TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION

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REDESIGNED AIR BAG SPECIAL STUDY (RABSS)
SCI TECHNICAL SUMMARY REPORT

NASS CDS CASE NO. 1998-12-165E

RABSS VEHICLE - 1998 CHEVROLET CAVALIER LS

LOCATION - STATE OF MICHIGAN

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 investigation focused on a two vehicle crash involving a 1998 Chevrolet Cavalier LS 4-door sedan (subject vehicle) and a 1991 Pontiac LeMans 2-door hatchback. The Chevrolet Cavalier was equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of an offset frontal collision with the Pontiac LeMans. The driver of the Chevrolet was operating the vehicle eastbound when she failed to observe the westbound Pontiac as she turned left (north) at a 4-leg rural intersection. As the Chevrolet crossed the westbound lanes, the front right area impacted the front left area of the Pontiac resulting in moderate damage to both vehicles. The restrained 41 year old female driver of the Chevrolet Cavalier initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Contact to the deployed driver air bag resulted in abrasions to the anterior neck and upper chest area. The Chevrolet driver was transported by ambulance to the emergency room of a local trauma center for treatment and released. The rear left and right seating positions of the Chevrolet were occupied by a 5 year old male and 8 year old female (respectively) who were restrained by the available 3-point manual lap and shoulder belt system and uninjured in the crash.			
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BACKGROUND

This investigation focused on a two vehicle crash involving a 1998 Chevrolet Cavalier LS 4-door sedan (subject vehicle) and a 1991 Pontiac LeMans 2-door hatchback. The Chevrolet Cavalier was equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of an offset frontal collision with the Pontiac LeMans. The driver of the Chevrolet was operating the vehicle eastbound when she failed to observe the westbound Pontiac as she turned left (north) at a 4-leg rural intersection. As the Chevrolet crossed the westbound lanes, the front right area impacted the front left area of the Pontiac resulting in moderate damage to both vehicles. The restrained 41 year old female driver of the Chevrolet Cavalier initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Contact to the deployed driver air bag resulted in abrasions to the anterior neck and upper chest area. The Chevrolet driver was transported by ambulance to the emergency room of a local trauma center for treatment and released. The rear left and right seating positions of the Chevrolet were occupied by a 5 year old male and 8 year old female (respectively) who were restrained by the available 3-point manual lap and shoulder belt system and uninjured in the crash.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as CDS case number 98-12-165E and also included in the Redesigned Air Bag Special Study. The Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) assigned the Special Crash Investigation (SCI) team at Veridian the task of case review and final report preparation.

SUMMARY

Crash Site

This two vehicle crash occurred during the morning hours of August, 1998. At the time of the crash, it was daylight with no adverse conditions as the roads were dry. The crash occurred in the westbound inboard lane of a straight and level 4-leg (concrete) intersection **(see Figure 7 - page 4)**. Traffic flow through the 4-lane rural intersection was controlled by an overhead signal system in a green phase for east/westbound traffic. The posted speed limit at the crash site was 72 km/h (45 mph).

Pre-Crash

The 41 year old female driver of the 1998 Chevrolet Cavalier was operating the vehicle eastbound **(Figure 1)** on the inboard lane of the 4-lane roadway when she failed to observe the westbound Pontiac as she turned left (north) at the 4-leg rural intersection. The 36 year old male driver of the 1991 Pontiac LeMans was operating the vehicle westbound on the inboard lane of the 4-lane roadway **(Figure 2)** when he observed the eastbound Chevrolet cross his path of travel. The NASS researcher reported no skid marks at the scene indicative of driver avoidance maneuvers.

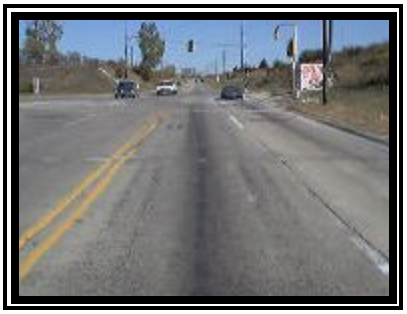

Figure 1. Eastbound approach for the 1998 Chevrolet Cavalier.

Figure 2. Westbound approach for the 1991 Pontiac LeMans.

Crash

As the Chevrolet crossed the westbound lanes of the 4-leg intersection, the front right area impacted the front left area of the Pontiac resulting in moderate damage to both vehicles. The *(SCI revised)* missing vehicle algorithm of the WinSMASH program computed velocity changes of 26.6 km/h (16.5 mph) for the subject vehicle and 32.6 km/h (20.3 mph) for the struck Pontiac. Respective longitudinal components were -25.0 km/h (-15.5 mph) and -32.1 km/h (-19.9 mph). The impact induced deceleration was sufficient to deploy the Chevrolet's redesigned frontal air bag system. Both vehicles came to rest in the northwest sector of the intersection faced northwest.

Post-Crash

All occupants of the Chevrolet exited the vehicle under their own power. The exit status of the Pontiac driver was unknown, however, he was reported by police as uninjured. Treatment was rendered at the scene by fire department personnel and emergency medical technicians (EMTs). The Chevrolet driver was transported by ambulance to the emergency room of a local trauma center for treatment and released. The child passengers of the Chevrolet were uninjured. Both vehicles were towed from the scene due to disabling damage.

RABSS VEHICLE

The 1998 Chevrolet Cavalier LS was identified by the Vehicle Identification Number (VIN): 1G1JF52T0W7 (production sequence deleted). The vehicle was a 4-door sedan equipped with front wheel drive and a 2.4 liter, 4-cylinder engine. The vehicle's odometer reading was 4,439 km (2,758 miles) at the time of the crash. The police report listed the driver as the owner of the vehicle. The seating was configured with front bucket and rear bench seats (with folding backs). Cellular phone usage, previous crashes and maintenance on the air bag system were unknown.

VEHICLE DAMAGE

Exterior Damage

The 1998 Chevrolet Cavalier LS sustained moderate frontal damage as a result of the impact with the Pontiac LeMans **(Figure 3)**. Exterior documentation was limited as the vehicle was under repair at the time of the NASS inspection. The bumper assembly, hood and fenders were replaced. Reduction in the right side wheelbase measured 6.0 cm (2.4 in). The right mid-windshield area was fractured from the interior passenger air bag flap (only).

Figure 3. 1998 Chevrolet Cavalier LS (under repair).

Figure 4. Frontal damage to the 1991 Pontiac LeMans.

The 1991 Pontiac LeMans 2-door hatchback sustained moderate frontal damage as a result of the impact with the Chevrolet Cavalier **(Figure 4)**. The direct contact damage began at the front left bumper corner and extended 75.0 cm (29.5 in) inboard. The impact deformed the entire frontal width resulting in a combined direct and induced damage length (Field L) of 136.0 cm (53.5 in). A maximum crush value of 36.0 cm (11.4 in) was documented at the C3 position. The Collision Deformation Classification (CDC) for this impact to the Pontiac was 12-FYEW-2 with a principal direction of force of (-)10 degrees. The hood and left fender were deformed slightly rearward from the impact force. The windshield was fractured from interior occupant contact (only).

Interior Damage

There was no damage to the interior surfaces of the Chevrolet Cavalier from intrusions or occupant contact.

REDESIGNED AIR BAG SYSTEM

The 1998 Chevrolet Cavalier was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags had deployed as a result of the crash. The driver air bag was housed in the center of the steering wheel **(Figure 5)** with a vertically oriented flap tear seam (I-configuration). The front right passenger air bag deployed from the right top instrument panel **(Figure 6)** with a single cover flap design hinged at the forward aspect. No dimensions were obtained as the vehicle was under repair at the time of the NASS inspection.

Figure 5. 1998 Chevrolet Cavalier redesigned driver air bag module (replaced).

Figure 6. 1998 Chevrolet Cavalier redesigned passenger air bag cavity (under repair).

DRIVER DEMOGRAPHICS

Age/Sex:	41 year old female
Height:	160 cm (63 in)
Weight:	57 kg (125 lb)
Seat Track Position:	Mid-to-forward position
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	NASS vehicle inspection, surrogate interview, police report
Eyeware:	None
Type of Medical Treatment:	Transported to the emergency room of a local trauma center and released

Driver Injuries

Injury	*Severity (AIS 90)*	*Injury Mechanism*
Anterior neck abrasion	Minor (390202.1,5)	Front left air bag
Central upper chest abrasion	Minor (490202.1,4)	Front left air bag
Left 4th metacarpal fracture	Moderate (752002.2,2)	Left side door panel
Left 4th metacarpal contusion	Minor (790402.1,2)	Left side door panel

Driver Kinematics

The 41 year old female driver of the 1998 Chevrolet Cavalier LS was restrained by the available 3-point manual lap and shoulder belt system, seated in an upright posture with the seat track adjusted to the mid-to-forward position. Belt usage was confirmed by the lack of significant interior contacts and injury. At impact, she initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Contact to the driver air bag resulted in abrasions to the anterior neck and upper chest area as evidenced by the size and location of the injury relative to the kinematic response pattern. She also sustained a fracture and associated soft tissue contusion of the left 4th metacarpal (finger) from contact to the left door panel. The driver was transported by ambulance to the emergency room of a local trauma center for treatment and released. The combination of restraint options provided protection against further contact to the steering wheel hub/rim and potential serious injury.

REAR OCCUPANT DEMOGRAPHICS / INJURIES

The rear left and right seating positions were occupied by a 5 year old male and 8 year old female, respectively. The children were seated in an upright posture and restrained by the available 3-point manual lap and shoulder belt system. The child occupants were uninjured in the crash.

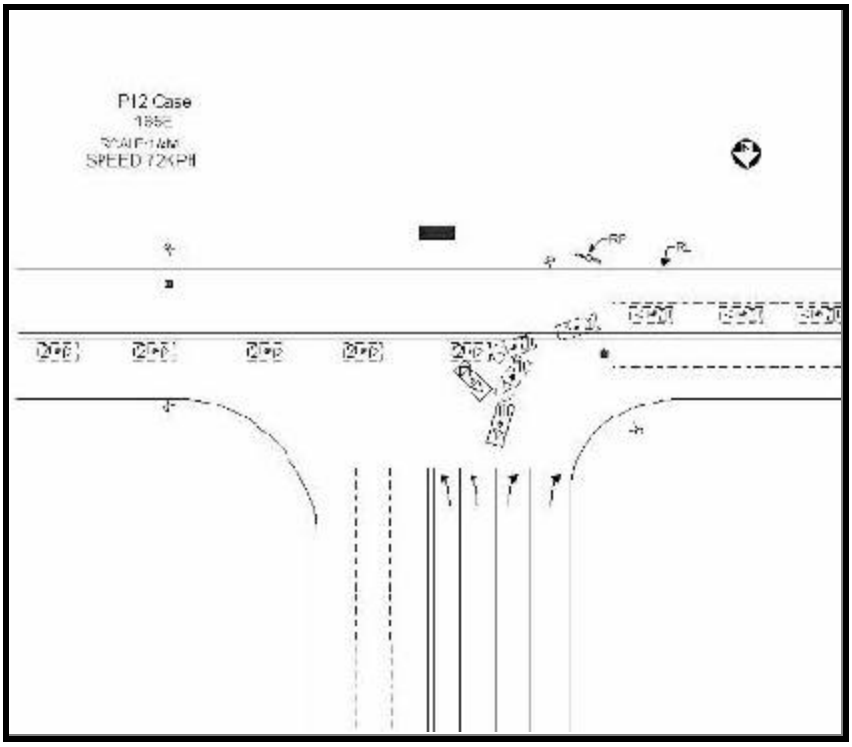

Figure 7. NASS Scene Diagram.