

**TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION**

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

NASS CDS CASE NO. 1998-13-182E

RABSS VEHICLE - 1998 CHEVROLET CAVALIER

LOCATION - STATE OF MICHIGAN

CRASH DATE - AUGUST, 1998

Contract No. DTNH22-94-D-07058

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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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<p>16. <i>Abstract</i> This investigation focused on a single vehicle crash involving a 1998 Chevrolet Cavalier 4-door sedan equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of a frontal collision with a ditch. The Chevrolet was northbound on a two lane rural roadway when the driver and front right passenger reportedly began arguing. The passenger grabbed the steering wheel and re-directed the vehicle towards the right (east) pavement edge. As the vehicle departed the east pavement edge, the front right area impacted a ditch which resulted in minor damage. At this point, the vehicle rotated clockwise as the ditch back slope initiated a 1 quarter turn left side rollover resulting in minor damage. The unrestrained 36 year old male driver of the Chevrolet Cavalier initiated a forward trajectory in response to the initial 12 o'clock impact force and loaded the deployed redesigned driver air bag. The driver was reported by police as uninjured. The 40 year old female front right passenger was restrained by the available 3-point manual lap and shoulder belt system, seated out-of-position to the left in attempts at grabbing the steering wheel. At impact with the ditch, she initiated a forward trajectory in response to the 12 o'clock impact force and contacted the deployed driver air bag resulting in a contusion to the right orbital area. The front right passenger sought treatment later at a medical facility.</p>			
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SCI TECHNICAL SUMMARY REPORT
NASS CDS CASE NO. 1998-13-182E
RABSS VEHICLE - 1998 CHEVROLET CAVALIER
CRASH DATE - AUGUST, 1998**

BACKGROUND

This investigation focused on a single vehicle crash involving a 1998 Chevrolet Cavalier 4-door sedan equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of a frontal collision with a ditch. The Chevrolet was northbound on a two lane rural roadway when the driver and front right passenger reportedly began arguing. The passenger grabbed the steering wheel and re-directed the vehicle towards the right (east) pavement edge. As the vehicle departed the east pavement edge, the front right area impacted a ditch which resulted in minor damage. At this point, the vehicle rotated clockwise as the ditch back slope initiated a 1 quarter turn left side rollover resulting in minor damage. The unrestrained 36 year old male driver of the Chevrolet Cavalier initiated a forward trajectory in response to the initial 12 o'clock impact force and loaded the deployed redesigned driver air bag. The driver was reported by police as uninjured. The 40 year old female front right passenger was restrained by the available 3-point manual lap and shoulder belt system, seated out-of-position to the left in attempts at grabbing the steering wheel. At impact with the ditch, she initiated a forward trajectory in response to the 12 o'clock impact force and contacted the deployed driver air bag resulting in a contusion to the right orbital area. The front right passenger sought treatment later at a medical facility.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as CDS case number 98-13-182E 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 single vehicle crash occurred during the early evening 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 off the east pavement edge of a straight and level two lane north/south asphalt roadway which was bordered by narrow paved shoulders (**no NASS scene diagram available**) with a shallow ditch located approximately 9.2 meters (30.2 feet) to the east. No traffic control was present at the scene which had a posted speed limit of 89 km/h (55 mph).

Pre-Crash

The 36 year old male driver of the 1998 Chevrolet Cavalier was operating the vehicle northbound (**Figure 1**) when he became involved in an argument with the front right passenger. During the argument, the passenger reportedly grabbed the steering wheel which redirected the vehicle towards the right (east) pavement edge (**Figure 2**). The NASS researcher reported no brake marks at the scene indicative of driver avoidance maneuvers.



Figure 1. Northbound approach for the 1998 Chevrolet Cavalier.



Figure 2. Northeast approach to ditch impact.

Crash

As the Chevrolet exited the right (east) pavement edge of the two lane rural roadway, the front right area impacted the ditch resulting in minor damage. Although the impact with the ditch was classified as out-of-scope (yielding object), the (*SCI revised*) damage algorithm of the WinSMASH program computed a velocity change of 12.5 km/h (7.8 mph) with a matching negative longitudinal component. The impact induced deceleration was sufficient to deploy the Chevrolet's redesigned frontal air bag system. At this point, the vehicle rotated clockwise as it continued up the ditch back slope. This initiated a 1 quarter turn left side rollover ("flip over") which resulted in minor damage. The Chevrolet came to rest on its left side off the east pavement edge facing northeast.

Post-Crash

The exit status of the Chevrolet occupants were unknown. No ambulance was summoned to the crash site. The Chevrolet driver was reported by police as uninjured as the front right passenger sought treatment later at a medical facility. The vehicle was towed from the scene due to disabling damage.

RABSS VEHICLE

The 1998 Chevrolet Cavalier was identified by the Vehicle Identification Number (VIN): 1G1JC5245W7 (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 3,183 km (1,978 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 a folding back). The NASS interview was not obtained, therefore, previous crashes or maintenance on the air bag system were unknown.

VEHICLE DAMAGE

Exterior Damage

The 1998 Chevrolet Cavalier sustained minor frontal damage as a result of the impact with the ditch (**Figure 3**). The (*SCI revised*) direct contact damage began at the front right bumper corner and extended 52.0 cm (20.5 in) inboard. The impact deformed the full frontal width resulting in a combined direct and induced damage length (Field L) of 129.0 cm (50.8 in). Six crush measurements

were documented at the level of the bumper: C1= 0 cm, C2= 0 cm, C3= 0 cm, C4= 2.0 cm (0.8 in), C5= 3.0 cm (1.2 in), C6= 8.0 cm (3.1 in). The (*SCI revised*) Collision Deformation Classification (CDC) for this impact to the Chevrolet was 12-FZEW-1 with a principal direction of force of 0 degrees. The grille and right headlight assembly fractured and separated from the vehicle during the collision sequence. The right front wheel/tire was deflated (not restricted). The right fender was displaced rearward as the hood was displaced up and rearward from the impact force. No windshield damage was sustained from exterior impact forces. Direct contact damage was also documented to the left side surface attributed to the rollover impact (**Figure 4**). This damage pattern consisted of surface scratching, mud/dirt deposits and small areas of (lateral) sheet metal deformation. A maximum crush value of 9.0 cm (3.5 in) was identified at the left rear side surface area (left rear wheel/tire deflated not restricted). The CDC for this second and final impact was 00-LDAO-2.



Figure 3. Frontal damage to the 1998 Chevrolet Cavalier.



Figure 4. Rollover damage to the left side surface.

Interior Damage

The windshield was fractured from occupant contact and the front right air bag module cover flap. A spider-web type fracture pattern was also documented to the right upper windshield area. Although omitted in the NASS case file, a lateral door panel intrusion which measured approximately 5.0 cm (2.0 in) was identified.

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 ditch impact. 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 (7.9 in) square. The NASS researcher measured the diameter of the driver air bag at 54.0 cm (21.3 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 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 17.0 cm (6.7 in) in height. The cover flap fractured the right mid-windshield area during the air bag deployment. The NASS researcher measured the passenger air bag at 55.0 cm (21.7 in) in width and 50.0 cm (19.7 in) in height in its deflated state (**Figure 6**). No vent ports or internal tether straps were present. No cutoff switch was found for the front right air bag.



Figure 5. 1998 Chevrolet Cavalier redesigned driver air bag.



Figure 6. 1998 Chevrolet Cavalier redesigned passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex:	36 year old male
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Middle position
Manual Restraint Use:	None
Usage Source:	NASS vehicle inspection, police report
Eyewear:	Unknown
Type of Medical Treatment:	None

Driver Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
None reported	N/A	N/A

Driver Kinematics

The unrestrained 36 year old male driver of the 1998 Chevrolet Cavalier was presumed to be seated in an upright posture with the seat track adjusted to the middle position. The police report stated he was not belted, further evidenced by the interior data. At impact with the ditch, the driver initiated a forward trajectory in response to the 12 o'clock impact force and loaded the deployed redesigned driver air bag. The driver was reported by police as uninjured. The driver redesigned air bag provided

protection against further contact to the steering wheel hub/rim and potential serious injury.

FRONT RIGHT PASSENGER DEMOGRAPHICS

Age/Sex: 40 year old female
Height: Unknown
Weight: Unknown
Seat Track Position: Mid-to-rear position
Manual Restraint Use: 3-point lap and shoulder belt system
Usage Source: NASS vehicle inspection, police report, medical report
Eyewear: Unknown
Type of Medical Treatment: Treatment later at a medical facility

Front Right Passenger Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
Lateral right orbital contusion	Minor (297402.1,1)	Front left air bag

Front Right Passenger Kinematics

The 40 year old female front right passenger of the 1998 Chevrolet Cavalier was restrained by the available 3-point manual lap and shoulder belt system, seated out of position to the left in an attempt to grab the steering wheel from the driver. The police report stated the passenger was belted, further evidenced by the medical report data. At impact, she initiated a forward trajectory in response to the 12 o'clock impact force and contacted the deployed redesigned *driver* air bag resulting in a contusion of the right orbital area (*injury sourced to the steering wheel rim in the NASS case file*). This trajectory was evidenced by the pre-crash posture of the passenger in relation to the location of the injury. The front right passenger sought treatment later at a medical facility.