TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER

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REMOTE REDESIGNED AIR BAG ADULT DRIVER FATALITY INVESTIGATION
SCI TECHNICAL SUMMARY REPORT

VERIDIAN CASE NO. CA99-068

RABSS VEHICLE - 1998 PONTIAC SUNFIRE COUPE

LOCATION - STATE OF SOUTH CAROLINA

CRASH DATE - AUGUST 1998

Contract No. DTNH22-94-D-07058

Prepared for:

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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 focused on a two-vehicle crash that involved a 1998 Pontiac Sunfire coupe (subject vehicle) and a 1989 Dodge Ram pickup truck. The Sunfire was occupied by a 62-year-old female driver and her 12-year-old grandson seated in the front right position. The front right passenger was restrained by the manual 3-point lap and shoulder belt system, however the driver was unrestrained. The Sunfire was traveling eastbound on a two lane state highway when is crossed the centerline into the path of the westbound Dodge pickup truck. The full frontal area of the Sunfire underrode the front of the pickup truck resulting in a 12/12 o'clock impact configuration. The unrestrained driver of the Sunfire was seated in close proximity to the steering wheel and probably submarined the steering column and struck the knee bolster. She was probably struck by the expanding redesigned driver's air bag in the chest and rebounded rearward. She sustained fatal internal injuries and was pronounced dead at the scene. The front right passenger loaded the manual restraint and the deployed redesigned air bag, and sustained incapacitating injuries. He was flown by helicopter to a local hospital and admitted.			
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BACKGROUND

This remote investigation focused on a two-vehicle crash that involved a 1998 Pontiac Sunfire coupe (subject vehicle) and a 1989 Dodge Ram pickup truck **(Figure 1)**. The Sunfire was occupied by a 62-year-old female driver and her 12-year-old grandson seated in the front right position. The front right passenger was restrained by the manual 3-point lap and shoulder belt system, however the driver was unrestrained. The Sunfire was traveling eastbound on a two lane state highway when is crossed the centerline into the path of the westbound Dodge pickup truck. The full frontal area of the Sunfire underrode the front of the pickup truck resulting in a 12/12 o'clock impact configuration. The unrestrained driver of the Sunfire was seated in close proximity to the steering wheel and probably submarined the steering column and struck the knee bolster. She was probably struck by the expanding redesigned driver's air bag in the chest and rebounded rearward. She sustained fatal internal injuries and was pronounced dead at the scene. The front right passenger loaded the manual restraint and the deployed redesigned air bag, and sustained incapacitating injuries. He was flown by helicopter to a local hospital and admitted.

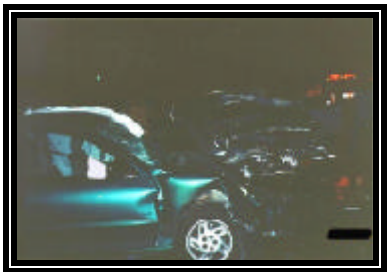

Figure 1. On-scene photograph showing vehicle final rest positions

This crash was identified through a search of the Fatality Analysis Reporting System (FARS) for fatalities that occurred in vehicles equipped with redesigned air bags. The crash occurred in August 1998 and was assigned to the Veridian Special Crash Investigation Team on September 2, 1999 as a remote investigation effort. A coroner's field report and on-scene photographs were obtained, which provided the basis for this narrative report.

SUMMARY

Crash Site

This two-vehicle crash occurred during the nighttime hours of August 1998 at the intersection of a two-lane east/west state roadway and a two-lane north/south secondary roadway. At the time of the crash, it was dark with no roadway illumination. There were no adverse conditions as the asphalt roadway surface was dry. The roadway was straight with a level grade. Traffic control consisted of stop signs for northbound/southbound traffic. The posted speed limit was 88 km/h (55 mph) for east/west traffic.

Pre-Crash

The 62-year-old female driver of the 1998 Pontiac Sunfire was operating the vehicle eastbound on a two-lane state roadway. The vehicle crossed the centerline for an unknown reason and traveled into the westbound lane prior to entering the intersection and into the path of the Dodge pickup truck. The driver of the pickup truck realized the impending harmful event, applied the brakes and attempted to steer left. Approximately 9m (30') of pre-impact skid marks from the pickup truck's left front tire were noted in the on-scene photographs **(Figure 2)**.

Figure 2. Skid mark from Dodge pickup truck

Crash

As the 1998 Sunfire traveled into the intersection, it impacted the front of the Dodge pickup truck with the entire front area. The principal directions of force were in the 12 o'clock sectors for both vehicles. The frontal impact caused the front of the Sunfire to underride the front area of the pickup truck. The damage algorithm of the WinSMASH program computed total velocity changes of 46.3 km/h (29.9 mph) for the Sunfire and 34.5 km/h (21.6 mph) for the pickup truck based on the estimated crush profiles of both vehicles. The longitudinal and lateral components for the Sunfire were -45.5 km/h (-28.4 mph) and 8.0 km/h (5.0 mph) respectively. The longitudinal and lateral components for the Dodge pickup truck were -33.9 km/h (-21.2 mph) and -6.0 km/h (-4.0 mph) respectively. The delta-V results appear reasonable for the damage severity. The impact induced deceleration was sufficient to deploy the redesigned frontal air bag system in the Sunfire.

Post-Crash

The occupants of both vehicles were removed by rescue personnel. The driver of the Sunfire was pronounced dead at the scene and was removed from the vehicle by the coroner. The front right passenger of the Sunfire was transported to a local hospital by helicopter with incapacitating injuries. Both occupants of the Dodge pickup truck were transported by ambulance to a local hospital with incapacitating injuries.

***RABSS VEHICLE* - 1998 Pontiac Sunfire**

The 1998 Pontiac Sunfire was identified by the Vehicle Identification Number (VIN):1G2JB1249W7 (production sequence omitted). The vehicle was a 2-door coupe equipped with front wheel drive, automatic transmission, and a 2.2 liter, 4-cylinder engine. The seating was configured with front bucket seats with folding backs and a rear bench seat. The police report listed a rental car company as the owner of the vehicle.

VEHICLE DAMAGE

Exterior Damage - 1998 Pontiac Sunfire

The 1998 Pontiac Sunfire sustained moderately severe frontal damage as a result of the impact with the Dodge pickup truck. On-scene photographs provided the basis for exterior damage of the vehicle. The Collision Deformation Classification (CDC) for the impact with the pickup truck was 12-FDEW-3. Direct contact damage involved the entire frontal width of the vehicle **(Figure 3)**. The front bumper fascia had become displaced from the vehicle and the bumper reinforcement beam was displaced rearward. The hood was displaced rearward and buckled at the designed fold points. Scratches were noted on the hood from underriding the pickup truck. Both front fenders were buckled and displaced rearward, which restricted both front wheels **(Figure 4)**. Six crush measurements were estimated at the level of the bumper reinforcement beam and were as follows: C1: 50cm (20"), C2: 50cm (20"), C3: 45cm (18"), C4: 45cm (18"), C5: 40cm (16"), C6: 35cm (14").

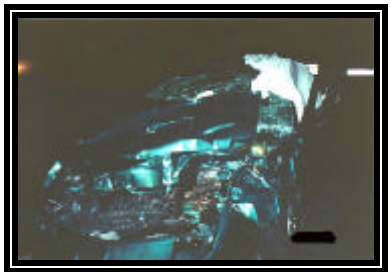

Figure 3. Frontal damage to the Pontiac Sunfire

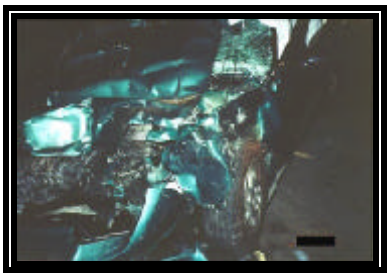

Figure 4. Close-up of front left damage to the Pontiac Sunfire

Interior Damage - 1998 Pontiac Sunfire

The interior of the Chevrolet Cavalier sustained moderate damage that was associated with exterior deformation and driver contact **(Figure 5)**. The left instrument panel intruded into the driver's compartment due to rearward displacement of the left A-pillar. The left toe pan displaced approximately 10-12" rearward to a near vertical position. The unrestrained driver initiated a forward trajectory and loaded the steering assembly through the redesigned air bag. Her loading force deformed the upper and lower aspects of the steering wheel rim and probably compressed the energy absorbing steering column. This was evident by the close proximity of the steering wheel rim to the instrument panel. The driver's knees contacted and deformed the plastic knee bolster directly below and to the left of the steering column. Scuff marks identified both knee strikes to the bolster panel.

Figure 5. Interior view of the Pontiac Sunfire

Exterior Damage - 1989 Dodge Pickup Truck

The 1989 Dodge pickup truck sustained moderate frontal damage as a result of the impact with the Sunfire. On-scene photographs provided the basis for exterior damage of the vehicle **(Figure 6)**. The Collision Deformation Classification (CDC) for the impact with the Sunfire was 12-FDEW-2. The direct contact damage involved the entire frontal width of the vehicle. The direct contact damage extended vertically from the bumper to the face of the hood. The front bumper was displaced rearward and downward from the override to the Sunfire. The left front wheel was restricted from the rearward displacement of the left fender. Six crush measurements were estimated at the level of the bumper reinforcement beam and were as follows: C1: 40 cm (16"), C2: 40 cm (16"), C3: 35 cm (14"), C4: 30 cm (12"), C5: 25 cm (10"), C6: 20 cm (8").

Figure 6. Exterior damage to the Dodge pickup truck

***REDESIGNED AIR BAG SYSTEM* - 1998 Pontiac Sunfire**

The 1998 Pontiac Sunfire was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags deployed as a result of the impact with the Dodge pickup truck. The driver's air bag was housed in the center of the steering wheel with a vertically oriented flap tear seam (I-configuration). The cover flaps were symmetrical in shape. There was no apparent damage to the driver's air bag.

The front right passenger's air bag deployed from the right upper instrument panel area (top mount) with a single cover flap design. There were no sufficient photographic documentation of the front right air bag. The air bag appeared to have deployed as designed which offered the child passenger additional crash protection.

OCCUPANT DEMOGRAPHICS

Driver - 1998 Pontiac Sunfire

Age/Sex:	62-year-old female
Height:	Not reported
Weight:	Not reported
Seat Track Position:	Forward (from on-scene photographs)
Manual Restraint Use:	Unrestrained
Usage Source:	Police/Coroner's reports
Eyewear:	Not reported
Type of Medical Treatment:	Removed from vehicle by Coroner

Driver Injuries - 1998 Pontiac Sunfire

Injury	Injury Severity (AIS 90)	Injury Mechanisms
Abrasion - abdomen	Minor (590202.1,7)	Lower aspect of steering wheel rim
Linear contusion - abdomen	Minor (590402.1,8)	Lower aspect of steering wheel rim
Unspecified open bilateral extremity wounds	Unknown (815099.7,0)	Toepan / knee bolster

Injury source: Coroner's field report

Driver Kinematics - 1998 Pontiac Sunfire

The 62 year old female driver was seated in a presumed upright attitude with the seat track adjusted to a forward position and the back rest adjusted to a near vertical position. The forward and upright seat adjustments placed the driver in a close proximity to the steering assembly and within the deployment path of the redesigned air bag. She was not wearing the manual 3-point lap and shoulder belt system. The lack of belt usage was supported by observations of the first responders to the crash scene and photographs of the deceased driver in the vehicle at final rest. She was dressed in a short sleeve T-shirt and slacks.

At impact, the redesigned frontal air bag system deployed. The driver's torso was probably contacted by the deploying air bag as she initiated a forward trajectory in response to the frontal impact force. Due to the lack of an autopsy, it was unknown if internal injury resulted from the initial bag expansion. The driver subsequently loaded through the air bag and deformed the upper and lower aspects of the four-spoke steering wheel rim. In addition, she probably compressed the energy absorbing steering column. The Coroner identified and abrasion and contusion of the lower abdomen which probably resulted from loading against the lower steering wheel rim.

The driver's knees impacted the knee bolster. The left knee scuffed and deformed the left side of the bolster while the right knee scuffed and deformed the bolster at the base of the steering column. This contact, in combination with the intrusion of the left toe pan produced unspecified bilateral open wounds of the lower extremities.

The driver submarined the knee bolster and steering assembly coming to rest on the left floor and seat cushion of the vehicle. At rest, the driver's head was positioned between the outboard aspect of the seat back support and the left door panel. The driver expired immediately following the crash and was pronounced dead at the scene by the local Coroner. There was no autopsy performed on the body. The Coroner listed the cause of death as severe internal injuries.

Front Right Passenger - 1998 Pontiac Sunfire

Age/Sex:	12-year-old male
Height:	Not reported
Weight:	Not reported
Seat Track Position:	Mid-to-full rear (from on-scene photographs)
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	Police/Coroner's report
Eyewear:	Not reported
Type of Medical Treatment:	Transported by helicopter to a local hospital and admitted

Front Right Passenger Kinematics- 1998 Pontiac Sunfire

The 12-year-old male front right passenger of the 1998 Pontiac Sunfire was seated in a presumed upright posture with the seat track adjusted to the mid-to-rear track position. He was restrained by the available 3-point lap and shoulder belt system. At impact, he initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual restraint. He probably loaded the front right passenger's air bag which offered additional protection against the frontal crash forces. His injuries were not reported. He was transported by helicopter to a local hospital and admitted for treatment.