TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION

Veridian Engineering
Buffalo, New York 14225

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

NASS CDS CASE NO. 1998-13-209E

RABSS VEHICLE - 1998 CHEVROLET CAVALIER LS

LOCATION - STATE OF MICHIGAN

CRASH DATE - OCTOBER, 1998

Contract No. DTNH22-94-D-07058

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National Highway Traffic Safety Administration
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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 1997 Ford LN8000 tractor truck (bobtail). The Chevrolet was equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of a right angle collision with the Ford tractor. The driver of the Chevrolet Cavalier was operating the vehicle westbound when he failed to observe the stop sign or northbound Ford as he proceeded straight through a 4-leg intersection. As the Chevrolet entered the intersection, the frontal area impacted the right side surface of the Ford resulting in moderate damage to both vehicles. The restrained 44 year old male driver of the Chevrolet Cavalier initiated a forward and lateral trajectory in response to the 11 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Loading of the manual restraint resulted in a contusion to the central chest while contact to the deployed driver air bag resulted in a superficial laceration of the nose (between the nostrils). The driver of the Chevrolet was transported to a local hospital for treatment and released.			
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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 1997 Ford LN8000 tractor truck (bobtail). The Chevrolet was equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of a right angle collision with the Ford tractor. The driver of the Chevrolet Cavalier was operating the vehicle westbound when he failed to observe the stop sign or northbound Ford as he proceeded straight through a 4-leg intersection. As the Chevrolet entered the intersection, the frontal area impacted the right side surface of the Ford resulting in moderate damage to both vehicles. The restrained 44 year old male driver of the Chevrolet Cavalier initiated a forward and lateral trajectory in response to the 11 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Loading of the manual restraint resulted in a contusion to the central chest while contact to the deployed driver air bag resulted in a superficial laceration of the nose (between the nostrils). The driver of the Chevrolet was transported to a local hospital for treatment and released.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as CDS case number 98-13-209E 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 afternoon hours of October, 1998. At the time of the crash, it was daylight with no adverse conditions as the roads were dry. The crash occurred in the northbound lane of a straight and level 4-leg asphalt intersection **(see Figure 7 - page 4)**. The posted speed limit at the crash site was 56 km/h (35 mph) with east/westbound traffic controlled by stop signs.

Pre-Crash

The 44 year old male driver of the 1998 Chevrolet Cavalier was operating the vehicle westbound **(Figure 1)** at a (driver reported) speed of 56 km/h (35 mph) when he failed to observe the stop sign or northbound Ford tractor as he proceeded straight through the 4-leg intersection. The Chevrolet driver reported to police that he was "daydreaming" and did not notice the stop sign. The 32 year old male driver of the Ford LN8000 was operating the vehicle northbound **(Figure 2)** and proceeding straight. The NASS researcher reported no brake marks at the scene indicative of driver avoidance maneuvers.

Figure 1. Westbound approach for the 1998 Chevrolet Cavalier LS.

Figure 2. Northbound approach for the 1997 Ford LN8000 tractor truck.

Crash

As the Chevrolet Cavalier entered the northbound lane of the 4-leg rural intersection, the frontal area impacted the right side surface of the Ford tractor resulting in moderate damage to both vehicles. Although the impact was classified as out-of-scope (heavy trucks beyond scope) the WinSMASH program computed a (barrier equivalent) velocity change of 23.4 km/h (14.5 mph) with a longitudinal component of -20.3 km/h (-12.6 mph). The impact induced deceleration was sufficient to deploy the Chevrolet's redesigned frontal air bag system. At this point, the Chevrolet rotated clockwise and came to rest in close proximity to the point of impact (in the intersection) facing north. The Ford tractor was re-directed slightly in a northwesterly direction and came to rest approximately 37.0 meters (121.4 feet) north of the intersection also facing north.

Post-Crash

The Chevrolet driver exited the vehicle under his own power. The exit status of the Ford 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 a local hospital for treatment and released. 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): 1G1JF5240W7 (production sequence deleted). The vehicle was a 4-door sedan equipped with front wheel drive and a 2.2 liter, 4-cylinder engine. The vehicle's odometer reading was 32,179 km (19,996 miles) at the time of the crash. The police report did not specify the owner of the vehicle. The seating was configured with front bucket and rear bench seats (with folding backs). The driver reported no previous crashes or maintenance on the air bag system (original equipment). No cell phone was present or in-use at the time of the collision.

VEHICLE DAMAGE

Exterior Damage

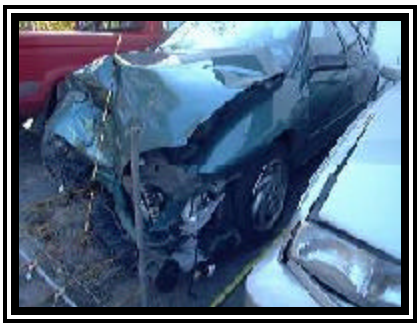

Figure 3. Frontal damage to the 1998 Chevrolet Cavalier LS.

The 1998 Chevrolet Cavalier sustained moderate frontal damage as a result of the impact with the Ford tractor **(Figure 3)**. The direct contact encompassed the full frontal width resulting in a combined direct and induced damage length (Field L) of 118.0 cm (46.5 in). Six crush measurements were documented at the level of the lower radiator *(bumper fascia/reinforcement bar separation)*: C1= 0 cm, C2= 13.0 cm (5.1 in), C3= 22.0 cm (8.7 in), C4= 33.0 cm (13.0 in), C5= 35.0 cm (13.8 in), C6= 17.0 cm (6.7 in). The Collision Deformation Classification (CDC) for this impact to the Chevrolet was 11-FDEW-2 with a principal direction of force of (-)30 degrees. The right and left fenders were displaced rearward and to the left. The grille and headlight assemblies fractured and separated from the vehicle during the collision sequence. A large wheel/tire imprint was noted to the end structure attributed to the right rear wheel of the Ford truck. The hood was deformed up and rearward from engagement against the side surface of the Ford. There was no reduction in the vehicle's wheelbase. The windshield was fractured from (exterior) impact forces and the (interior) front right air bag module cover flap .

Interior Damage

Figure 4. Interior view.

Interior damage to the Chevrolet was minimal and attributed to occupant contact **(Figure 4)**. Scuff marks were documented on the left knee bolster (rigid plastic type). No intrusions were found in the vehicle.

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 with a vertically oriented flap tear seam (I-configuration). No contact evidence was identified on the air bag or exterior surface of the module cover flaps. The flaps were symmetrical in shape and measured 10.0 cm (3.9 in) square. Multiple black vinyl transfers were noted to the face of the air bag from expansion within the module. The NASS researcher measured the diameter of the driver air bag at 50.0 cm (19.7 in) in its deflated state **(Figure 5)**. No internal straps were present. The bag was vented by two ports located at the 9 o'clock and 3 o'clock (centered) sectors on the rear aspect of the air bag.

The front right passenger air bag deployed from the right top instrument panel area with a single cover flap design hinged at the forward aspect. No contact evidence was identified on the air bag or exterior surface of the module cover flap. The cover flap was rectangular in shape and measured 32.0 cm (12.6 in) in width and 18.0 cm (7.1 in) in height *(right lower windshield area fractured by the flap)*. The NASS

researcher measured the passenger air bag at 50.0 cm (19.7 in) square in its deflated state **(Figure 6)**. The bag was tethered by two internal straps with no vent ports present. No cutoff switch was found for the front right air bag.

Figure 5. 1998 Chevrolet Cavalier LS redesigned driver air bag.

Figure 6. 1998 Chevrolet Cavalier LS redesigned passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex:	44 year old male
Height:	173 cm (68 in)
Weight:	77 kg (170 lb)
Seat Track Position:	Mid-to-rear position
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	NASS vehicle inspection, driver interview, police report
Eyeware:	None
Type of Medical Treatment:	Transported to a local hospital and released

Driver Injuries

Injury	***Severity (AIS 90)***	***Injury Mechanism***
Superficial laceration of the nose between the nostrils (minor)	Minor (290602.1,4)	Front left air bag
Central chest contusion	Minor (490402.1,4)	Shoulder belt webbing

Driver Kinematics

The 44 year old male 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-rear position. Belt usage was confirmed by the lack of significant interior contacts and injury. At impact, the driver initiated a forward/lateral trajectory in response to the 11 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Loading of the manual restraint resulted in a contusion to the central chest as evidenced by the location of the injury in relation to the driver's stated placement of the shoulder belt harness. He also sustained a superficial laceration of the nose (between the nostrils)

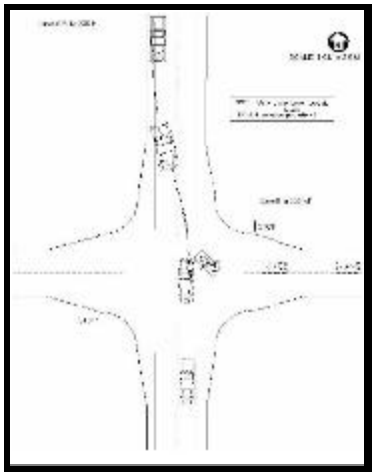

Figure 7. NASS Scene Diagram.

from contact to the deployed driver air bag, evidenced by the location of the injury in response to the kinematic response pattern. The driver was transported by ambulance to a local hospital for treatment and released. The combination of restraint options provided protection against further contact to the steering wheel hub/rim and potential serious injury.