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ON-SITE CHILD SAFETY SEAT INVESTIGATION

CASE NUMBER - IN-05-009

LOCATION - WISCONSIN

VEHICLE - 2004 CHEVROLET VENTURE

CRASH DATE - February 2005

Submitted:

August 31, 2006



Contract Number: DTNH22-01-C-07002

Prepared for:

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

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

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

Technical Report Documentation Page

1. <i>Report No.</i> IN-05-009		2. <i>Government Accession No.</i>		3. <i>Recipient's Catalog No.</i>	
4. <i>Title and Subtitle</i> On-Site Child Safety Seat Investigation Vehicle - 2004 Chevrolet Venture Location - Wisconsin		5. <i>Report Date:</i> August 31, 2006		6. <i>Performing Organization Code</i>	
		7. <i>Author(s)</i> Special Crash Investigations Team #2		8. <i>Performing Organization Report No.</i>	
9. <i>Performing Organization Name and Address</i> Transportation Research Center Indiana University 222 West Second Street Bloomington, Indiana 47403-1501		10. <i>Work Unit No. (TRAIS)</i>		11. <i>Contract or Grant No.</i> DTNH22-01-C-07002	
		12. <i>Sponsoring Agency Name and Address</i> U.S. Department of Transportation (NPO-122) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003		13. <i>Type of Report and Period Covered</i> Technical Report Crash Date: February 2005	
		14. <i>Sponsoring Agency Code</i>			
15. <i>Supplementary Notes</i> On-site air bag investigation involving a 2004 Chevrolet Venture with manual safety belts and dual front advanced air bag system.					
16. <i>Abstract</i> This report covers an on-site investigation of a crash that involved a 2004 Chevrolet Venture (case vehicle) and a 1997 Pontiac Bonneville SE (other vehicle), which were involved in an offset frontal crash on a two-lane state highway. This crash is of special interest because the case vehicle's second seat center passenger [7-month-old, White (non-Hispanic) female] was restrained in a rear-facing child safety seat and sustained a fatal injury as a result of the crash. In addition, the second seat left passenger [7-month-old, White (non-Hispanic) female] was also restrained in a rear-facing child safety seat, and the second seat right passenger [6-week-old, White (non-Hispanic) female] was restrained in a rear-facing infant seat. Both of these passengers sustained police reported "C" (possible) injuries as a result of the crash. In addition, the case vehicle was equipped with dual stage front air bags and an Event Data Recorder (EDR). The case vehicle was traveling northeast on a two-lane state highway. The Pontiac was traveling southwest. The Pontiac crossed the centerline, and its front left impacted the front left of the case vehicle causing both vehicle's driver and front right passenger air bags to deploy. The crash was very severe resulting in the death of both drivers. Following impact, the case vehicle rotated counterclockwise, departed the east side of the roadway, entered a ditch and rolled over onto its left side. The Pontiac rotated counterclockwise and came to final rest partially over the centerline heading east. The case vehicle's second seat center passenger was properly restrained in her rear-facing child safety seat. She sustained serious head and spine injury resulting in her death. The case vehicle's driver was restrained by her three-point, lap-and-shoulder safety belt. She sustained serious internal and head injuries resulting in her death. The case vehicle's second seat left passenger was properly restrained in her rear-facing child safety seat. She sustained serious injury and was hospitalized. The case vehicle's second seat right passenger was properly restrained in her rear-facing infant seat. She was transported to a hospital and was determined to be not injured and released. The case vehicle's back left passenger was restrained by the three-point, lap-and-shoulder safety belt. He was wearing the shoulder belt under his left arm. He was transported by helicopter to a hospital. His injury and treatment status are unknown. The case vehicle's back right passenger was restrained by his three-point, lap-and-shoulder safety belt. He was transported, treated and released.					
17. <i>Key Words</i> Advanced Air Bag Child Safety Seat		Motor Vehicle Traffic Crash Injury Severity		18. <i>Distribution Statement</i> General Public	
19. <i>Security Classif. (of this report)</i> Unclassified		20. <i>Security Classif. (of this page)</i> Unclassified		21. <i>No. of Pages</i> 38	22. <i>Price</i> \$16,300

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This investigation was brought to NHTSA's attention on February 23, 2005 by GES sampling activities. This crash involved a 2004 Chevrolet Venture (case vehicle) and a 1997 Pontiac Bonneville SE (other vehicle), which were involved in an offset frontal crash on a two-lane state highway. The crash occurred in February, 2005, at 5:52 p.m., in Wisconsin and was investigated by the county sheriff department and the Wisconsin State Patrol. This crash is of special interest because the case vehicle's second seat center passenger [7-month-old, White (non-Hispanic) female] was restrained in a rear-facing child safety seat and sustained a fatal injury as a result of the crash. In addition, the second seat left passenger [7-month-old, White (non-Hispanic) female] was restrained in a rear-facing child safety seat and the second seat right passenger [6-week-old, White (non-Hispanic) female] was restrained in a rear-facing infant seat. Both of these passengers sustained police reported "C" (possible) injuries as a result of the crash. The case vehicle was also equipped with dual stage front air bags and an Event Data Recorder (EDR). This contractor inspected the case vehicle and the Pontiac on March 2, 2005. Occupant interviews, child seat inspections, and scene inspections were completed on March 3, 2005. Each vehicle's Sensing and Diagnostic Module (SDM), which contain the EDR, were removed by investigating police personnel for subsequent download and to secure as evidence. A hard copy of the downloaded files from each vehicle's EDR was provided to this contractor. This report is based on the police crash report; scene, case vehicle, Pontiac and child safety seat inspections; review of the EDR data, medical records for the case vehicle's second seat center passenger, driver, front right passenger, second seat right passenger and back right passenger; interviews with investigating police personnel and surviving vehicle occupants, occupant kinematic principles and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling northeast in the northeastbound lane of a two-lane state highway. The Pontiac was traveling southwest in the southwestbound lane. The Pontiac crossed the centerline and its front left impacted the front left of the case vehicle causing both vehicles' driver and front right passenger air bags to deploy. The case vehicle rotated counterclockwise, departed the east side of the roadway, entered a ditch and rolled over onto its left side. The Pontiac rotated counterclockwise and came to final rest partially over the centerline heading east. The case vehicle's driver attempted to avoid the crash by steering right and braking. At the time of the crash, the light condition was dark, the atmospheric condition was clear, the roadway pavement was dry bituminous, traffic density was light and the site of the crash was rural.

The CDC for the case vehicle's front impact with the Pontiac was determined to be: **12-FDAW-7 (350 degrees)**. The CDC for the case vehicle's subsequent rollover onto its left side was determined to be: **00-LDAO-1**. The WinSMASH reconstruction program, damage only algorithm, calculated the case vehicle's Total, Longitudinal, and Lateral Delta Vs for the front impact respectively as: 84.0 km.p.h. (52.2 m.p.h.), -82.7 km.p.h. (-51.4 m.p.h.), and 14.6 km.p.h. (9.1 m.p.h.). This contractor considers this a borderline reconstruction due to the severity of the crush to both vehicles. The case vehicle's EDR recorded a maximum longitudinal Delta V of 50.95 km.p.h. (-31.66 m.p.h.), which appeared to be low based on the damage to the case vehicle.

The Pontiac's CDC was determined to be: **12-FDEW-5 (0 degrees)**. The WinSMASH reconstruction program, damage only algorithm, calculated the Pontiac's Total, Longitudinal, and Lateral Delta Vs respectively as: 107.0 km.p.h. (66.5 m.p.h.), -107.0 km.p.h. (-66.5 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). This contractor considers this a borderline reconstruction due to the severity of the crush to both vehicles. The Pontiac's EDR data indicated that power was lost during the recording process. As a result, a complete recording of the Delta V history was interrupted and not obtained. The last recorded Delta V value was -56.84 km.p.h. (-35.32 m.p.h.) occurring at 80 milliseconds after AE.

Immediately prior to the crash, the case vehicle's second seat center passenger [7-month-old, female; 84 centimeters and 10 kilograms (33 inches, 22 pounds)] was seated in her rear-facing child safety seat in a slightly reclined position. Her back was against the back of her child safety seat, and her feet and hands were within the confines of the child seat. She was asleep, holding a stuffed animal and was covered with a blanket. She was properly restrained in her child safety seat. The child seat was properly secured in the case vehicle with the child seat's LATCH straps attached to the case vehicle's LATCH system lower anchors. The seat track was adjusted to its forward-most position. The seat back was slightly reclined.

The case vehicle's impact with the Pontiac caused the second seat center passenger to load into the back of her child seat as the case vehicle decelerated. As the impact progressed, the driver's seat was displaced rearward and the back right portion of the child seat impacted the right portion of the intruding driver's seat back. The child seat was compressed between the driver's seat back and the second row seat back deforming the child seat. The deformation of the back of the child seat most likely compressed the child between the back of the child seat, the tray-shield and the case vehicle's second row seat back. The initial loading of the child into the child seat's seat back, caused a subarachnoid hemorrhage, ring fracture of the lower occipital and a contusion of the spinal cord with underlying fracture through C₆- C₇. The subsequent deformation of the child seat's seat back forced the child into the tray shield and caused multiple contusions through the right lung. As the case vehicle separated from impact and rotated counterclockwise, the child most likely moved to the right within her child seat and then to the left as the case vehicle rolled over onto its left side to final rest. The child seat remained secured in the vehicle, and the child remained restrained in her child seat following the crash. The child was subsequently removed from the vehicle by rescue personnel. She sustained fatal injuries and was pronounced dead at the scene

Immediately prior to the crash the case vehicle's second seat left passenger [7-month-old, female; 76 centimeters and 10 kilograms (30 inches, 22 pounds)] was seated in her rear-facing child safety seat in a slightly reclined position. The child's back was against the back of her child seat, and her feet and hands were within the confines of the child seat. She was asleep, holding a stuffed animal and was covered with a blanket. She was properly restrained in her rear-facing child safety seat. The child seat was properly secured in the case vehicle with the lap-and-shoulder belt. The seat track was adjusted to its rear-most position. The seat back was slightly reclined.

The case vehicle's impact with the Pontiac caused the second seat left passenger to load into the back of her rear-facing child seat and her head to impact the back of the child seat. She also

likely rode up the incline of her seat back and loaded her harness straps. As the impact progressed, the driver's seat was displaced rearward and the back of the child seat impacted the intruding driver's seat back as well as the intruding left rear door and B-pillar. As the case vehicle separated from impact and rotated counterclockwise, the child most likely moved to the right within her child seat and then to the left as the case vehicle rolled over onto its left side to final rest. The child seat remained secured in the vehicle, and the child remained restrained in her child seat following the crash. The child was subsequently removed from the vehicle by rescue personnel. She sustained a police reported "C" (possible) injury and was transported by helicopter to the hospital. She sustained serious injuries and was hospitalized for five days. The interviewee reported that the child sustained a possible brain hematoma with fluid on the brain and blood in her spinal fluid.

Immediately prior to the crash the case vehicle's second seat right passenger [6-week-old, female; 56 centimeters and 4 kilograms (22 inches, 8 pounds)] was seated in her rear-facing infant seat with detachable base. The infant was seated in a reclined position with her back and head against the back of her infant seat, and her hands and feet were within the confines of the infant seat. She was properly restrained in her infant seat by a five-point harness. The infant seat was properly secured in the case vehicle with the lap-and-shoulder belt. The seat track was adjusted to its middle position. The seat back was slightly reclined.

The case vehicle's impact with the Pontiac caused the second seat right passenger to move forward and load into the back of her infant seat. The infant most likely rode slightly up the incline of her seat back and loaded her five-point harness straps. As the case vehicle separated from impact and rotated counterclockwise, the infant most likely moved slightly to the right within her infant seat and then to the left as the case vehicle rolled over onto its left side to final rest. It is unknown if the infant seat remained secured in the case vehicle following the crash; however, the infant reportedly remained restrained in her infant seat following the crash. The infant was subsequently removed from the vehicle by rescue personnel. She sustained a police reported "C" (possible) injury and was transported by ambulance to a local hospital. She reportedly did not sustain any injuries and was not hospitalized, but did undergo a precautionary CT scan.

Immediately prior to the crash, the case vehicle's driver [27-year-old, female; 168 centimeters and 110 kilograms (66 inches, 242 pounds)] was most likely seated in a nominal upright driving position with her left foot on the floor and her right foot on the brake. In addition, the driver most likely had both hands on the steering wheel and was bracing for impact. Due to the damage to the vehicle, it was not possible to determine the position of the driver's seat track, seat back or the tilt steering column. However, based on the height of the driver, her seat track was most likely positioned between its middle and forward positions. The driver was restrained by her manual, three-point, lap-and-shoulder safety belt system. The driver was not wearing glasses or contact lenses at the time of the crash.

The case vehicle's impact with the Pontiac caused the driver to continue forward and slightly left along a path opposite the case vehicle's 350 degree direction of principal force as the case vehicle decelerated. She loaded her safety belt lacerating her spleen. Her face and chest impacted her deployed air bag, her knees impacted the knee bolster, her left foot loaded the toe pan and her

right foot loaded the brake pedal. She continued to move forward and upward, rode down the deployed air bag and her chest and abdomen loaded the steering wheel deforming the steering wheel, compressing the energy absorbing steering column and causing a laceration of her aorta and posterior hemi-diaphragm. Her head then impacted the intruding roof causing an open vault fracture, basilar skull fracture and subarachnoid hemorrhage. As the case vehicle rolled onto its left side, the driver's left side impacted the driver's door and her head impacted the roof and left roof side rail. The driver remained restrained in her seat laying against the drivers' door, left roof side rail and roof. She was entrapped by the intruded instrument panel, steering wheel and toe pan and was extricated from the case vehicle by rescue personnel. The driver sustained fatal injuries and was pronounced dead at the scene.

Immediately prior to the crash, the case vehicle's front right passenger [28-year-old, female; 165 centimeters and 57 kilograms (65 inches, 125 pounds)] was seated in an upright position with both feet on the floor, her left hand pointing to the oncoming Pontiac and her right hand in an unknown position. Due to the damage to the vehicle, it was not possible to determine the position of the her seat track. However, based on the height of the passenger, her seat track was most likely positioned between its middle and forward position. The front right passenger was restrained by her three-point, lap-and-shoulder safety belt system. The front right passenger was not wearing glasses or contact lenses at the time of the crash.

The case vehicle's impact with the Pontiac caused the front right passenger to continue forward along a path opposite the case vehicle's 350 degree direction of principal force as the case vehicle decelerated. She loaded her safety belt and her face and chest impacted her deployed air bag. Her left hand also impacted the center instrument panel causing a comminuted, displaced fracture of her left distal radius, and her knees and lower legs impacted the glove box door. She rode down the air bag and her head impacted the intruding windshield causing a nonanatomic brain injury. As the case vehicle separated from impact and rotated counterclockwise, the passenger most likely moved right, and then left as the case vehicle rolled over onto its left side. As the case vehicle rolled over, the passenger's outer left thigh impacted the center console. Following the crash, the passenger remained restrained in her seat laying against the center console and the driver. She was removed from the case vehicle by rescue personnel. The front right passenger sustained a police reported "A" (incapacitating) injury and was transported from the scene to a local hospital and hospitalized for two days.

Immediately prior to the crash, the case vehicle's back left passenger [4-year-old, male; 91 centimeters and 20 kilograms (36 inches, 45 pounds)] was seated in an upright position with both feet dangling over the seat edge and his hands on his lap. His seat track and seat back were both non-adjustable. He was restrained by his three-point, lap-and-shoulder safety belt system. However, he was wearing the shoulder portion of the safety belt under his left arm.

The case vehicle's impact with the Pontiac caused the back left passenger to continue forward and left along a path opposite the case vehicle's 350 degree direction of principal force as the case vehicle decelerated. His lower legs most likely impacted the back of the seat in front of him. In addition, his torso most likely jackknifed over the lap belt and the shoulder belt that was under his left arm, and he possibly impacted his head on the back of the seat in from of him.

As the case vehicle separated from impact and rotated counterclockwise, the passenger most likely moved right, and then left as the case vehicle rolled over onto its left side. As the case vehicle rolled over, the passenger's left side impacted the case vehicle's left side surface. Following the crash, the passenger remained restrained in his seat laying against the left side of the case vehicle. He was removed from the case vehicle by rescue personnel. The left rear passenger sustained a police reported "C" (possible) injury including a possible head injury and abdomen tenderness. He was transported by helicopter to a local hospital. The nature and extent of his injuries and his treatment status are unknown.

Immediately prior to the crash, the case vehicle's back right passenger [30-year-old, male; 183 centimeters and 84 kilograms (72 inches, 185 pounds)] was seated in an upright position with his back against the seat back, his feet on the floor and his hands on his lap. His seat track and seat back were both non-adjustable. He was restrained by his three-point, lap-and-shoulder safety belt system.

The case vehicle's impact with the Pontiac caused the back right passenger to continue forward and left along a path opposite the case vehicle's 350 degree direction of principal force as the case vehicle decelerated. He loaded his safety belt fracturing his right clavicle and sternum. Both of his hands and lower legs impacted the back of the seat in front of him causing a comminuted fracture of the 5th metacarpal of his right hand and abrasions to both hands. As the case vehicle separated from impact and rotated counterclockwise, the passenger most likely moved right, and then left as the case vehicle rolled over onto its left side. As the case vehicle rolled over, the passenger's left side most likely impacted the passenger seated to his left. The passenger remained restrained in his seat and was able to exit the case vehicle under his own power. The police crash report did not indicate the right rear passenger's level of injury. He was transported by ambulance to a local hospital and was treated and released.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which both vehicles were traveling was a two-lane, undivided, bituminous, state highway traversing in a northeast and southwest direction. There was one travel lane in each direction and a wide bituminous and gravel shoulder adjacent to each side of the roadway. Each travel lane was approximately 3.5 meters (11.5 feet) in width. The bituminous shoulders were each 1 meter (3.3 feet) in width. The gravel shoulder on the north side of the roadway was approximately 2 meters (6.6 feet) in width. The gravel shoulder on the south side of the roadway was approximately 3 meters (9.8 feet) in width. The roadway was level and gently curved to the north. The speed limit was 88 km.p.h. (55 m.p.h.). Roadway markings consisted of a broken yellow centerline and white edge lines. There was no regulatory speed limit sign posted near the crash site. At the time of the crash the light condition was dark, the atmospheric condition was clear and the roadway pavement was dry bituminous with an estimated coefficient of friction of 0.68. Traffic density was light and the site of the crash was rural. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle was traveling northeast in the northeastbound lane (**Figure 1** below). The case vehicle's driver was intending to continue straight ahead. The Pontiac was traveling

southwest in the southwestbound lane (**Figure 2**). The Pontiac's driver was most likely intending to continue straight ahead. The Pontiac crossed the centerline and entered the case vehicle's travel lane. The case vehicle's driver attempted to avoid the crash by steering right and braking. The crash occurred in the northeastbound lane of the roadway (**Figure 3**).



Figure 1: Approach of case vehicle northeastbound to area of impact (arrow) in northeastbound lane



Figure 2: Approach of Pontiac southwestbound to area of impact (arrow) in northeastbound lane



Figure 3: Overview of impact area from case vehicle's approach, arrow shows impact gouges



Figure 4: Damage to Pontiac from impact with case vehicle, each increment on rods is 5 cm (2 in)

Crash: The front of the Pontiac (**Figure 4**) impacted the front of the case vehicle (**Figure 5**). The impact caused both vehicle's driver and front right passenger air bags to deploy. The case vehicle's downloaded EDR data indicated that both stages of the dual-stage air bags activated. The case vehicle rotated counterclockwise approximately 165 degrees, departed the east side of the roadway, entered a ditch and rolled over onto its left side.

Post-Crash: The case vehicle came to final rest in a ditch on the east side of the roadway on its left



Figure 5: Damage to case vehicle from impact with the Pontiac

side heading southwest (**Figure 6**). The impact caused the Pontiac to rotate counterclockwise approximately 150 degrees. It came to final rest partially over the centerline heading east (**Figure 7**).



Figure 6: Police on-scene photo showing rest position of case vehicle, view to north



Figure 7: Police on-scene photo showing rest position of Pontiac, view to southwest

CASE VEHICLE

The 2004 Chevrolet Venture was a front wheel drive, four-door mini van (VIN: 1GNDX03EX4-----) equipped with a 3.4L, V6 engine and a four-speed automatic transmission. The front seating row was equipped with bucket seats with adjustable head restraints, tilt steering column, dual stage driver and front right passenger air bags and driver and front right passenger manual, three-point, lap-and-shoulder safety belt systems with pretensioners and adjustable upper anchors. The second seating row was equipped with bucket seats with folding backs and adjustable head restraints; three point, lap-and-shoulder safety belt systems in the outboard seat positions and a two-point lap belt in the middle seat position. The back seating row was equipped with a bench seat with folding back, adjustable head restraints and three-point, lap-and-shoulder safety belts in the outboard seat positions and a two-point lap belt in the middle seat position. In addition, the case vehicle was equipped with a LATCH system for securing child safety seats. Anti-lock brakes were an option, but it is unknown if the case vehicle was so equipped. The case vehicle's wheelbase was 305 centimeters (120 inches). The odometer reading at the time of the vehicle inspection was unknown because the case vehicle was equipped with an electronic odometer.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's impact with the Pontiac involved the front plane (**Figure 5** above) and as the impact progressed, the left front and rear doors (**Figure 8**). The case vehicle's



Figure 8: Damage to case vehicle's left side doors from impact with the Pontiac

front bumper, bumper fascia, grille, radiator, hood, left headlamp/turn signal assemblies, left front tire, left fender, windshield, and left front and rear doors were directly damaged and crushed rearward. The direct damage started at the left bumper corner and extended 150 centimeters (59 inches) along the bumper. The Field-L was very short, only 29 centimeters (11.4 inches), due to the extent of crush at the front left corner, and required only four C-measurements to define the crush profile. Residual maximum crush (Figure 9) was measured as 148 centimeters (58.3 inches) occurring at C₁. The direct D value was based on the initial impact overlap. The table below shows the case vehicle's crush profile.

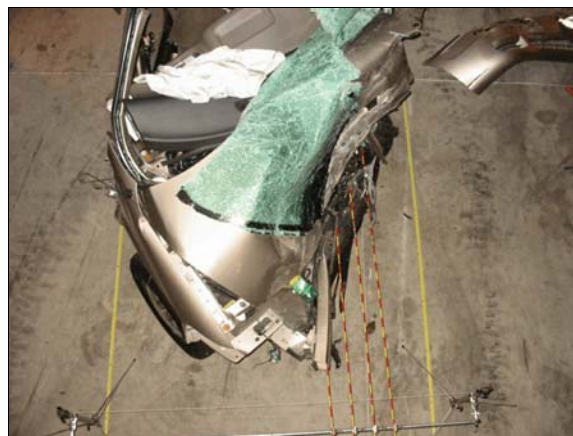


Figure 9: Top view of crush to front of case vehicle

Units	Event	Direct Damage		Field L	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	150	148	29	148	123	101	18	N/A	N/A	-33	0
in		59.1	58.3	11.4	58.3	48.4	39.8	7.1	N/A	N/A	-13.0	0.0

The case vehicle's left side wheelbase was shortened 107 centimeters (42.1 inches) while the right side wheelbase was extended 17 centimeters (6.7 inches). Induced damage involved the roof, right fender and the left quarter panel. The right B-pillar was cut away, the right front door was removed and the roof was cut laterally at approximately the second seat row area by rescue personnel to facilitate extrication of the occupants.

The case vehicle's recommended tire size was P215/70R15, and the vehicle was equipped with tires of this size. The case vehicle's tire data are shown in the table below.

Tire	Measured Pressure		Recommend Pressure		Tread Depth		Damage	Restricted	Deflated
	kpa	psi	kpa	psi	milli-meters	32 nd of an inch			
LF	0	0	221	32	9	11	Tire debaded and jammed onto back of wheel house	Yes	Yes
RF	200	29	221	32	8	10	None	No	No
LR	193	28	221	32	7	9	None	No	No
RR	193	28	221	32	8	10	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior revealed evidence of occupant contact to both front air bags, the steering wheel rim, driver's knee bolster, both front safety belts, both outboard third seat row safety belts, and the roof of the case vehicle. There was significant intrusion into the driver's occupant space (**Figure 10**), the front right occupant space and the second seat left occupant space. The primary intrusions into the driver's occupant space were: 115 centimeters (45.3 inches) of longitudinal toe pan intrusion, 82 centimeters (32.3 inches) of longitudinal instrument panel intrusion and 72 centimeters (28.3 inches) of longitudinal steering wheel intrusion. The primary intrusions into the front right occupant space were: 76 centimeters (29.9 inches) of longitudinal toe pan intrusion and 22 centimeters (8.7 inches) of longitudinal instrument panel intrusion. The primary intrusion into the second seat left occupant space was 37 centimeters (14.6 inches) of lateral door panel intrusion. Lastly, there was significant deformation of the upper half of the steering wheel rim and the energy absorbing steering column (**Figure 11**).



Figure 10: Intrusion into driver's occupant space



Figure 11: Deformation to case vehicle's steering wheel and overview of air bag module flaps

Damage Classification: Based on the vehicle inspection, the CDC for the case vehicle's front impact with the Pontiac was determined to be: **12-FDAW-7 (350 degrees)**. The CDC for the case vehicle's subsequent rollover onto its left side was determined to be: **00-LDAO-1**.

The WinSMASH reconstruction program, damage only algorithm, was used to reconstruct the case vehicle's Delta Vs for the front impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 84.0 km.p.h. (52.2 m.p.h.), -82.7 km.p.h. (-51.4 m.p.h.), and 14.6 km.p.h. (9.1 m.p.h.). This contractor considers this to be a borderline reconstruction. The crush to the case vehicle was severe enough to collapse the passenger compartment. This indicates that this crash is likely beyond the scope of the program's stiffness coefficients to reasonably model the case vehicle's crush characteristics. The stiffness coefficients used in the reconstruction are derived from 35 m.p.h. barrier tests, which most likely do not adequately model the dynamics of the crush sustained by the case vehicle in this crash. The case vehicle's EDR recorded a maximum longitudinal Delta V of -50.95 km.p.h. (-31.66 m.p.h.), which appeared to be low based on the damage to the case vehicle. It is likely that clipping of the acceleration data occurred due to the high severity of the crash, resulting in an inaccurate Delta V recording. Based on the damage to the case vehicle's left side due to the rollover (2nd event), the rollover severity was estimated to be minor. The case vehicle was towed due to damage.

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module cover flaps and the air bag fabric revealed that the cover flaps opened at the designated tear points. There was no evidence of damage during the deployment to the air bag or the cover flaps (**Figure 11** above). The air bag module cover consisted of symmetrical "I"-configuration cover flaps constructed of thick vinyl. Each cover flap was 9 centimeters (3.5 inches) in width and 11 centimeters (4.3 inches) in height along the center tear seam. The deployed driver's air bag (**Figure 12**) was round with a diameter of approximately 65 centimeters (25.6 inches). It was designed with four tethers, each approximately 7 centimeters (2.8 inches) in width. The driver's air bag had two vent ports (**Figure 13**), each approximately 2 centimeters (0.8 inches) in diameter, located at the 11 and 1 o'clock positions. An inspection of the air bag revealed blood and body fluid from the driver on the air bag fabric on the lower half (front and back) and the upper right quadrant of the air bag. The on-scene police photographs show this was due to the driver coming to rest on the air bag following the crash and bleeding on the air bag from a head injury. In addition there were two small holes in the front of the air bag in the upper right quadrant (**Figure 14**). The source of these holes was not determined. They did not appear related to the deployment.

The front right passenger's air bag was located in the top of the instrument panel (**Figure 15** below). An inspection of the front right passenger air bag module cover flaps and the air bag's fabric revealed that the cover flaps opened at the designated tear points. There was no evidence of damage during the deployment to the air bag or the cover flap. The single cover flap was approximately rectangular and constructed of metal with a vinyl cover. The cover flap was 40 centimeters (15.7 inches) in width and 24 centimeters (9.5 inches) in height. The deployed



Figure 12: Case vehicle's driver air bag, orange dots show small holes in air bag

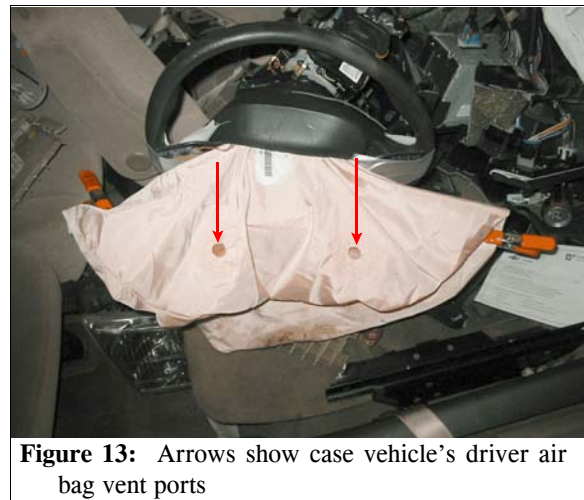


Figure 13: Arrows show case vehicle's driver air bag vent ports



Figure 14: Close view of small holes in driver's air bag

front right air bag (**Figure 16**) was square with a height and width of approximately 52 centimeters (20.5 inches). The air bag was designed with two wide tethers, each approximately 20 centimeters (7.9 inches) in width. The front right passenger's air bag had two vent ports, approximately 3 centimeters (1.2 inches) in diameter, located at the 9:30 and 2:30 clock positions. An inspection of the air bag fabric revealed a 12 centimeter (4.7 inches) scuff on the air bag's lower left side, just below the lower tether stitching. Also noted was a small stress mark (a near puncture) near the center of the air bag and just above the top tether stitching.



Figure 15: Location of front right air bag in top of instrument panel

CRASH DATA RECORDING

The case vehicle's SDM, which contains the EDR, was removed by investigating police personnel for subsequent download and to secure as evidence. A hard copy of the downloaded EDR data was provided to this contractor. The data indicated that a non-deployment and a deployment event were recorded. The non-deployment event was recorded 142 ignition cycles prior to the deployment event and is, therefore, not related to this crash. The EDR reports for the deployment event are presented at the end of this report (**Figures 37 and 38**). The system status report shows that the SIR warning lamp was recorded off, and the driver's seat belt switch circuit was recorded buckled. In addition, the maximum SDM recorded velocity change was recorded as -50.95 km.p.h. (-31.66 m.p.h.) occurring 107.5 milliseconds after algorithm enable (AE), which appeared to be low based on the damage to the case vehicle. It is likely that clipping of the acceleration data occurred due to the high severity of the crash, resulting in an inaccurate Delta V recording. The system status report also shows that both the first and second stage deployment criteria were met for the driver and front right passenger air bags, and that the event recording was complete. The first stage deployment criteria for both air bags was met at 7.5 milliseconds after AE. The second stage deployment criteria for both air bags was met at 10 milliseconds after AE.



Figure 16: Case vehicle's front right passenger air bag

The pre-crash data shows that the case vehicle's speed was recorded as 103 to 105 km.p.h. (64 to 65 m.p.h.) at 15% throttle from five to two seconds prior to AE, and the brake switch circuit was recorded off. At one second prior to AE the vehicle's speed was recorded as 97 km.p.h. (60 m.p.h.) at 0% throttle, and the brake switch circuit is recorded on. The recorded status of the brake switch circuit at this time increment supports the front right passenger's statement that the driver attempted to avoid the crash by applying the brakes just prior to the impact.

A convertible child safety seat with tray-shield was used to restrain the case vehicle's second seat center passenger [7-month-old, female; 84 centimeters and 10 kilograms (33 inches, 22 pounds)]. It was positioned in the rear facing orientation at the time of the crash. The child seat (**Figure 17**) was manufactured by Dorel Juvenile Group, Inc. on January 1, 2005 and identified by model name "Touriva" and model number 22-130-WAL. The child seat was purchased new about two weeks prior to the crash and was used on a daily basis. It was designed with a three-point, tray-shield harness with harness retainer clip, a recessed buckle and a LATCH system. The child seat was slightly reclined and secured tightly with the child seat's LATCH straps attached to the case vehicle's LATCH system lower anchors. Also, the case vehicle's lap belt was pulled out to switch the retractor to automatic locking mode, routed through the guide below the child seat cushion and retracted to tighten it against pool noodles, which were used to help position the child seat.

The convertible child safety seat consisted of a one-piece plastic shell with a hinged tray-shield. The shell had cloth covered foam padding on the back support, seat and the tray-shield. On the bottom of the child safety seat was a fold-out support for adjusting the seat to different vehicle seat cushions. There were three slots in the seat back to thread the three-point harness through, depending on the child's height. In this case, the harness belts were threaded through the center slots.

Inspection of the child seat revealed evidence it had been compressed between the intruding driver's seat back and the back of the seat in which the child seat was secured. The back, upper right portion of the child seat had extensive stress marks and cracks in the plastic shell (**Figure 18**), and contact marks were observed on the back right portion of the driver's



Figure 17: Case vehicle's second seat center child safety seat



Figure 18: Stress marks and cracks to back, upper right portion of 2nd seat center child seat

seat back (**Figure 19**). Stress marks were also observed in the harness guides (**Figure 20**) located in the back of the child seat and along the entire length of the right side of the child seat (**Figure 21** below) due to the buckling of the child seat from contact with the driver's seat back (**Figure 22** below) during impact. In addition, the right shield arm was pulled out of its socket. The right side of the plastic shell (**Figure 21** below) was also cracked open vertically at about mid-level, below the shield arm's attachment socket. Just above this point was a crack in the shell running diagonally upward. Also found on the right side of the child seat were abrasions to the lower outer portion of the seat. This was likely due to contact with the child seat located in the second seat left position. The left side of the child seat was largely unremarkable. However, there were some minor abrasions to the left edge of the child seat. All the harness webbing appeared in good condition; however, it had been cut by rescue personnel. Lastly, the latch clip for the right lower anchor connector was deformed and would not close (**Figure 23** below).

The stress marks in the harness belt guides and the deformation and stress marks observed on the child seat indicate that as the child seat back was crushed rearward and twisted to the left, the harness belts were pulled tight loading the plastic harness guides and most likely pulling the belt tightly against the child. In addition, the deformation of the back of the child seat most likely compressed the child between the back of the child seat, the tray-shield and the case vehicle's seat back.

There were manufacturer's information and warning labels affixed to both sides of the child seat giving the child safety seat's weight and height limitations in addition to illustrations depicting the proper installation method. In the forward facing configuration, the child's height, weight and age limitations were given respectively as: 73-102 centimeters (20-40 inches), 9-18 kilograms (20-40 pounds) and over 1 year of age. In the rear facing configuration, the height, weight and age limitations were given respectively as: 48-91 centimeters (19-36 inches), 2.3-15 kilograms (5-35 pounds) and under 1 year of age.



Figure 19: Overview of child seat contact marks (arrows) on the case vehicle driver's seat back, arrows on right show second seat center child seat marks, arrows on left show second seat left child seat marks

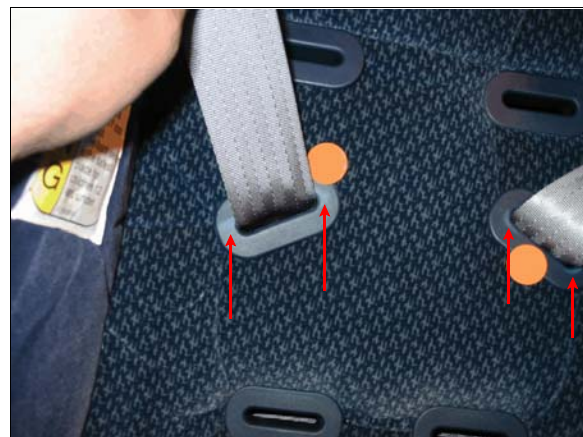


Figure 20: Close view of stress marks in harness guides (arrows) of 2nd seat row, center child seat



Figure 21: Stress marks and damage to right side of 2nd seat center child seat

The second seat left passenger [7-month-old, female; 76 centimeters and 10 kilograms (30 inches, 22 pounds)] was restrained in an identical model child safety seat as the second seat center passenger. However, no inspection of the child seat was possible because it had been discarded following the crash. The child seat had been purchased new approximately three weeks prior to the crash and was used on a daily basis. The child seat was positioned in the case vehicle in the rear-facing position. The interviewee indicated that pool noodles were used to help position the child seat, and it was secured in the case vehicle by the lap-and-shoulder belt. The case vehicle's safety belt was pulled out to switch the retractor to automatic locking mode, the belt was routed through the guide below the child seat cushion, the child seat was pressed down and the vehicle belt retracted until the child seat was secured. The interviewee stated that the child seat remained secured by the vehicle's safety belt following the crash.

An infant safety seat with detachable base was used to restrain the case vehicle's second seat right passenger [6-week-old, female; 56 centimeters and 3.6 kilograms (22 inches, 8 pounds)]. It was secured in the case vehicle in a rear facing position. The infant seat was manufactured by Graco on July 20, 2004 and was identified by Model name "Snugride" and model number



Figure 22: Intrusion of the case vehicle driver's seat into the 2nd seat center and left seat positions; arrow shows pool noodles used to position child seats

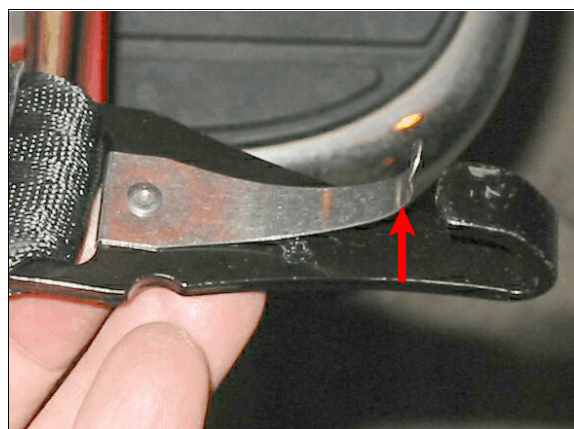


Figure 23: Latch clip deformation (arrow) on right lower anchor connector of case vehicle's 2nd seat center child seat

8643DOH. The infant seat (**Figure 24**) was purchased new approximately six weeks prior to the crash and was used on a daily basis. The unit was designed with a five-point harness with harness retainer clip and a non-recessed buckle. There were two sets of harness slots in the back of the infant seat, and the harness straps were located in the bottom slots. The infant seat was designed to snap into a detachable base (**Figure 25**), which was secured to the case vehicle's seat. In addition, there was an indicator on the left side of the infant seat to assure that the seat was installed at the proper angle.

According to the interviewee, the infant seat was attached to its base, which was secured tightly by the case vehicle's lap-and-shoulder belt. Nothing was placed behind the infant seat to position it. The case vehicle's safety belt was pulled out to switch the retractor to automatic locking mode, and the belt was retracted as the infant seat base was pressed down into the seat. The infant seat was then snapped into the base. The interviewee was not sure if the infant seat remained secured to its base following the crash.

The infant seat consisted of a plastic one-piece shell, which was lined with a "comforter" pad. A close inspection of the infant seat revealed no damage or stress to the shell, base, or harness. Manufacturer's information and warning labels in English and Spanish were affixed to both sides of the infant seat giving height and weight limitations in addition to illustrations depicting the proper installation method. The infant seat's height and weight limitations were given respectively as: 66 centimeters (26 inches) or less and 9 kilograms (20 pounds) or less.



Figure 24: Case vehicle's 2nd seat right infant seat, a Graco "Snugride"



Figure 25: Infant seat base

CASE VEHICLE SECOND SEAT CENTER PASSENGER KINEMATICS

Immediately prior to the crash, the case vehicle's second seat center passenger [7-month-old, White (non-Hispanic) female; 84 centimeters and 10 kilograms (33 inches, 22 pounds)] was restrained in her rear-facing child safety seat in a slightly reclined position. Her back was against the back of her child safety seat, and her feet and hands were within the confines of the child seat.

She was asleep, holding a stuffed animal and was covered with a blanket. The case vehicle's seat track was adjusted to its forward-most position. The seat back was slightly reclined.

Based on this contractor's vehicle inspection, child seat inspection and interview data, this passenger was properly restrained in her rear-facing child safety seat, and the child seat was properly secured in the case vehicle. In addition, the interviewee indicated there was approximately two fingers of space between the harness and the child's chest, and the harness clip was positioned at approximately armpit level.

The case vehicle's driver steered right and braked in an attempt to avoid the crash. As a result, the child most likely moved slightly forward and leftward into the back of her rear-facing child seat just prior to impact. The case vehicle's impact with the Pontiac caused the child to load into the back of her child seat as the case vehicle decelerated. As the impact progressed, the driver's seat was displaced rearward and the back right portion of the child seat impacted the right portion of the intruding driver's seat back (**Figures 19** and **22** above). The child seat was compressed between the driver's seat back and the second row seat back deforming the child seat. The stress marks in child seat's harness belt guides and the deformation and stress marks observed on the child seat indicates that as the back of the child seat was crushed rearward and twisted to the left, the harness belts were pulled tight loading the plastic harness guides and most likely pulling the belt tightly against the child. In addition, the deformation of the back of the child seat most likely compressed the child between the back of the child seat, the tray-shield and the case vehicle's second row seat back. The initial loading of the child into the child seat's seat back, caused a subarachnoid hemorrhage, ring fracture of the lower occipital and a contusion of the spinal cord with underlying fracture through C₆- C₇. The subsequent deformation of the child seat's seat back forced the child into the tray shield and caused multiple contusions through the right lung. As the case vehicle separated from impact and rotated counterclockwise, the child most likely moved to the right within her child seat and then to the left as the case vehicle rolled over onto its left side to final rest. The child seat remained secured in the vehicle and the child remained restrained in her child seat following the crash. The child was subsequently removed from the vehicle by rescue personnel.

CASE VEHICLE SECOND SEAT CENTER PASSENGER INJURIES

The case vehicle's second seat center passenger was not transported by ambulance to the hospital. She sustained fatal injuries and was pronounced dead at the scene. The table below shows the passenger's injuries and injury mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion spinal cord underlying fracture through C ₆ -C ₇ intervertebral disc with softening of cord and surrounding subarachnoid hemorrhage	critical 640224.5,6 ¹	Child safety seat's back top surface	Probable	Autopsy
2	Dislocation {complete separation} atlanto-occipital joint, posteriorly with "softening" of spinal cord at C ₁ and "softening" of lower medulla oblongata	moderate 650208.2,6	Noncontact injury: impact forces with axial stretching (i.e., distraction)	Probable	Autopsy
3 4	Subarachnoid hemorrhage left frontal, parietal, and temporal lobes and right inferior frontal and temporal lobes	serious 140684.3,1 140684.3,2	Child safety seat's back top surface	Probable	Autopsy
5	Lacerations to deep soft tissue right lobe of liver	moderate 541822.2,1	Child safety seat tray shield	Probable	Autopsy
6	Fracture, "ring", lower occipital skull, not further specified	severe 150206.4,8	Child safety seat's back top surface	Probable	Autopsy
7	Fracture ribs: right 6 th through 8 th , posteriorly; left 1 st through 3 rd , posteriorly with laxity {looseness} overlying facets of left 2 nd through 7 th ribs and right 1 st through 5 th ribs	moderate 450220.2,3	Child safety seat tray shield	Probable	Autopsy
8	Contusions, multiple, throughout right lung, not further specified	serious 441406.3,1	Child safety seat tray shield	Probable	Autopsy
9	Fracture mid right humerus, not further specified	moderate 752602.2,1	Child safety seat's back top surface	Probable	Autopsy
10	Fracture left proximal humerus, not further specified	moderate 752602.2,2	Child safety seat's back top surface	Probable	Autopsy
11 12	Fracture mid-shaft right tibia and fibula, not further specified	moderate 851606.2,1 853420.2,1	Child safety seat's side wall	Probable	Autopsy
13	Abrasion, small, left posterior parietal scalp	minor 190202.1,2	Child safety seat's back top surface	Probable	Autopsy

¹ The choice of injury code is difficult because the NASS CDS Injury Coding manual presumes there was a complete or an incomplete cord syndrome. Because the only available medical record is an autopsy, the syndrome issue is not discernable (i.e., you cannot determine the difference in a deceased person). In the absence of protocol, this contractor chooses to assume that the syndrome was complete.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
14	Contusion {subgaleal hemorrhage} right and lower right occipital scalp	minor 190402.1,1	Child safety seat's back top surface	Probable	Autopsy
15	Contusion {subgaleal hemorrhage} left mastoid region	minor 190402.1,2	Child safety seat's back top surface	Probable	Autopsy
16	Laceration {tear} upper frenulum	minor 290602.1,4	Child safety seat tray shield	Probable	Autopsy
17	Contusion lateral right upper arm overlying humeral fracture	minor 790402.1,1	Child safety seat's back top surface	Probable	Autopsy
18	Contusion dorsum left hand	minor 790402.1,2	Child safety seat's back top surface	Probable	Autopsy
19	Contusions anterolateral right thigh and right knee	minor 890402.1,1	Child safety seat tray shield	Probable	Autopsy
20	Contusion medial left knee	minor 890402.1,2	Child safety seat tray shield	Probable	Autopsy

CASE VEHICLE SECOND SEAT LEFT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's second seat left passenger [7-month-old, White (non-Hispanic) female; 76 centimeters and 10 kilograms (30 inches, 22 pounds)] was seated in her rear-facing child safety seat in a slightly reclined position. In addition, the interviewee (i.e., child's parents) indicated that the child's head was leaning forward indicating that the child seat may have been only very slightly reclined. The child's back was against the back of her child seat, and her feet and hands were within the confines of the child seat. She was asleep, holding a stuffed animal and was covered with a blanket. The case vehicle's seat track was adjusted to its rear-most position. The seat back was slightly reclined.

Based on this contractor's vehicle inspection and interview data, this passenger was properly restrained in her rear-facing child safety seat, and the child seat was properly secured in the case vehicle. In addition, the interviewee indicated there was approximately two fingers of space between the harness and the child's chest, and the harness clip was positioned at approximately armpit level.

Just prior to the crash, the case vehicle's driver steered right and braked in an attempt to avoid the crash. As a result, the child most likely moved slightly forward and leftward into the back of her child seat. The case vehicle's impact with the Pontiac caused the child to load into the back of her rear-facing child seat and her head to impact the back of the child seat. She also likely rode up the incline of her seat back and loaded her harness straps. As the impact progressed, the driver's seat was displaced rearward and the back of the child seat impacted the intruding driver's

seat back as well as the intruding left rear door and B-pillar (**Figure 26** and **Figure 22** above). The child seat's contact with these components produced contact scuffs and small tears in the back left of the driver's seat back, as well as scuffs on the left rear sliding door and B-pillar. The child seat most likely sustained some deformation due to this interaction. As the case vehicle separated from impact and rotated counterclockwise, the child most likely moved to the right within her child seat and then to the left as the case vehicle rolled over onto its left side to final rest. The child seat remained secured in the vehicle and the child remained restrained in her child seat following the crash. The child was subsequently removed from the vehicle by rescue personnel.



Figure 26: Overview of contact marks (arrows) on the case vehicle driver's seat back, B-pillar and left rear door from 2nd seat row, left child seat

CASE VEHICLE SECOND SEAT LEFT PASSENGER INJURIES

According to the police crash report, the second seat left passenger sustained a "C" (possible) injury and was transported by helicopter to the hospital. She sustained serious injuries and was hospitalized for five days. The interviewee reported that the child sustained a possible brain hematoma with fluid on the brain and blood in her spinal fluid. This contractor was unable to acquire this passenger's medical records because the hospital would not honor our request.

CASE VEHICLE SECOND SEAT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's second seat right passenger [6-week-old, White (non-Hispanic) female, 56 centimeters and 4 kilograms (22 inches, 8 pounds)] was restrained in her rear-facing infant seat. The infant was seated in a reclined position with her back and head against the back of her infant seat, and her hands and feet were within the confines of the infant seat. The case vehicle's seat track was adjusted to its middle track position. The seat back was slightly reclined.

Based on this contractor's vehicle inspection and interview data, the second seat right passenger was properly restrained in her rear-facing infant seat, and the infant seat was properly secured in the case vehicle. In addition, the interviewee indicated there was approximately one finger of space between the harness and the child's chest, and the harness clip was positioned at approximately armpit level.

As a result of the case vehicle driver's right steer and braking just prior to the crash, the second seat right passenger most likely moved slightly forward and leftward into the back of her infant seat just prior to impact. The case vehicle's impact with the Pontiac caused the infant to move forward and load into the back of her infant seat. The infant most likely rode slightly up the incline of her seat back and loaded her five-point harness straps. As the case vehicle separated

from impact and rotated counterclockwise, the infant most likely moved slightly to the right within her infant seat and then to the left as the case vehicle rolled over onto its left side to final rest. It is unknown if the infant seat remained secured to its base following the crash; however, the infant reportedly remained restrained in her infant seat. The infant was subsequently removed from the vehicle by rescue personnel.

CASE VEHICLE SECOND SEAT RIGHT PASSENGER INJURIES

According to the police crash report, the second seat right passenger sustained a “C”- (possible) injury and was transported by ambulance to a local hospital. She reportedly did not sustain any injuries and was not hospitalized, but did undergo a precautionary CT scan. The emergency room records indicated that the second seat right passenger sustained no apparent injury.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash, the case vehicle's driver [27-year-old, White (non-Hispanic) female; 168 centimeters and 110 kilograms (66 inches, 242 pounds)] was most likely seated in a nominal upright driving position with her left foot on the floor and her right foot on the brake. In addition, the driver most likely had both hands on the steering wheel and was bracing for impact. Due to the damage to the vehicle it was not possible to determine the position of the driver's seat track, seat back or the steering wheel. However, based on the height of the driver, her seat track was most likely positioned between its middle and forward positions. The driver was not wearing glasses or contact lenses at the time of the crash.

Based on the vehicle inspection, police on-scene photographs and supported by the EDR data, the case vehicle's driver was restrained by her manual, three-point, lap-and-shoulder safety belt system. The safety belt system was equipped with a buckle-mounted pretensioner, which activated as a result of the crash.

Just prior to the impact, the case vehicle's driver steered right and braked in an attempt to avoid the crash. As a result, her safety belt retractor most likely locked and she moved forward into her safety belt. The case vehicle's impact with the Pontiac caused the driver's pretensioner to activate and she continued forward and slightly left along a path opposite the case vehicle's 350 degree direction of principal force as the case vehicle decelerated. She loaded her safety belt lacerating her spleen. Her face and chest impacted her deployed air bag, her knees impacted the knee bolster, her left foot loaded the toe pan and her right foot loaded the brake pedal. She continued to move forward and upward, rode down the deployed air bag and her chest and abdomen loaded the steering wheel deforming the steering wheel rim, compressing the energy absorbing steering column and causing a laceration of her aorta and posterior hemi-diaphragm. Her head then impacted the intruded roof causing an open vault fracture, basilar skull fracture and subarachnoid hemorrhage. As the case vehicle rolled onto its left side, the driver's left side impacted the driver's door and her head impacted the roof and left roof side rail (**Figure 27** below). The driver remained restrained in her seat laying against the drivers' door, left roof side rail and roof. She was entrapped by the intruded instrument panel, steering wheel and toe pan and

was extricated from the case vehicle by rescue personnel.

CASE VEHICLE DRIVER INJURIES

The case vehicle’s driver was not transported by ambulance to the hospital. She sustained fatal injuries and was pronounced dead at the scene. The table below shows the case vehicle driver’s injuries and injury mechanisms.

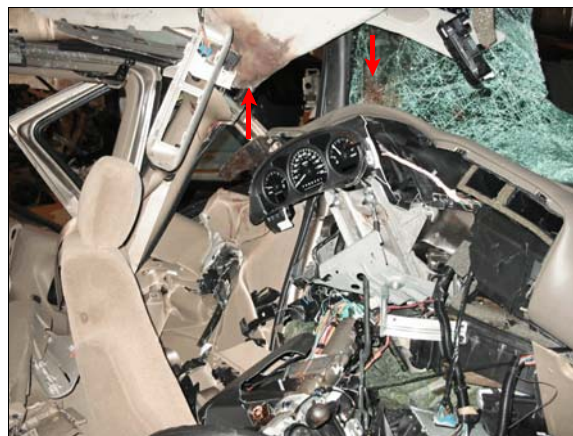


Figure 27: Arrows show driver contact to windshield and roof

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Fracture, open, right vault extending through lower right parietal, upper right temporal, and into lateral right frontal bone with multiple bone fragments within underlying brain matter; also included is a fracture from the posterior portion of the defect to the right lambdoidal suture and a diastatic fracture along the lambdoidal suture to the vertex	severe 150406.4,1	Roof (intruded)	Probable	Autopsy
2	Fracture left vault including along left lambdoidal suture, extending into left parietal bone, and left temporal bone along its suture lines, extending from left mastoid bone	moderate 150402.2,2	Roof (intruded)	Probable	Autopsy
3	Fracture left frontal bone extending from left orbit into left parietal bone	moderate 150402.2,5	Roof (intruded)	Probable	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
4	Fracture, complex, basilar involving left and right anterior cranial fossa- specifically across left and right orbital plates, the cribriform plate and the sphenoid bone; the middle cranial fossasella turcica of the sphenoid bone; and the posterior cranial fossa-a hinge fracture extends through the petrous ridges, associated with the aforementioned fractures, and a ring fracture surrounds the foramen magnum extending through bone sides of the occipital bone as well as extending rightward into the right lambdoidal suture	severe 150206.4,8	Roof (intruded)	Probable	Autopsy
5	Fracture nasal bones, not further specified	minor 251000.1,4	Front left windshield's glazing	Probable	Autopsy
6 7	Fracture lateral orbits, bilaterally, not further specified	moderate 251200.2,1 251200.2,2	Roof (intruded, indirect)	Probable	Autopsy
8	Fracture right maxilla, not further specified	moderate 250800.2,1	Front left windshield's glazing	Probable	Autopsy
9	Fracture ribs: left 2nd, anteriorly, 11th and 12th, posteriorly; right 1st, 2nd, and 3rd, anteriorly	moderate 450220.2,3	Steering wheel hub and/or spokes and rim	Certain	Autopsy
10	Dislocation {fracture} right sternoclavicular joint ²	moderate 751230.2,1	Steering wheel hub and/or spokes and rim	Probable	Autopsy
11	Fracture right ilium, not further specified	moderate 852600.2,1	Steering wheel rim	Probable	Autopsy
12	Fracture right superior pubic ramus	moderate 852600.2,5	Steering wheel rim	Probable	Autopsy
13	Fracture pubic symphysis, not further specified	serious 853000.3,5	Steering wheel rim	Probable	Autopsy

² The exact nature of this lesion is unknown; however, the AISes for a fracture of the sternum, the fracture of a clavicle, or the dislocation of the sternoclavicular joint are all "2". This contractor chose to code a dislocation of the joint.

Case Vehicle Driver Injuries (Continued)

IN-05-009

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
14	Fracture right distal femur with possible fracture right tibial plateau	serious 851822.3,1	Knee bolster, driver's, right of steering column	Probable	Autopsy
15	Fracture right foot, not further specified	moderate 852000.2,1	Floor, foot controls	Probable	Autopsy
16 17	Fracture distal left tibia and fibula, not further specified	moderate 851606.2,2 853420.2,2	Knee bolster, driver's, left of steering column	Probable	Autopsy
18	Laceration right cerebrum including right parietal and temporal lobes, inferior right frontal lobe, anterior portion of third ventricle, and right basal ganglia	severe 140688.4,1	Roof (intruded)	Probable	Autopsy
19	Laceration inferior left frontal lobe	severe 140688.4,2	Roof (intruded)	Probable	Autopsy
20	Laceration cerebellum, not further specified (but most likely inferiorly)	severe 140474.4,6	Roof (intruded)	Probable	Autopsy
21 22	Hemorrhage, subarachnoid, overlying right superior parietal, frontal, and occipital lobes, and around left Sylvian fissure and diffusely over left lateral hemisphere	serious 140684.3,1 140684.3,2	Roof (intruded)	Probable	Autopsy
23	Hemorrhage, subarachnoid, superior cerebellum	serious 140466.3,6	Roof (intruded)	Probable	Autopsy
24	Laceration {near complete transection} aorta, 1 cm (0.4 in) distal to left subclavian artery creating communication with left chest cavity and a small communication to right chest cavity with 650 cc left hemothorax and 30 cc right hemothorax	maximum 420218.6,4	Steering wheel hub and/or spokes and rim	Certain	Autopsy
25	Laceration left posterior hemidiaphragm	serious 440604.3,8	Steering wheel hub and/or spokes and rim	Certain	Autopsy
26	Lacerations throughout liver, not further specified	moderate 541822.2,1	Steering wheel hub and/or spokes and rim	Certain	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
27	Lacerations spleen at hilum	severe 544226.4,2	Lap portion of safety belt system	Probable	Autopsy
28	Lacerations {tears} mesentery, not further specified, with hemoperitoneum	moderate 542020.2,8	Lap portion of safety belt system	Probable	Autopsy
29	Abrasions, multiple, linear and diffuse over left parietal temporal scalp	minor 190202.1,2	Roof, left front side rail	Probable	Autopsy
30	Laceration, superficial, over left parietal temporal scalp	minor 190602.1,2	Roof, left front side rail	Probable	Autopsy
31	Subgaleal hemorrhage {hematoma} surrounding right vault defect both anteriorly and posteriorly and extending into occipital region of scalp	minor 190402.1,1	Roof (intruded)	Probable	Autopsy
32	Abrasions center and right forehead and left medial eyebrow	minor 290202.1,7	Roof (intruded)	Probable	Autopsy
33	Contusions center forehead	minor 290402.1,7	Roof (intruded)	Probable	Autopsy
34	Abrasion left lateral upper eyelid	minor 297202.1,2	Front left windshield's glazing	Probable	Autopsy
35	Contusions {ecchymosis} bilateral periorbital	minor 297402.1,1	Front left windshield's glazing	Probable	Autopsy
36		297402.1,2			
37	Abrasions extending over right bridge of nose and right cheek	minor 290202.1,1	Front left windshield's glazing	Probable	Autopsy
38	Abrasion left mandibular angle and just under left side of chin	minor 290202.1,8	Air bag, driver's	Probable	Autopsy
39	Abrasion anterior left lower neck, extending over medial left clavicle	minor 390202.1,2	Torso portion of safety belt system	Probable	Autopsy
40	Abrasions, multiple, lower left anterior chest	minor 490202.1,2	Steering wheel hub and/or spokes and rim	Probable	Autopsy
41	Contusions, vague and blue, to anterior chest, lower mid-right axilla, right lateral breast, and lower left anterior chest	minor 490402.1,3	Steering wheel hub and/or spokes and rim	Probable	Autopsy
42	Abrasions, multiple, left upper quadrant of abdomen and surrounding umbilicus	minor 590202.1,2	Steering wheel hub and/or spokes and rim	Probable	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
43	Contusions, vague and blue, left upper quadrant of abdomen	minor 590402.1,2	Steering wheel hub and/or spokes and rim	Probable	Autopsy
44	Laceration, large, through muscle left posterolateral and posterior 11th rib intercostal space	moderate 690604.2,2	Steering wheel hub and/or spokes and rim	Probable	Autopsy
45	Abrasions lower posterior left upper arm as well as elbow and dorsal left forearm	minor 790202.1,2	Left instrument panel and below	Probable	Autopsy
46	Abrasions ventral left wrist and distal dorsal left forearm	minor 790202.1,2	Left instrument panel and below	Probable	Autopsy
47	Abrasions, superficial dorsal right forearm and hand	minor 790202.1,1	Front left windshield's glazing	Probable	Autopsy
48	Contusion ventral left forearm and dorsomedial left forearm	minor 790402.1,2	Left instrument panel and below	Probable	Autopsy
49	Abrasion over left hip, not further specified	minor 890202.1,2	Lap portion of safety belt system	Probable	Autopsy
50	Contusion over left hip, not further specified	minor 890402.1,2	Lap portion of safety belt system	Probable	Autopsy
51	Abrasions to left posterior and upper left posterior thigh with extension upward onto left buttock; abrasion to lateral left buttock; abrasions left lateral thigh	minor 890202.1,2	Seat cushion, driver's	Possible	Autopsy
52	Laceration, 3 cm (1.2 in) left posterior thigh	minor 890602.1,2	Unknown contact mechanism	Unknown	Autopsy
53	Contusions right groin region, not further specified	minor 890402.1,1	Unknown contact mechanism	Unknown	Autopsy
54	Abrasions right upper anterior thigh	minor 890202.1,1	Steering wheel rim	Possible	Autopsy
55	Contusions right mid-anterior thigh	minor 890402.1,1	Steering wheel rim	Possible	Autopsy
56	Abrasions, small, right lateral knee	minor 890202.1,1	Knee bolster, driver's, right of steering column	Probable	Autopsy
57	Abrasion left anterior shin	minor 890202.1,2	Knee bolster, driver's, left of steering column	Probable	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
58	Laceration, 1.5 cm (0.6 in) left anterior shin	minor 890602.1,2	Knee bolster, driver's, left of steering column	Probable	Autopsy
59	Contusion {ecchymosis} medial left calf and lateral left calf	minor 890402.1,2	Seat cushion, driver's	Probable	Autopsy
60	Abrasion lateral mid-right calf	minor 890202.1,1	Seat cushion, driver's	Probable	Autopsy
61	Contusions right medial shin	minor 890402.1,1	Knee bolster, driver's, right of steering column	Probable	Autopsy
62	Contusion medial right calf	minor 890402.1,1	Seat cushion, driver's	Probable	Autopsy
63	Abrasions, multiple, distal left ankle	minor 890202.1,2	Floor, foot controls	Probable	Autopsy
64	Contusions, multiple, distal left ankle	minor 890402.1.2	Floor, foot controls	Probable	Autopsy
65	Laceration, small, left anterior ankle-foot	minor 890602.1,2	Floor, foot controls	Probable	Autopsy

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash, the case vehicle's front right passenger [28-year-old, White (non-Hispanic) female; 165 centimeters and 57 kilograms (65 inches, 125 pounds)] was seated in an upright position with both feet on the floor, her left hand pointing to the oncoming Pontiac and her right hand in an unknown position. Due to the damage to the vehicle, it was not possible to determine the position of the her seat track. However, based on the height of the passenger, her seat track was most likely positioned between its middle and forward position. The front right passenger was not wearing glasses or contact lenses at the time of the crash.

Based on the case vehicle inspection and interview data, the front right passenger was restrained by her three-point, lap-and-shoulder safety belt system. The safety belt system was equipped with a buckle-mounted pretensioner, which actuated as a result of the crash. In addition, the safety belt webbing had been cut by rescue personnel during the extrication process.

As a result of the case vehicle driver's right steer and braking, the front right passenger's safety belt retractor most likely locked and she moved forward into her safety belt. The case vehicle's impact with the Pontiac caused the passenger to continue forward along a path opposite the case vehicle's 350 degree direction of principal force as the case vehicle decelerated. She loaded her safety belt and her face and chest impacted her deployed air bag. Her left hand also impacted the center instrument panel causing a comminuted, displaced fracture of her left distal

radius and her knees and lower legs impacted the glove box door. She rode down the deployed air bag and her head impacted the intruded windshield causing a nonanatomic brain injury. As the case vehicle separated from impact and rotated counterclockwise, the passenger most likely moved right and then left as the case vehicle rolled over onto its left side. As the case vehicle rolled over, the passenger's outer left thigh impacted the center console. Following the crash, the passenger remained restrained in her seat laying against the center console and the driver. She was removed from the case vehicle by rescue personnel.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The police crash report indicated that the front right passenger sustained an "A" (incapacitating) injury and was transported from the scene to a local hospital. The passenger reported that she was hospitalized for two days and received follow-up treatment for the fractures to her left arm. In addition, she stated she was not working prior to the crash. The table below shows the front right passenger's injuries and injury mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury: awake, alert on admission but amnesic to events	moderate 160410.2,0	Front left windshield's glazing ³	Probable	Emergency room records
2	Fracture left distal radius, Colles type, with comminution and displacement	serious 752804.3,2	Center instrument panel and below	Probable	Emergency room records
3	Fracture base/proximal left 3 rd metacarpal with displacement	moderate 752002.2,2	Center instrument panel and below	Probable	Emergency room records
4	Abrasion left side of forehead, not further specified	minor 290202.1,7	Air bag, front right passenger's	Probable	Emergency room records
5	Abrasion left side of nose	minor 290202.1,4	Air bag, front right passenger's	Probable	Interviewee (same person)
6	Abrasion left side of face, not further specified	minor 290202.1,2	Air bag, front right passenger's	Probable	Interviewee (same person)
7	Contusion {hematoma} left conjunctiva	minor 240416.1,2	Air bag, front right passenger's	Probable	Emergency room records
8	Contusion {hematoma, ecchymosis} left orbit	minor 297402.1,2	Air bag, front right passenger's	Probable	Emergency room records
9	Contusion over left anterior humerus from left elbow to axilla and/or left chest areas	minor 790402.1,2	Center instrument panel and below	Probable	Emergency room records
10	Abrasion dorsum left hand, not further specified	minor 790202.1,2	Center instrument panel and below	Probable	Emergency room records

³ Occupant impacted and rode down the deployed 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
11	Lacerations x 2 left hand, including 3 cm (1.2 in) left inner thumb and 1 cm (0.4 in) dorsal surface left longer finger (3 rd)	minor 790602.1,2	Center instrument panel and below	Probable	Emergency room records
12	Contusion {bruise}, small, at right hip, not further specified	minor 890402.1,1	Lap portion of safety belt system	Probable	Interviewee (same person)
13	Abrasion, small, medial right knee, not further specified	minor 890202.1,1	Glove compartment door	Probable	Emergency room records
14	Contusion medial right knee and	minor 890402.1,1	Glove compartment door	Probable	Emergency room records
	along medial right lower leg, continuing down to right ankle				Interviewee (same person)
15	Contusion {bruise}, 2.5 x 10.2 cm (1 x 4 in) along lateral side of left thigh	minor 890402.1,2	Floor, center console	Probable	Interviewee (same person)

CASE VEHICLE BACK LEFT PASSENGER KINEMATICS

Immediately prior to the crash, the case vehicle's back left passenger [4-year-old, White (non-Hispanic) male; 91 centimeters and 20 kilograms (36 inches, 45 pounds)] was seated in an upright position, with both feet dangling over the seat edge and his hands on his lap. His seat track and seat back were both non-adjustable.

Based on the vehicle inspection and interview data, this passenger was restrained by his three-point, lap-and-shoulder safety belt system. However, he was wearing the shoulder portion of the safety belt under his left arm. The safety belt webbing had been cut by rescue personnel and inspection of the D-ring revealed light load marks in the plastic.

As a result of the case vehicle driver's right steer and braking, the passenger's safety belt retractor most likely locked and he moved forward into his safety belt. The case vehicle's impact with the Pontiac caused the passenger to continue forward and left along a path opposite the case vehicle's 350 degree direction of principal force as the case vehicle decelerated, and his lower legs most likely impacted the back of the seat in front of him. In addition, his torso most likely jackknifed over the lap belt and the shoulder belt

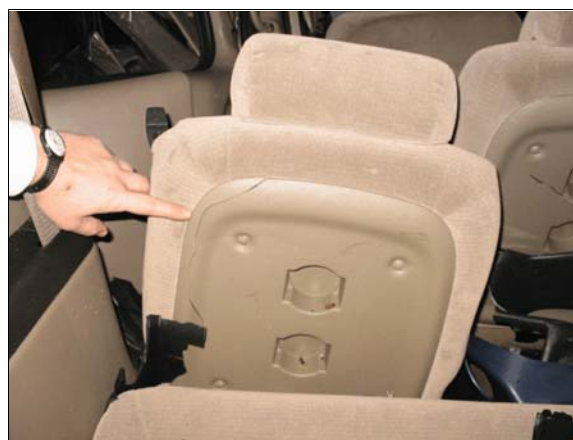


Figure 28: Crack in the plastic drink holder panel on the back of the seat in front of the 3rd seat left passenger

that was under his left arm and he possibly impacted his head on the back of the seat in front of him. The plastic drink holder panel on the back of the seat in front of him was observed to cracked and scuffed (**Figure 28** above). As the case vehicle separated from impact and rotated counterclockwise, the passenger most likely moved right and then left as the case vehicle rolled over onto its left side. As the case vehicle rolled over, the passenger's left side impacted the case vehicle's left side surface. Following the crash, the passenger remained restrained in his seat laying against the left side of the case vehicle. He was removed from the case vehicle by rescue personnel.

CASE VEHICLE BACK LEFT PASSENGER INJURIES

The police crash report indicated the left rear passenger sustained a "C" (possible) injury including a possible head injury and abdomen tenderness. This passenger was transported by helicopter to a local hospital. The nature and extent of his injuries and his treatment status are unknown. This contractor was unable to acquire this passenger's medical records because the hospital would not honor our request.

CASE VEHICLE BACK RIGHT PASSENGER KINEMATICS

Immediately prior to the crash, the case vehicle's back right passenger [30-year-old White (non-Hispanic) male; 183 centimeters and 84 kilograms (72 inches, 185 pounds)] was seated in an upright position with his back against the seat back, his feet on the floor and his hands on his lap. His seat track and seat back were both non-adjustable.

Based on the vehicle inspection and interview data, this passenger was restrained by his three-point, lap-and-shoulder safety belt system. Blood stains were found on the safety belt in a location that was consistent with the belt being worn at the time of the crash. In addition, the passenger sustained injuries consistent with usage of the safety belt.

As a result of the case vehicle driver's right steer and braking, the passenger's safety belt retractor most likely locked and he moved forward into his safety belt. The case vehicle's impact with the Pontiac caused the passenger to continue forward and left along a path opposite the case vehicle's 350 degree direction of principal force as the case vehicle decelerated. He loaded his safety belt fracturing his right clavicle and sternum. Both of his hands and lower legs impacted the back of the seat in front of him causing a comminuted fracture of the 5th metacarpal of his right hand and abrasions to both hands. As the case vehicle separated from impact and rotated counterclockwise, the passenger most likely moved right and then left as the case vehicle rolled over onto its left side. As the case vehicle rolled over, the passenger's left side most likely impacted the passenger seated to his left. The passenger remained restrained in his seat and was able to exit the case vehicle under his own power.

The police crash report did not indicate the back right passenger’s level of injury. He was transported by ambulance to a local hospital and was treated and released. The passenger received follow-up treatment for his injuries and had lost 15 work days at the time of his interview. The table below shows the back right passenger’s injuries and injury mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Fracture, non-displaced, of anterior and posterior cortex of sternum	moderate 450804.2,4	Torso portion of safety belt system	Probable	Emergency room records
2	Fracture, non-displaced, right mid-clavicle, not further specified	moderate 752200.2,1	Torso portion of safety belt system	Probable	Emergency room records
3	Fracture, mildly comminuted, distal right 5 th metacarpal with angulation	minor 752002.2,1	Seat back, second seat right passenger's	Probable	Emergency room records
4	Abrasions, superficial, hands, not further specified	minor 790202.1,3	Seat back, second seat right passenger's	Probable	Emergency room records
5	Contusion {ecchymoses} and swelling over distal right 5th metacarpal	minor 790402.1,1	Seat back, second seat right passenger's	Probable	Emergency room records
6	Contusion, small, over left iliac crest	minor 890402.1,2	Lap portion of safety belt system	Probable	Emergency room records
7	Laceration {cut}, very small, over left shin, not further specified	minor 890602.1,2	Seat back, second seat right passenger's	Probable	Interviewee (other occupant)

OTHER VEHICLE

The 1997 Pontiac Bonneville SE was a front wheel drive, four-door sedan (VIN: 1G2HX52KXVH-----) equipped with a 3.8L, V6 engine and automatic transmission. The front seating row was equipped with bucket seats with adjustable head restraints; manual, three-point, lap-and-shoulder safety belts and non-redesigned driver and front right passenger air bags, which deployed as a result this vehicle’s front impact. The Pontiac’s wheelbase was 281 centimeters (110.6 inches). The Pontiac’s odometer reading is not known.

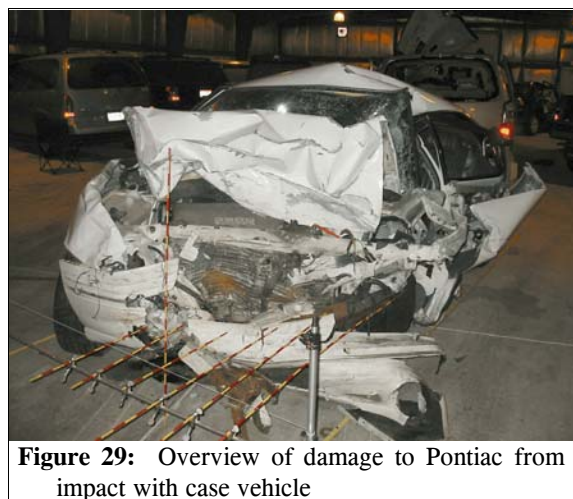


Figure 29: Overview of damage to Pontiac from impact with case vehicle

Exterior Damage: The Pontiac’s impact with the case vehicle involved the front of the vehicle (Figures 29 above). The front bumper, grille, hood and left fender were directly damaged and crushed rearward. The direct damage began at the Pontiac’s front left bumper corner and extended 144 centimeters along the bumper. The residual maximum crush was measured as 142 centimeters (55.9 inches) occurring at C₁ (Figure 30). The direct D value is based on the initial impact overlap. The table below shows the Pontiac’s front crush.

Units	Event	Direct Damage		Field L	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	144	142	79	142	123	107	91	75	53	-24	0
in		56.7	55.9	31.1	55.9	48.4	42.1	35.8	29.5	20.9	-9.4	0.0

The Pontiac’s left side wheelbase was reduced 76 centimeters (29.9 inches). The right side wheelbase was extended 8 centimeters (3.1 inches). Induced damage involved the roof, back of the hood, windshield, right fender, right front door, left front and rear doors and the left quarter panel.

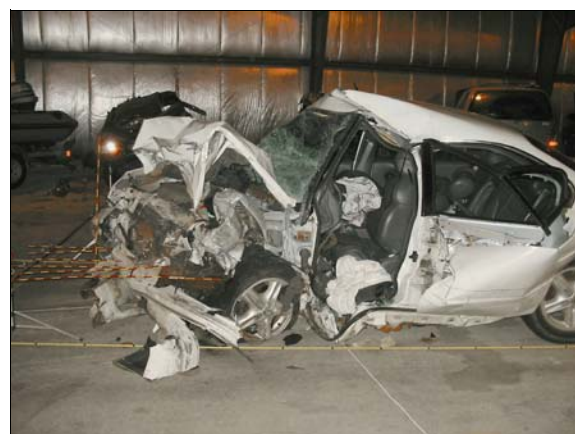


Figure 30: Left side view of front crush to Pontiac

The Pontiac’s recommended tire size was P225/60R16, and the vehicle was equipped with tires this size. The Pontiac’s tire data are shown in the table below.

Tire	Measured Pressure		Recommend Pressure		Tread Depth		Damage	Restricted	Deflated
	kpa	psi	kpa	psi	milli-meters	32 nd of an inch			
LF	0	0	207	30	9	11	Tire debaded and jammed onto back of wheel house	Yes	Yes
RF	193	28	207	30	7	9	None	No	No
LR	193	28	207	30	7	9	None	Yes	No
RR	193	28	207	30	8	10	None	No	No

Damage Classification: Based on the vehicle inspection, the Pontiac’s CDC was determined to be: **12-FDEW-5 (0 degrees)**. The WinSMASH reconstruction program, damage only algorithm, was used to reconstruct the Pontiac's Delta Vs for the front impact. The Total, Longitudinal, and

Lateral Delta Vs are, respectively: 107.0 km.p.h. (66.5 m.p.h.), -107.0 km.p.h. (-66.5 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). This contractor considers this to be a borderline reconstruction. The crush to the Pontiac was severe enough to collapse the passenger compartment. This indicates that this crash is likely beyond the scope of the program's stiffness coefficients to reasonably model the Pontiac's crush characteristics. The stiffness coefficients used in the reconstruction are derived from 35 m.p.h. barrier tests, which most likely do not adequately model the dynamics of the crush sustained by the Pontiac in this crash. The Pontiac was towed due to damage.

Crash Data Recording: The Pontiac's SDM, which contains the EDR, was removed by investigating police personnel for subsequent download and to secure as evidence. A hard copy of the downloaded EDR data was provided to this contractor. The time from AE to deployment command was recorded a 7.5 milliseconds. In addition, ignition cycles at investigation were indicated as 0, which indicates power was lost during the recording process and a complete recording of the Delta V history was interrupted and not obtained. The last recorded Delta V value was -56.84 km.p.h. (-35.32 m.p.h.) occurring at 80 milliseconds after AE. Lastly, the driver's safety belt switch circuit status was recorded as unbuckled; however, this is not reliable due to the power loss to the SDM during the crash and the resulting incomplete crash recording. The police on-scene photographs show that the Pontiac's driver was in fact restrained at the time of the crash. The Pontiac's EDR reports are presented at the end of this report in **Figures 34 and 35**.

Pontiac's Occupants: According to the police crash report and the police on-scene photographs, the Pontiac's driver [48-year-old, White (non-Hispanic) male] was restrained by his three-point, lap-and-shoulder safety belt system. The Pontiac's driver was fatally injured and expired at the crash scene.

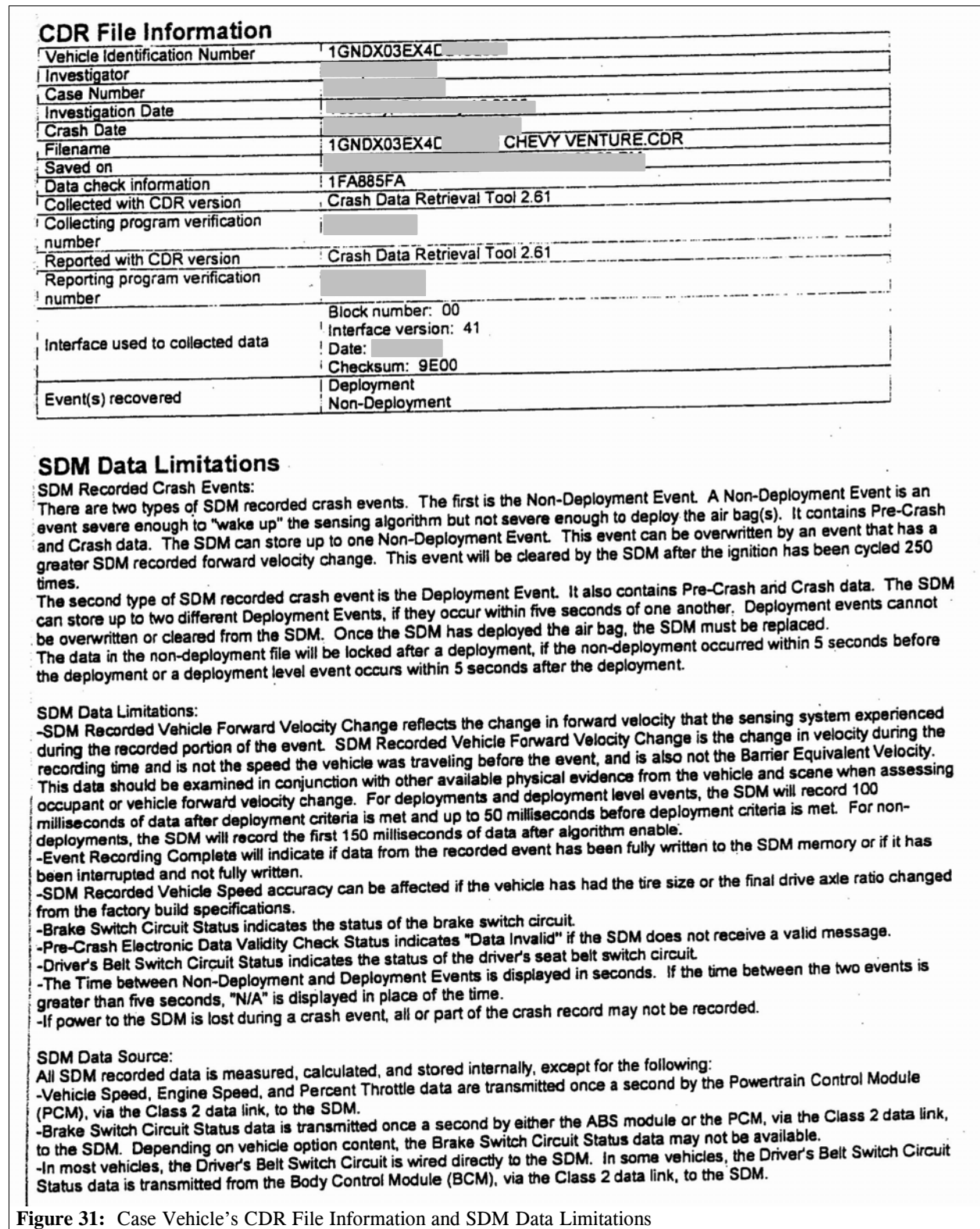
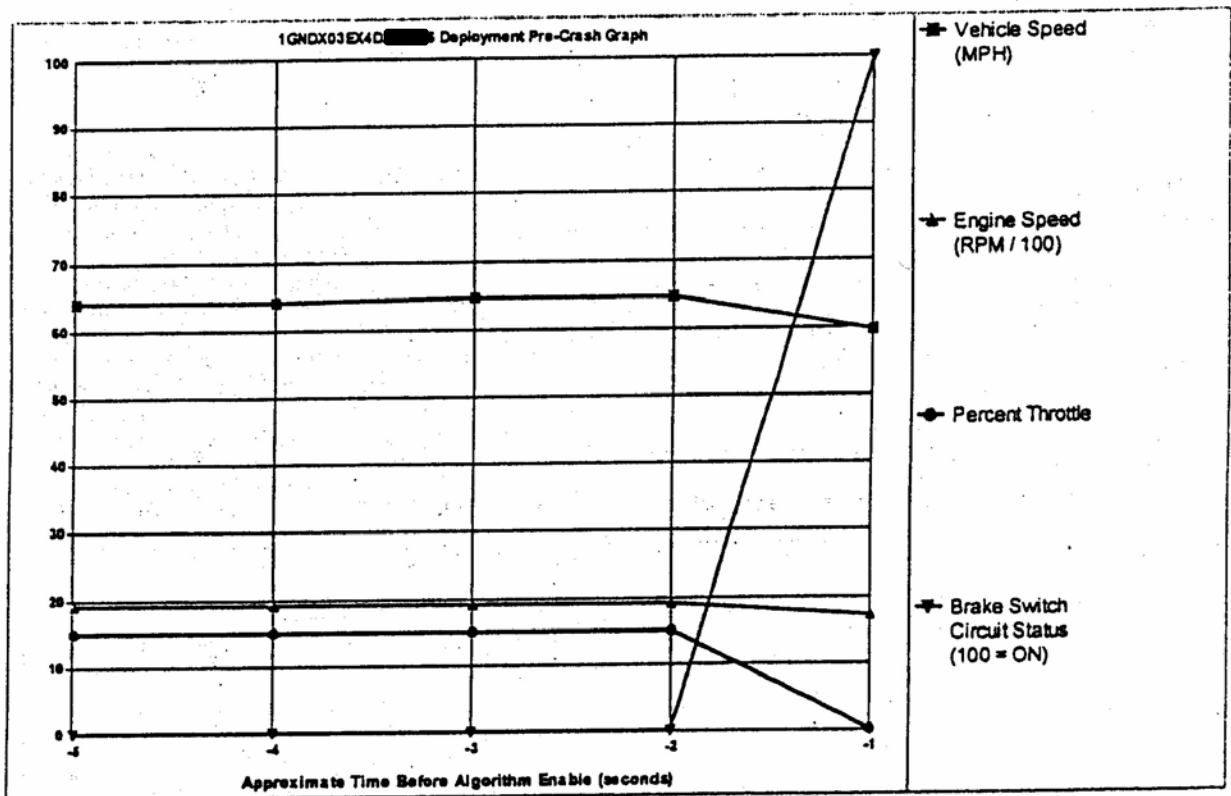


Figure 31: Case Vehicle's CDR File Information and SDM Data Limitations

System Status At Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Ignition Cycles At Deployment	1073
Ignition Cycles At Investigation	1078
Maximum SDM Algorithm Forward Velocity Change (MPH)	-31.66
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	107.5
Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	7.5
Driver Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	10
Passenger First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	7.5
Passenger Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	10
Time Between Non-Deployment And Deployment Events (sec)	N/A
Event Recording Complete	Yes



Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	64	1920	15	OFF
-4	64	1920	15	OFF
-3	65	1920	15	OFF
-2	65	1920	15	OFF
-1	60	1728	0	ON

Figure 32: Case vehicle's System Status as Deployment Report and Deployment Pre-Crash Graph

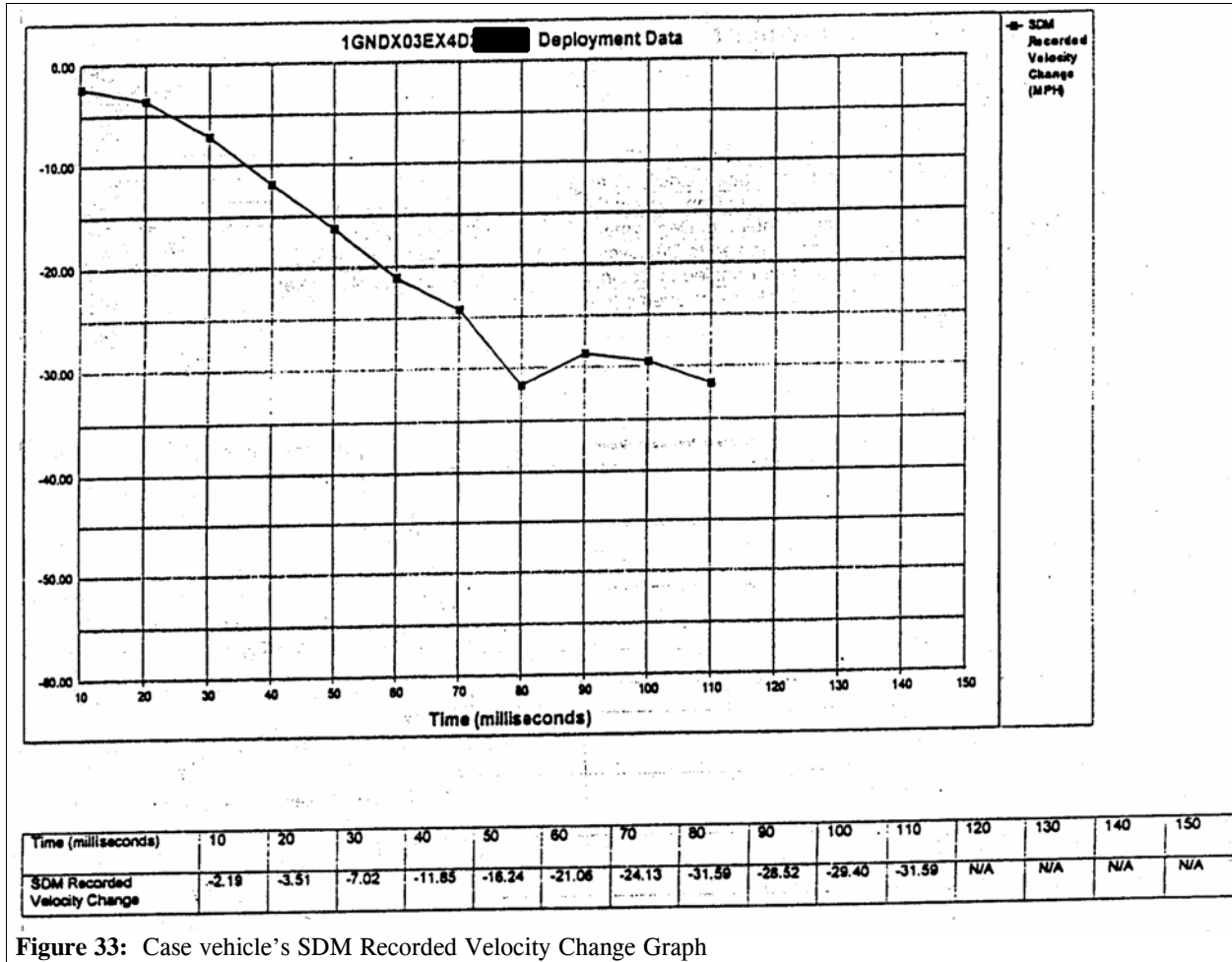


Figure 33: Case vehicle's SDM Recorded Velocity Change Graph

CDR File Information	
Vehicle Identification Number	1G2HX52KXVH
Investigator	
Case Number	
Investigation Date	
Crash Date	
Filename	1G2HX52KXVH BONNEVILLE.CDR
Saved on	
Data check information	76BCAC89
Collected with CDR version	Crash Data Retrieval Tool 2.61
Collecting program verification number	
Reported with CDR version	Crash Data Retrieval Tool 2.61
Reporting program verification number	
Interface used to collected data	Block number: 00 Interface version: 41 Date: 11-04-04 Checksum: 9E00
Event(s) recovered	Deployment

SDM Data Limitations

SDM Recorded Crash Events:

There are two types of SDM recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event is an event severe enough to "wake up" the sensing algorithm but not severe enough to deploy the air bag(s). The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded forward velocity change. This event will be cleared by the SDM after the ignition has been cycled 250 times.

The second type of SDM recorded crash event is the Deployment Event. The SDM can store up to two different Deployment Events, if they occur within five seconds of one another. Deployment events cannot be overwritten or cleared from the SDM. Once the SDM has deployed the air bag, the SDM must be replaced.

The data in the non-deployment file will be locked after a deployment, if the non-deployment occurred within 5 seconds before the deployment or a deployment level event occurs within 5 seconds after the deployment.

SDM Data Limitations:

-SDM Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Forward Velocity Change is the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change. The SDM records the first 300 milliseconds of Vehicle Forward Velocity Change after Algorithm Enable. The maximum value that can be recorded for Vehicle Forward Velocity Change is 56 MPH.

-Driver's Belt Switch Circuit Status indicates the status of the driver's seat belt switch circuit.

-The Time between Non-Deployment and Deployment Events is displayed in seconds. If the time between the two events is greater than five seconds, "N/A" is displayed in place of the time.

-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded. An indication of a loss of power would be if the ignition cycles at Deployment or Non-Deployment is recorded as zero. Data recorded after that may not be reliable, such as Time Between Non-Deployment and Deployment Events, Driver Belt Switch Circuit Status, and Passenger SIR Suppression Switch Circuit Status.

SDM Data Source:

All SDM recorded data is measured, calculated, and stored internally, except for the following:

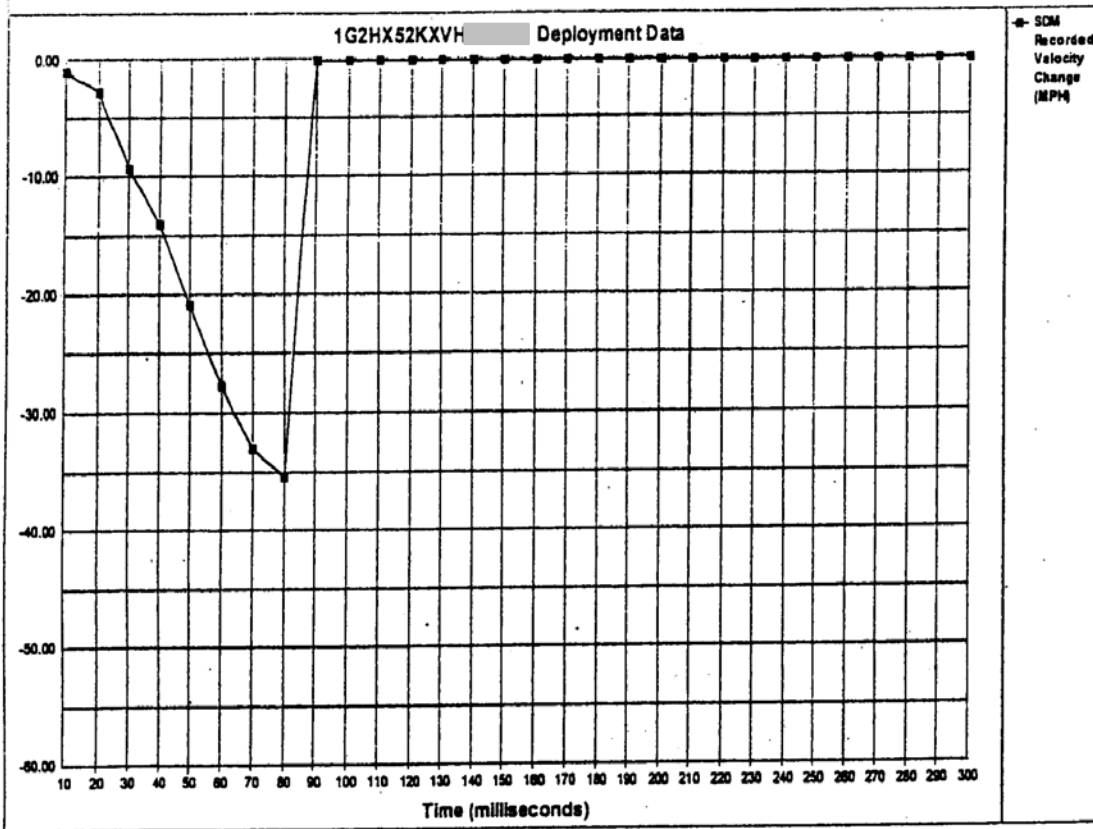
-The Driver's Belt Switch Circuit is wired directly to the SDM.

-The Passenger Front Air Bag Suppression Switch Circuit is wired directly to the SDM.

Figure 34: Pontiac's CDR File Information and SDM Data Limitations

System Status At Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	UNBUCKLED
Passenger Front Air Bag Suppression Switch Circuit Status	Air Bag Not Suppressed
Ignition Cycles At Deployment	0
Ignition Cycles At Investigation	12844
Time From Algorithm Enable To Deployment Command (msec)	7.5
Time Between Non-Deployment And Deployment Events (sec)	N/A



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-0.88	-2.63	-9.21	-14.04	-20.84	-27.84	-32.91	-35.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 35: Pontiac's System Status at Deployment report and, SDM recorded velocity change data

