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REMOTE AIR BAG INVESTIGATION

CASE NUMBER - IN01-011

LOCATION - Illinois

VEHICLE - 1996 GEO METRO LSI

CRASH DATE - September 2000

Submitted:

May 9, 2002

Revised:

October 18, 2002



Contract Number: DTNH22-94-D-17058

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> IN01-011		2. <i>Government Accession No.</i>		3. <i>Recipient's Catalog No.</i>	
4. <i>Title and Subtitle</i> Remote Air Bag Fatality Investigation Vehicle - 1996 Geo Metro LSI Location - Illinois			5. <i>Report Date:</i> May 9, 2002		
			6. <i>Performing Organization Code</i>		
7. <i>Author(s)</i> Special Crash Investigations Team #2			8. <i>Performing Organization Report No.</i> Task # 0257		
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> DTNH22-94-D-17058		
12. <i>Sponsoring Agency Name and Address</i> U.S. Department of Transportation (NRD-32) 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: September 2000		
			14. <i>Sponsoring Agency Code</i>		
15. <i>Supplementary Notes</i> Remote air bag deployment investigation involving a 1996 Geo Metro LSI four-door sedan with three-point manual safety belts and dual front air bags, and a 2000 Ford Taurus SES, four-door sedan.					
16. <i>Abstract</i> This report covers a remote investigation of an air bag deployment crash that involved a 1996 Geo Metro LSI (case vehicle) and 2000 Ford Taurus SES (other vehicle). This crash is of special interest because the case vehicle's unrestrained, out-of-position (i.e., seated between the legs of an adult) front right passenger (3-year-old male) sustained fatal injuries as a result of impacting the front right air bag module cover flap. The case vehicle was traveling south in the outside southbound lane of a five-lane, undivided city street and was approaching a four-leg intersection, intending to continue traveling south. The Ford had been traveling north in the left turn lane of the same city street and turned left, intending to travel west. The case vehicle's driver braked, depositing approximately 9.1 meters [29.7 feet] of front tire skid marks, in an attempt to avoid the crash. The crash occurred within the intersection. The front of the case vehicle impacted the right fender of the Ford, causing the case vehicle's driver and front right passenger air bags to deploy. Both vehicles were towed from the scene due to damage. The case vehicle's front right seat was occupied by a restrained adult, with the unrestrained child seated between the adult passenger's legs. The child sustained fatal injuries which included: lacerations to his brain stem, upper cervical spinal cord, vertebral arteries, larynx, and trachea; upper cervical dislocations; basilar subarachnoid hemorrhage; and other injuries. The child's brain stem and neck injuries were caused by his contact with the front right air bag module's cover flap and deploying air bag. According to the Police Crash Report, the case vehicle's unrestrained driver (23-year-old female) and restrained front right adult passenger (25-year-old male) did not sustain any injuries as a result of the crash. The case vehicle's unrestrained, back right passenger (4-year-old female) sustained minor injuries and was transported via ambulance to a hospital. Her specific injuries and treatment status are not known.					
17. <i>Key Words</i> Air Bag Deployment			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> 8
					22. <i>Price</i> \$7,500

TABLE OF CONTENTS

	<u>Page No.</u>
BACKGROUND	1
CRASH CIRCUMSTANCES	1
CASE VEHICLE: 1996 GEO METRO LSI	2
CASE VEHICLE OUT-OF-POSITION FRONT RIGHT CHILD PASSENGER	3
FRONT RIGHT PASSENGER'S INJURIES	4
CASE VEHICLE DRIVER	6
CASE VEHICLE FRONT RIGHT ADULT PASSENGER	6
CASE VEHICLE BACK RIGHT PASSENGER	7
OTHER VEHICLE: 2000 FORD TAURUS	7
SELECTED PHOTOGRAPHS	
Figure 1: On-scene: looking south along case vehicle's path of travel	1
Figure 2: On-scene: close-up of case vehicle's right tire skid mark	1
Figure 3: On-scene: case vehicle's front end damage	2
Figure 4: On-scene: case vehicle's cracked windshield	2
Figure 5: On-scene: case vehicle's front seat row, view from right	3
Figure 6: On-scene: case vehicle's instrument panel and deployed air bags	3
Figure 7: Other vehicle's right front damage area	8
Figure 8: On scene: other vehicle at final rest	8

This remote report was brought to the NHTSA's attention on April 11, 2001 by an Illinois county coroner. This crash involved a 1996 Geo Metro LSI (case vehicle) and a 2000 Ford Taurus SES (other vehicle). The crash occurred in September 2000, at 3:49 p.m., in Illinois and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's unrestrained, out-of-position (i.e., seated between the legs of an adult) front right passenger (3-year-old male) sustained fatal injuries from the deploying front right passenger air bag. The case vehicle's driver and front right adult passenger declined to cooperate with this investigation. This summary is based on the Police Crash Report, an interview with the investigating police officer, police scene and vehicle photographs, occupant kinematic principles, autopsy records for the fatal victim, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling south in the outside southbound lane of a five-lane, undivided, city street and was approaching a controlled four-leg intersection, intending to continue traveling southward (i.e., there were two through lanes for both directions and a center left turn lane on the north and south legs of the intersection). The other vehicle had been traveling north in the left turn lane of the same city street and turned left, intending to travel westward (**Figure 1**). According to witness statements, the automatic signals had changed to red as the case vehicle entered the intersection while the other vehicle completed the left turn. The case vehicle's driver braked, depositing approximately 9.1 meters [29.7 feet] of front tire skid marks, in an attempt to avoid the crash (**Figure 2**). The crash occurred within the intersection of the two roadways.

The front of the case vehicle impacted the Ford's right fender and right front wheel, causing the case vehicle's driver and front right passenger air bags to deploy. After impacting the Ford, the case vehicle rotated approximately 75 degrees clockwise, coming to rest in the outside southbound lane, heading west-southwest. The Ford rotated approximately 60 degrees counterclockwise and came to rest on the west leg of the intersection, in the outside eastbound lane, straddling the north-south crosswalk, heading southwest (**Figure 1**).



Figure 1: On-scene view looking south along case vehicle's travel path into intersection; Note: final rest positions of case vehicle (foreground) and other vehicle (background) and case vehicle's right tire skid mark (case photo #02)

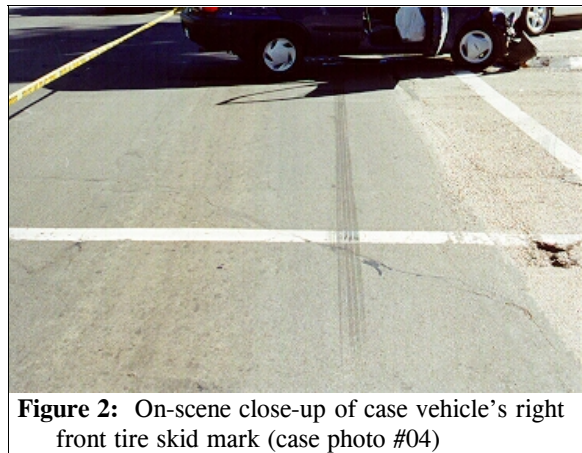


Figure 2: On-scene close-up of case vehicle's right front tire skid mark (case photo #04)

The case vehicle was a 1996 Geo Metro LSI front wheel drive, four-door, five-passenger sedan (VIN: 2C1MR5290T6-----), equipped with a four cylinder 1.3 liter engine and an automatic transmission with a console-mounted selector lever. The case vehicle was not equipped with anti-lock brakes. The case vehicle's wheelbase was 237 centimeters [93.3 inches] and the odometer reading was 123,662 kilometers [76,842 miles]. The case vehicle was towed due to damage.

Based on a police inspection and photographs of the case vehicle, the case vehicle's initial contact with the Ford involved the entire front (**Figure 3**). Direct damage extended from the right bumper corner to the left bumper corner. Maximum crush was estimated as approximately 45.7 centimeters [18 inches] at the front right corner of the engine hood. The case vehicle's front was shifted slightly to the right. The windshield glazing was cracked due to impact stress, suspected contact by the passenger's air bag and suspected contact by the back right passenger (**Figure 4**). The hood was buckled back and upward, and the right fender was crushed rearward, restricting the right front tire.



Figure 3: On-scene view of case vehicle's front damage at final rest; Note: front bumper fascia on ground and radiator fluid spill (case photo #07)

Based on the available photographs, the CDC for the case vehicle was estimated as: **11-FDEW-3 (330)**. The WinSMASH reconstruction program, CDC-only algorithm based on estimated CDCs for the two vehicles, was used. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 38 km.p.h. [23.6 m.p.h.], -33 km.p.h. [-20.5 m.p.h.], and +19 km.p.h. [+11.8 m.p.h.]. Based on the Police Crash Report and the case vehicle's driver, the case vehicle was going approximately 56 km.p.h. [35 m.p.h.] prior to braking.



Figure 4: On-scene view of cracks in case vehicle's windshield glazing (case photo #16)

A review of the police photographs of the case vehicle's interior revealed that there were several spider web-type impacts in the windshield's glazing (**Figure 4**). The uppermost contact to the center of the windshield was probably a result of the windshield being impacted by the back of the rearview mirror when it was contacted by the front right passenger's air bag. The sources of the two apparent contacts towards the right side of the windshield are unclear. Finally, the impact to the upper part of the center windshield is probably a result of impact by the case vehicle's back right passenger. There was also damage to the case vehicle's center instrument panel, including deformation to a center vent and displacement in the center instrument panel's plastic trim pieces (**Figure 8**).

The case vehicle's driver air bag was located in the steering wheel hub. Police photographs of the driver's air bag revealed that the cover flaps opened at the designated tear points, and there was no visible evidence of damage to the air bag or cover flaps. The investigating police officer made no mention of any evidence of contact or damage to the air bag's fabric.

The front right passenger air bag was located in the top of the right instrument panel (**Figure 5**). Police photographs of the front right passenger air bag revealed that the cover flap opened at the designated tear points and there was no visible evidence of damage to the air bag, but the cover flap appears to have evidence of contact (i.e., cloth or skin transfers) from interaction with the out-of-position front right occupant (**Figure 6**). The investigating police officer made no mention of any evidence of contact or damage to the air bag's fabric.



Figure 5: Case vehicle's front seat row, showing deployed air bags (case photo #20)

CASE VEHICLE OUT-OF-POSITION FRONT RIGHT CHILD PASSENGER

The case vehicle's out-of-position front right child passenger (3-year-old male, black, non-Hispanic, 89 centimeters [35 inches], weight not known) was not restrained by any restraint system. He was unconscious at the scene, was transported via ambulance to a hospital and was pronounced dead approximately three hours post-crash.

Immediately prior to the crash, the exact posture of the case vehicle's out-of-position front right passenger is unknown, but he was sitting between the legs of an adult front right passenger. Probably, he was in a slightly reclined posture with his back against the adult passenger's chest, his buttocks on the front edge of the seat, his feet on the floor, and both hands on the adult front right passenger's legs. The location of the front right seat track is unknown.



Figure 6: Case vehicle's instrument panel, deployed air bags and center console; Note: scuffs on front right air bag module's cover flap and scuffed and cracked center console (case photo #19)

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver, the child moved forward and slightly upward just prior to impact, regardless of whether the restrained front right adult passenger was attempting to hold him back. The case

vehicle's impact with the Ford caused the child passenger to continue forward, upward, and slightly leftward, toward the 330 degree direction of force. The deploying front right air bag module's cover flap contacted the child in the neck area, lifting him slightly upward and hyper-extending his neck, causing: dislocations at the atlanto-occipital junction and between C1-C2; a laceration of the brain stem; lacerations of the spinal cord just below the medulla and between C1-C2; subarachnoid hemorrhage at the base of the brain; lacerations of the vertebral arteries at the C1-C2 level; laceration of the larynx; laceration of the trachea; contusions on his chin, left mandible and neck; and causing him to bite his tongue. As the front right passenger air bag expanded, the air bag's fabric contacted the occupant's face, neck, chest, and arms, causing: contusions of his right lung; and abrasions on the right side of his forehead, near his right eye, anterior neck bilaterally, left shoulder, upper chest and his right and left arms. The expanding air bag lifted him further upward and pushed him rearward against the adult front right passenger. The child passenger's torso was most likely compressed between the air bag and the adult front right passenger, who was moving forward into the child's back. This compression caused: fractures of right ribs 1 - 10 posteriorly, adjacent to the vertebrae; laceration of the right pleura with fractured rib edges protruding into the pleural cavity; a laceration of the liver; a laceration of the splenic capsule; and a broad band of contusion across his lower neck posteriorly. The case vehicle rotated approximately 75 degrees clockwise to final rest. Although the exact posture of the child at final rest is unknown, presumably the out-of-position front right passenger either remained within the front right adult passenger's grasp or was "grabbed" by the front right passenger shortly thereafter. In either case, according to the statements on the Police Crash Report, the child was removed from the vehicle and laid on the pavement.

CASE VEHICLE OUT-OF-POSITION FRONT RIGHT PASSENGER'S INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Laceration of brainstem anterior to pons	140212.6 untreatable	Front right module's cover flap	Certain	Autopsy
2	Laceration of cervical spinal cord just below medulla oblongata and at level between C ₁ and C ₂ with dislocations {separations} at the atlanto-occipital junction and between C ₁ and C ₂	640274.6 ¹ untreatable	Front right module's cover flap	Certain	Autopsy
3	Subarachnoid hemorrhage at base of brain [Aspect = Unknown ²]	140684.3 serious	Front right module's cover flap	Probable	Autopsy

¹ The choice of injury code is difficult because the NASS CDS Injury Coding manual presumes that one knows whether the spinal lesion involves 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 dead person). In the absence of protocol, this contractor chooses to assume that the syndrome was complete.

² Strictly according to NASS CDS Injury Coding protocol, the desired Aspect codes are "Right" and "left". However, the actual injury description does not fit either of these two alternatives; therefore, the valid Aspect code "Unknown" is used.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
4	Laceration {severed} vertebral arteries at C ₁ and C ₂ level [Aspect = Unknown]	321012.3 serious	Front right module's cover flap	Certain	Autopsy
5	Laceration larynx below vocal cords, not further specified	340204.2 moderate	Front right module's cover flap	Certain	Autopsy
6	Laceration {severed} trachea with separation between 1 st and 2 nd tracheal cartilages	442608.4 severe	Front right module's cover flap	Certain	Autopsy
7	Contusions right lung, not further specified	441406.3 serious	Air bag, front right passenger's	Probable	Autopsy
8	Laceration right pleura {most likely parietal pleura} with bone {rib} edges protruding into pleural cavity and 100 ml of right hemothorax	441802.3 serious	Other occupant: adult front right passenger	Probable	Autopsy
9	Fractured right ribs: 1 st through 10 th , posteriorly, adjacent to vertebra	450230.3 serious	Other occupant: adult front right passenger	Probable	Autopsy
10	Laceration, superficial, right dome of liver	541822.2 moderate	Other occupant: adult front right passenger	Probable	Autopsy
11	Laceration, minor {tiny}, splenic capsule near hilar region	544222.2 moderate	Other occupant: adult front right passenger	Probable	Autopsy
12	Lacerated {bite marks with hemorrhage} tongue, right and left sides	243400.1 minor	Front right module's cover flap	Probable	Autopsy
13	Abrasion, rectangular, right forehead	290202.1 minor	Air bag, front right passenger's	Possible	Autopsy
14	Abrasions, x3, minor, right face, beyond the eye	290202.1 minor	Air bag, front right passenger's	Probable	Autopsy
15	Abrasions, dried, on chin and under chin, extending to upper neck	290202.1 minor	Front right module's cover flap	Probable	Autopsy
16	Contusion on crest of chin and along left mandible extending down onto the neck	290402.1 minor	Front right module's cover flap	Probable	Autopsy
17	Abrasions upper neck: anterior, right and left sides; dense on left upper neck with abrasions extending toward left shoulder	390202.1 minor	Air bag, front right passenger's	Certain	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
18	Contusion, broad band, across lower neck, posteriorly	390402.1 minor	Other occupant: adult front right passenger	Probable	Autopsy
19	Abrasion over sternal notch of upper chest, extending upward onto right and left neck	490202.1 minor	Air bag, front right passenger's	Certain	Autopsy
20	Abrasion, triangular, on medial right upper arm	790202.1 minor	Air bag, front right passenger's	Certain	Autopsy
21	Abrasion, linear, left forearm, not further specified	790202.1 minor	Air bag, front right passenger's	Probable	Autopsy

CASE VEHICLE DRIVER

The case vehicle's driver (23-year-old female, black, non-Hispanic, unknown height and weight) was not using her available, active, three-point, lap-and-shoulder, safety belt system. According to the police crash report, she did not sustain any injuries in the crash and was not transported via ambulance.

Immediately prior to the crash the case vehicle driver was probably seated in an upright posture with her back against the seat back, her left foot on the floor, her right foot on the brake, and both hands on the steering wheel, bracing for the impending crash. Her seat track adjustment position is unknown. Based on the available photographs, the seat back was slightly reclined. The vehicle was not equipped with a tilt steering wheel.

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver she moved slightly forward prior to the impact. The case vehicle's impact with the Ford resulted in her continuing to move forward, upward and slightly leftward, toward the 330 degree direction of force. The deploying driver air bag most likely contacted her in the face. The case vehicle rotated approximately 75 degrees clockwise to final rest. As a result, the driver probably moved slightly to the left. At final rest she probably remained within her seat somewhat near her original seating position.

CASE VEHICLE FRONT RIGHT ADULT PASSENGER

Based on the Police Crash Report, the case vehicle's front right adult passenger (25-year-old male, black, non-Hispanic, unknown height and weight) was restrained by his available, active, three-point, lap-and-shoulder safety belt system, with the out-of-position child passenger seated between his legs. According to the police crash report, the front right adult passenger did not sustain any injuries as a result of this crash, and was not transported via ambulance.

The exact posture of the case vehicle's front right adult passenger prior to the crash is unknown, but he was probably seated in an upright posture with his back against the seat back, his feet on the floor, and with both arms around the out-of-position child passenger's waist. The location of his seat track is unknown and, based on the available police photos, the seat back was slightly reclined.

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver, the front right adult passenger moved forward until his seat belt retractor locked. The case vehicle's impact with the Ford resulted in him moving further forward and slightly leftward, toward the 330 degree direction of force, loading against the safety belt webbing. As the front right passenger air bag deployed, the air bag pushed the out-of-position child passenger upward and backward against the adult passenger's chest. The case vehicle rotated approximately 75 degrees clockwise to final rest. Although his exact posture at final rest is unknown, the front right adult passenger probably remained near his original seat position due to his being restrained.

CASE VEHICLE BACK RIGHT PASSENGER

Based on the Police Crash Report, the case vehicle's back right passenger (4-year-old female, black, non-Hispanic, unknown height and weight) was not restrained in any manner. The police crash report indicates that she was not injured, but she was transported via ambulance to a hospital. Her specific injuries and treatment status are not known.

The exact posture of the case vehicle's back right passenger is unknown, but she was probably seated in an upright posture with her back against the seat back and her feet dangling over the front edge of the seat's cushion, angled downward. Her seat track and seat back were not adjustable.

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver, the back right passenger moved forward prior to the impact. The case vehicle's impact with the Ford caused her to move forward, upward and leftward, toward the 330 degree direction of force. This investigator believes that, at impact, this passenger pitched forward between the two front bucket seats and impacted the windshield. Her position at final rest is not known. According to witness testimony recorded in the Police Crash Report, she had a bloody nose.

OTHER VEHICLE

The other vehicle was a front wheel drive 2000 Ford Taurus SE SVG, four-door, six-passenger sedan (VIN: 1FAFP55S3YG-----), equipped with a 3.0 liter V6 engine. Four-wheel anti-lock brakes were a standard feature for this vehicle. The wheelbase was 276 centimeters [108.5 inches] and the odometer reading was 9,896 kilometers [6,149 miles]. The Ford was towed due to damage.

Based on a police inspection of the Ford and police photographs, the case vehicle's initial contact with the Ford involved the front fender and forward most edge of the front right passenger door (**Figures 7 and 8**). Direct damage extended from the left front bumper corner rearward to the right front door. Based on the available photographs, the CDC for the Ford is estimated as: **01-RFEW-2 (040)**. The WinSMASH reconstruction program, CDC only algorithm based on the estimated CDCs for the two vehicles, was used. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 25 km.p.h. [15.5 m.p.h.], -19 km.p.h. [-11.8 m.p.h.], and -16 km.p.h. [-9.9 m.p.h.].

The Ford's driver (52-year-old female, unknown height, weight, race, ethnicity) was restrained by the available safety belt system, according to the Police Crash Report. The driver was the lone occupant in the Ford, and she did not sustain any injuries as a result of the crash.



Figure 7: On-scene front of left view of damage to Ford's right front from impact with case vehicle; Note: direct damage begins near right front corner (case photo #31)



Figure 8: On-scene view looking east-northeast at case vehicle's (left) and Ford's (foreground, right) final rest positions (case photo #06)