centimeters and 109 kilograms (65 inches, 240 pounds)] was seated in an upright posture with her back against the seat back, both feet on the floor, and her right arm around the “on-lap” passenger’s waist. The exact location of her left arm is unknown. Her seat track was located between its middle and rearmost positions, and the seat back was upright. It should be noted that her seat back was deformed forward—approximately 10 degrees forward of 90 degrees (**Figures 10 and 11** above).

In the opinion of this contractor, the case vehicle's adult, front right passenger was not using her available, active, three-point, lap-and-shoulder, safety belt system. It should be noted that an inspection of the front right passenger's, three-point, seat belt system did show evidence of loading but only on the "D"-ring (**Figure 17**). Furthermore, this occupant’s self-reported injuries **are consistent** with safety belt usage. However, an inspection of the seat belt webbing showed no evidence of rippling (i.e., loading from the hefty front right passenger) **and** only one spot of blood, which most likely occurred while it was in its storage position against the “B”-pillar. In addition, assuming that the “on-lap” passenger came to rest on the seated front right passenger’s lap, this investigator would have expected to find blood

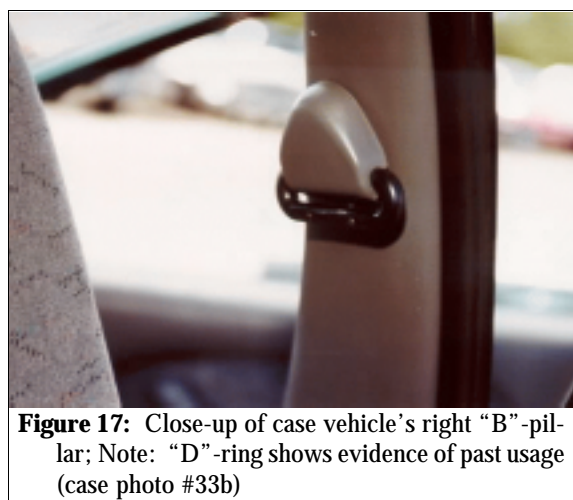


Figure 17: Close-up of case vehicle’s right “B”-pillar; Note: “D”-ring shows evidence of past usage (case photo #33b)

evidence on the shoulder portion of the front right belt webbing; however, little blood was found on any portion of the seat belt's webbing. Finally, according to the Police Crash Report, the investigating officer noted that there was a lot of blood on the front right passenger's "shirt" which was "... coming from the infant's head, nose, and mouth." If the adult front right passenger had been belted, then copious amounts of blood would have been expected on the seat belt's webbing. Based on the vehicle inspection, the case vehicle had previously been in another crash (i.e., the case vehicle has been sold at least two times). The loading evidence on the "D"-ring was deemed most likely to have occurred prior to this crash.

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse her available safety belts, the front right passenger moved forward and slightly upward just prior to impact. The case vehicle's impact with the Pontiac enabled the case vehicle's adult, front right passenger to continue forward, slightly leftward, and upward toward the case vehicle's **340** degree Direction of Principal Force as the case vehicle decelerated. As a result, she contacted the deploying air bag, circumferentially, while simultaneously compressing the "on-lap" front right passenger into the air bag's fabric and possibly the instrument panel. As the air bag reached maximum expansion, both the "on-lap" and adult front right passengers were most likely pushed backwards. As the case vehicle reached maximum engagement, the case vehicle rotated clockwise. Based on occupant kinematic principals, the front right passenger most likely moved toward the right front door as the vehicle moved to final rest. In this contractor's opinion, the adult front right passenger most likely fractured her right clavicle (i.e., "collar bone") when she contacted the door's window sill or window frame or even the right "B"-pillar. It should be noted that the right front window's glazing was completely rolled down and inside the door prior to the collision. According to the adult front right passenger, she has no recollection of her exact posture at final rest, most likely as a result of the traumatic nature of this event.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger was transported by ambulance to the hospital. She sustained moderate injuries and was treated and released. According to her interview, she sustained a fractured right collarbone, contusions to her upper right chest and left knee, and a sprained left ankle. In addition, the adult front right passenger had a history of polio in her right arm and indicated that her right arm was also weak.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Fracture right clavicle {collar bone}, not further specified	752200.2 moderate	Right side window frame and/or right "B"-pillar	Possible	Interviewee (same person)
2	Contusion right upper chest	490402.1 minor	Air bag, front right passenger's	Probable	Interviewee (same person)

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
3	Contusion left knee	890402.1 minor	Knee bolster, front right passenger's	Probable	Interviewee (same person)
4	Sprain left foot, not further specified	850404.1 minor	Foot well/toe pan	Certain	Interviewee (same person)

CASE VEHICLE BACK RIGHT PASSENGER KINEMATICS

The exact posture of the case vehicle's back right passenger [9-year-old, White (Hispanic) female; 122 centimeters and 18 kilograms (48 inches, 40 pounds)] is unknown but presumably she was seated, most likely in an upright posture with her back against the seat back and her feet on the floor. The back right passenger's hands were most likely outstretched in front of her just prior to the crash. Her seat track and seat back were not adjustable.

Based on the interior inspection, the case vehicle's back right passenger was not using her available, active, three-point, lap-and-shoulder, safety belt system. The inspection of the back right passenger's seat belt webbing and latch plate showed no evidence of usage during this crash.

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse her available safety belts, the back right passenger moved forward and slightly upward just prior to impact. The case vehicle's impact with the Pontiac enabled the case vehicle's back right passenger to continue forward, slightly leftward, and upward toward the case vehicle's 340 degree Direction of Principal Force as the case vehicle decelerated. As a result, she impacted the back surface of the case vehicle's front right seat back (**Figure 18**) with her head, face, and torso, deforming the seat back approximately 10 degrees forward (**Figure 11** above) and depositing contact evidence. The back right passenger's lip was lacerated, most likely from her own teeth. As the case vehicle reached maximum engagement, the case vehicle rotated clockwise. Based on occupant kinematic principals, the back right passenger most likely moved toward the right rear door, the right side

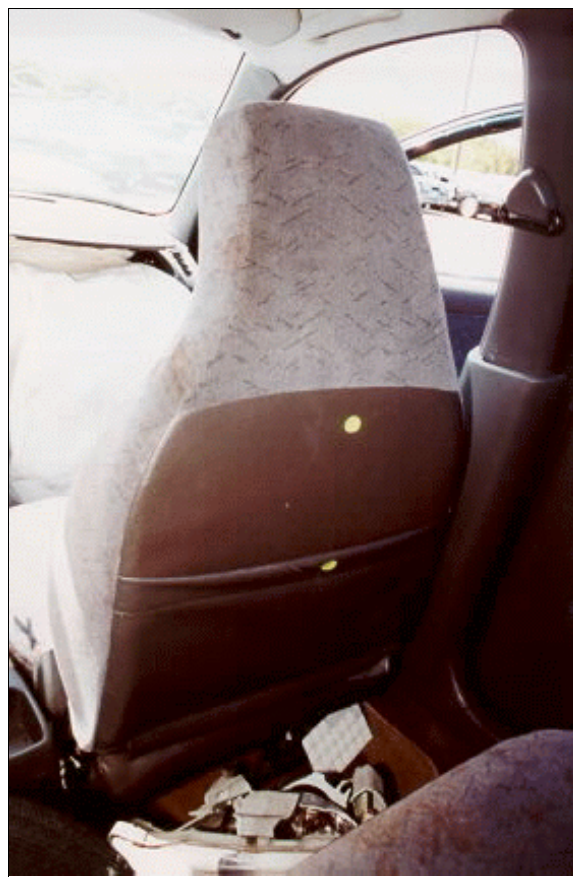


Figure 18: Case vehicle's front right seat back showing contact evidence on back surface from impact by back right passenger (case photo #33a)

of the back seat, and/or the “C”-pillar as the vehicle moved to final rest. According to the adult front right passenger, she has no recollection of the exact posture of this child at final rest.

CASE VEHICLE BACK RIGHT PASSENGER INJURIES

The back right passenger was transported by ambulance to the hospital. According to the interview with her mother (i.e., the adult, front right passenger), she sustained minor injuries and was treated and released. The back right passenger sustained a lip laceration and complained of head pain.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Laceration {cut} lip, not further specified	290602.1 minor	Seat back, front right passenger’s	Certain	Interviewee (other occupant)

OTHER VEHICLE

The 1992 Pontiac Grand Am SE was a front wheel drive, five-passenger, two-door coupe (VIN: 1G2NE1433NC-----) equipped with a 2.3L, L-4 engine and either the standard, five-speed manual *or* an unknown-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum, four-wheel, anti-lock system. The case vehicle’s wheelbase was 263 centimeters (103.4 inches), and the odometer reading is unknown because the interior of the Pontiac was not inspected.

The Pontiac’s contact with the case vehicle involved its front right half (**Figure 19**). Direct damage began 12 centimeters (4.7 inches) to the left of center and extended, a measured distance of 82 centimeters (32.3 inches), along the front bumper to the front right bumper corner. Residual maximum crush was measured as 38 centimeters (15.0 inches) at C₆. The Pontiac’s wheelbase was shortened approximately 1 centimeter (0.4 inches) on both the left and right sides.



Figure 19: Pontiac’s frontal damage with contour gauge present showing direct contact between tape and front right bumper corner (case photo #36)

Based on the vehicle inspection, the CDC for the Pontiac was determined to be: **01-FZEW-2 (30)**. The WinSMASH reconstruction program, damage only algorithm, was used on the Pontiac’s highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 24.1 km.p.h. (15.0 m.p.h.), -20.8 km.p.h. (-12.9 m.p.h.), and -12.0 km.p.h. (-7.5 m.p.h.). The Pontiac was towed due to damage.

