TRANSPORTATION SCIENCES
Crash Data Research Center

Veridian Engineering
Buffalo, New York 14225

VERIDIAN REMOTE ADULT AIR BAG RELATED FATALITY INVESTIGATION
VERIDIAN CASE NO. CA02-026
VEHICLE: 1994 GEO PRIZM
LOCATION: MASSACHUSETTS
CRASH DATE: DECEMBER 1995

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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 are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

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

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16. *Abstract* This remote investigation was assigned to the Veridian Special Crash Investigations (SCI) team on June 24, 2002, based on an allegation of an air bag related driver fatality. The December 1995 crash occurred in Massachusetts and was litigated by an attorney who notified NHTSA's Crash Investigations Division in June 2002. The crash involved a 1994 Geo Prizm that was equipped with a frontal air bag system for the driver and right passenger positions. The 60-year old female driver of the Prizm was police reported as unrestrained. She was traveling in a southerly direction on a two-lane road during daylight hours. The environmental conditions were police reported as clear and dry. Southbound traffic was traveling at a reported speed of 32-40 km/h (20-25mph). The Geo Prizm impacted the rear of a 1979 Cadillac that resulted in moderate damage to both vehicles. As a result of the crash, the Prizm's frontal air bag system deployed. The driver of the Prizm sustained a band-like abrasion under the chin, chest abrasions with contusions of the breasts, multiple bilateral rib fractures, a sternum fracture, a laceration of the right ventricle, a laceration of the pericardial sac, and liver lacerations from the deployment of the driver's air bag. She was transported by ambulance to a local hospital where she expired on arrival.			
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BACKGROUND

This remote investigation was assigned to the Veridian Special Crash Investigations (SCI) team on June 24, 2002, based on an allegation of an air bag related driver fatality. The December 1995 crash occurred in Massachusetts and was litigated by an attorney who notified NHTSA's Crash Investigations Division in June 2002. The crash involved a 1994 Geo Prizm that was equipped with a frontal air bag system for the driver and right passenger positions. The 60-year old female driver of the Prizm was police reported as unrestrained. She was traveling in a southerly direction on a two-lane road during daylight hours. The environmental conditions were police reported as clear and dry. Southbound traffic was traveling at a reported speed of 32-40 km/h (20-25mph). The Geo Prizm impacted the rear of a 1979 Cadillac that resulted in moderate damage to both vehicles. **Figure 1** is a lateral view of the Prizm's frontal damage. As a result of the crash, the Prizm's frontal air bag system deployed. The driver of the Prizm sustained a band-like abrasion under the chin, chest abrasions with contusions of the breasts, multiple bilateral rib fractures, a sternum fracture, a laceration of the right ventricle, a laceration of the pericardial sac, and liver lacerations. Based on the available data that was provided to the SCI team for this case, the air bag was the most likely source of the driver's injuries. She was transported by ambulance to a local hospital where she expired on arrival.

Figure 1. Lateral view of the frontal plane of the Geo Prizm.

SUMMARY

Crash Site

The crash occurred on a two lane road in a mid-block area during daylight hours. The weather was police reported as clear and dry with a temperature range of -9 to -3 degrees C (15-27 degrees F). The police further reported that southbound traffic was traveling into the morning sun.

Vehicle Data

1994 Geo Prizm

The subject vehicle in this crash was a 1994 Geo Prism, four-door sedan. The Prizm was powered by a transverse mounted 4-cylinder gasoline engine linked to a 5-speed manual transmission with a console mounted shifter. The interior was configured with front bucket seats and a rear bench seat. The front bucket seats were equipped with adjustable

head restraints. The supplied data for this case did not list the vehicle's identification number nor the vehicle mileage at the time of the crash.

1979 Cadillac Coupe Deville

The struck 1979 Cadillac was a two-door coupe. The vehicle was configured with a V-8 engine linked to a 3-speed automatic transmission and rear wheel drive. The interior was equipped with a split bench front seat with separate back cushions and a fold-down center armrest. The front seat backs had adjustable head restraints that appeared to be in the full down position. The Cadillac was not equipped with a frontal air bag system. The vehicle identification number and mileage were not reported.

Crash Sequence

Pre-Crash

The 49-year old male driver of the Cadillac was traveling in a southerly direction on the two-lane road. He stated to the investigating officer that traffic was moving at a constant speed estimated at 32-40 km/h (20-25 mph). The 60-year old female driver of the Geo Prizm was traveling in a southbound direction, following the Cadillac. The investigating officer noted on his report that the sun was in view of southbound traffic. It was unknown if this contributed to the causation of the crash. The Cadillac driver reported that he did not hear the sound of brakes prior to the crash, indicating avoidance action by the Prizm driver. The Prizm was not equipped with anti-lock brakes. The crash schematic is attached as **Figure 10** on Page 7 of this report.

Crash

Based on the supplied images of the vehicles, it appeared that the full frontal area of the Geo Prizm impacted the rear center and right areas of the Cadillac in a front-to-rear impact configuration. The resultant directions of force were 12 o'clock for the Geo and 6 o'clock for the struck Cadillac. The impact resulted in a longitudinal deceleration that was sufficient to deploy the Geo's frontal air bag system. Crush profiles could not be estimated, therefore, a WinSMASH reconstruction of the damage data was not performed. Based on SCI experience, the Geo sustained an estimated longitudinal delta V of 13-19 km/h (8-12 mph). **Figure 2** is a frontal view of the Geo Prism's damage.

Figure 2. Frontal view of the damage of the Geo Prizm.

Post-Crash

The final rest positions of the vehicles were unknown. The driver of the Geo was observed in her driving position unrestrained and unconscious. Police and ambulance personnel, inclusive of a paramedic, arrived on-scene within five minutes of the crash notification. The driver was checked for vitals and found to be without a pulse and blood pressure. She was removed from the vehicle, placed on a cot, administered an IV and

intubated. Oxygen was administered and Mast Trousers were applied. Ambulance personnel departed the scene within nine minutes of arrival and arrived at a local hospital within 32 minutes of the crash notification. The driver was pronounced deceased on arrival. An autopsy was performed on the body on the day of the crash. The driver of the Cadillac was reported as uninjured by the investigating officer. The police report did not identify the tow status of the vehicles.

Vehicle Damage

Exterior – Geo Prizm

The exterior damage to the Geo Prizm was rated as moderate. The direct contact damage on the bumper fascia began at the midpoint of the right headlamp lens and extended laterally to the left corner. The bumper fascia was abraded and scuffed. The mid aspect of the hood edge was dented from engagement against the rear of the Cadillac. The left aspect of the hood edge was crush rearward approximately 2.5 cm (1.0") over the left headlamp lens. The left turn signal lens appeared to be fractured and the left fender was deformed forward of the tire. The bumper fascia contact probably resulted in crush to the bumper beam, however, the fascia returned to its pre-crash position, thus concealing any underlying damage. There appeared to be minimal crush at the level of the upper radiator support panel. The Collision Deformation Classification (CDC) for this crash event was 12-FDEW-1. The police report noted an estimated damage repair cost of $2,000. **Figures 3 and 4** are frontal views of the Prizm's crash related damage.

Figure 3. Frontal view of the Prizm.

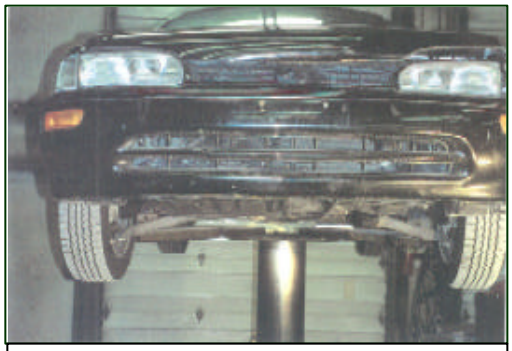

Figure 4. Additional view of the Prizm's frontal damage.

Interior – Geo Prizm

There was minor damage to the interior of the Geo that was associated with the deployment of the frontal air bag system and driver loading. The driver and front right passenger air bags deployed from their respective module locations. Both air bags were folded back into the modules. A piece of duct tape was placed over the driver's air bag to retain the bag in the module. This tape gives a false appearance of damage to the bag.

The left aspect of the steering wheel rim was deflected forward. A gap was visible between the spokes and the air bag module/hub cover. It was unknown if there was compression of the energy absorbing steering column **(Figure 7)**.

Exterior – 1979 Cadillac Coupe DeVille

The back plane of the Cadillac sustained moderate damage as a result of the crash sequence with the Geo Prizm. The direct contact damage to the rear of the Cadillac appeared to be distributed across the bumper **(Figure 5)**. Both vertical bumper extensions that housed the taillight assemblies were deflected outward as a result of the crash. There was no apparent crush to the mid aspect of the bumper. The right corner aspect of the bumper was displaced forward which resulted in induced buckling to the right quarter panel **(Figure 6)**. The CDC for this damage was 06-BZEW-1.

Figure 5. Rear view of the struck Cadillac.

Figure 6. Induced buckling of the right rear quarter panel.

Frontal Air Bag System - 1994 Geo Prizm

The Geo Prizm was equipped with a frontal air bag system for the driver and right passenger positions. The system deployed as a result of the front-to-rear crash event with the Cadillac **(Figure 7)**. The frontal air bag system consisted of a driver air bag module that was housed within the four-spoke steering wheel rim, a mid mount passenger air bag in the right instrument panel, two crash sensors that were mounted on the front frame rails, inboard of the fenders, and the Diagnostic Energy Reserve Module (DERM) that was located under the front right instrument panel.

Figure 7. Deployed frontal air bag system in the Geo Prizm.

The driver air bag was concealed by symmetrical H-configuration module cover flaps. Based on the limited images for this remote investigation, it was unknown if the air bag was vented or tethered. Additionally, it was unknown if damage occurred to the bag membrane or module assembly. There appeared to be minimal forward deflection of the left half of the steering wheel rim. A gap was visible between the left spokes and the air bag module/hub cover.

The front right air bag deployed from the right mid instrument panel. The air bag was concealed by a single rectangular cover flap that was reinforced by sheet metal and

hinged at the top surface. The bag membrane was folded into the module, therefore it was unknown if the bag was vented or tethered. There was no damage to the windshield or windshield mounted rear view mirror.

Driver Demographics – Geo Prizm

Age/Sex:	60-year old female
Height:	167.6 cm (66.0")
Weight:	79.4 kg (175.0 lb)
Manual Restraint Usage:	None
Usage Source:	Police report, observations of the first responders
Eyeware:	Unknown (not reported)
Seat Track Position:	Mid-to-forward based on vehicle images
Mode of Transport From Scene:	Ambulance
Type of Medical Treatment:	Transported to a local hospital where she expired on arrival

Driver Injuries

Injury	Severity (AIS 90/Update 98	Injury Source
2.5 cm vertically oriented laceration to the anterior base of the right ventricle with extensive pericardial hemorrhage	Critical (441012.5,4)	Deploying front left air bag
1.9 cm horizontally oriented laceration (tear) of the anterolateral portion of the right ventricle, extending over the interventricular septum with 600 cc of hemorrhage in the thoracic cavities	Critical (441012.5,4)	Deploying front left air bag
Multiple bilateral anterior/lateral rib fractures, left 1-7, right 1-8	Severe (450240.4,3)	Deploying front left air bag
Laceration of the anterior pericardial sac	Moderate (441602.2,4)	Deploying front left air bag
Multiple superficial lacerations of the anterior aspect of the right lobe of the liver	Moderate (541822.2,1)	Deploying front left air bag
Upper sternum fracture	Moderate (450804.2,4)	Deploying front left air bag
Bilateral clavicle fractures	Moderate (752200.2,1; 752200.2,2)	Deploying front left air bag
12.7x2.5 cm red abrasion w/underlying blistering below the chin	Minor (290202.1,8)	Deploying front left air bag
10x10 cm abrasion over the sternum above the breasts	Minor (490202.1,4)	Deploying front left air bag
Scattered blue contusions over both breasts	Minor (490402.1,3)	Deploying front left air bag

Source of Injury Data - Autopsy Report

Driver Kinematics

The driver of the Geo Prism was presumed to have been in an upright driving posture, centered behind the steering assembly immediately prior to the crash. Although unconfirmed by the limited data for this remote investigation, the driver's seat track appeared to be adjusted to a mid-to-forward track position. She was police reported as unrestrained, although a manual 3-point lap and shoulder belt system was available. The lack of belt usage was determined by the observations of the first responders who found the driver unconscious post-crash.

Figure 8. View of the deployed front left air bag and the deformation to the steering wheel rim.

Figure 9. Lateral view of the deployed front left air bag.

Immediately prior to the crash, the driver of the struck Cadillac stated to the investigating officer that he did not hear skid marks indicative of heavy pre-crash braking. The driver of the Geo may have braked without locking the tires of the Geo Prism. The frontal area of the Geo impacted the rear of the Cadillac resulting in deployment of the Geo's frontal air bag system **(Figure 8)**.

At deployment, the driver of the Geo was positioned in close proximity to the steering wheel **(Figure 9)** due to a forward seated position, or forward displacement due to possible pre-crash braking or a response to the frontal crash forces with a delayed air bag deployment. The driver's air bag expanded against the driver's chest as evidenced by the abrasions across her breasts and sternum. The initial deployment of the air bag compressed the chest, resulting in anterolateral rib fractures 1-7 on the left and 1-8 on the right side, a fractured sternum, and bilateral clavicle fractures. Additionally, air bag deployment produced two lacerations of the right ventricle, a laceration of the pericardial sac, and multiple superficial liver lacerations. As the air bag continued to expand, the bag membrane contacted the underside of the driver's chin, producing a 12.7x2.5 cm (5.0x2.5") band-like abrasion with blistering. There were no cervical spine injuries documented in the autopsy report.

The driver's forward motion in response to the frontal crash forces, in combination with air bag expansion, resulted in forward displacement of the left aspect of the steering wheel rim. This was evidence by a separation between the wheel rim and the air bag

module/spoke cover. Due to the remote nature of this investigation, it was unknown if the energy absorbing steering column compressed.

The driver was found unconscious, slumped in the driver's seat. Emergency personnel arrived on-scene within five minutes of the crash. The driver was found with out a pulse and blood pressure. She was removed from the vehicle and placed on a cot where an IV and oxygen was administered and Mast Trousers were applied. She was transported by ambulance to a local hospital and was pronounced deceased on arrival. An autopsy was performed on the body that provided the basis for this remote level investigation.

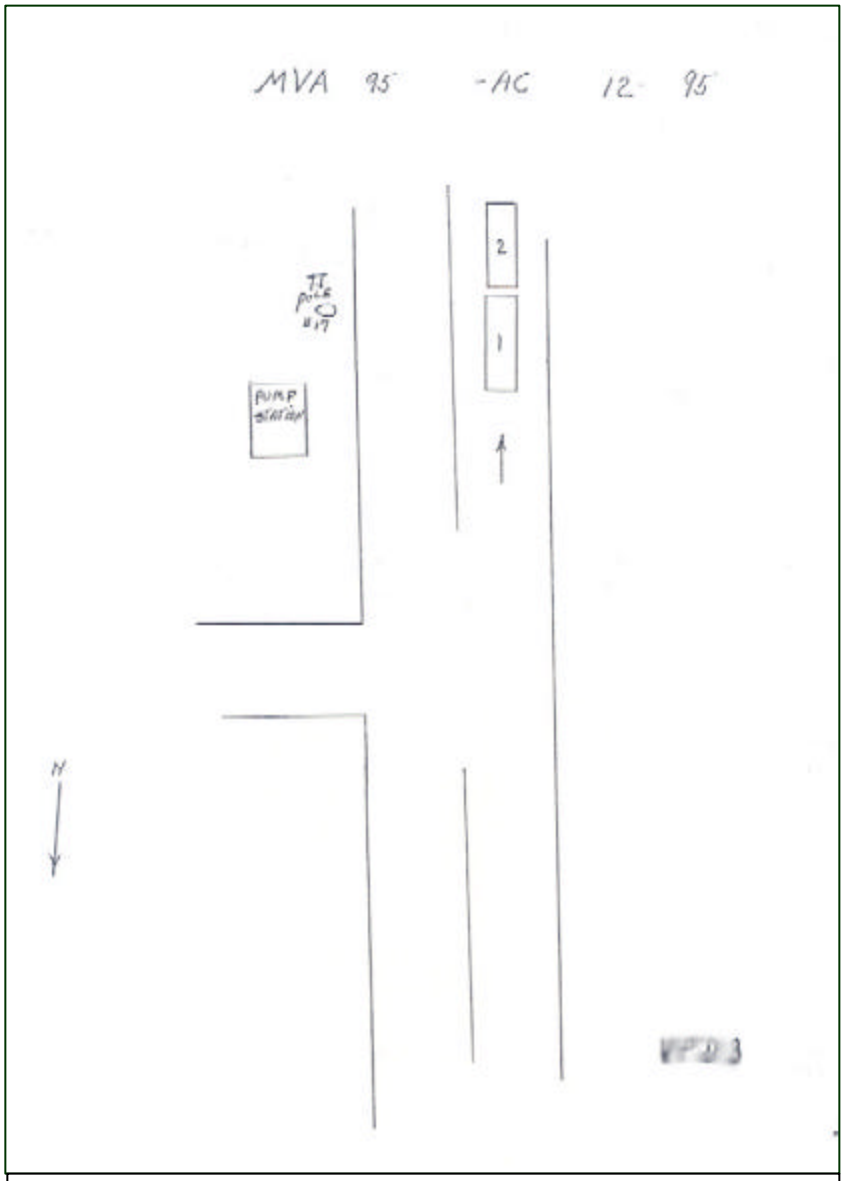

Figure 10. Police crash schematic.