TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION

Veridian Engineering
Buffalo, New York 14225

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

NASS RABSS CASE NO. 1998-12-803E

RABSS VEHICLE - 1998 CHEVROLET CAVALIER

LOCATION - STATE OF MICHIGAN

CRASH DATE - SEPTEMBER, 1998

Contract No. DTNH22-94-D-07058

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

DISCLAIMER

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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.

TECHNICAL REPORT STANDARD TITLE PAGE

1. *Report No.* 98-12-803E	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* Redesigned Air Bag Special Study (RABSS) RABSS Vehicle - 1998 Chevrolet Cavalier Location - State of Michigan		5. *Report Date*: July, 2000 6. *Performing Organization Code*	
7. *Author(s)* Crash Research Section		8. *Performing Organization Report No.*	
9. *Performing Organization Name and Address* Transportation Sciences Crash Research Section Veridian Engineering P.O. Box 400 Buffalo, New York 14225		10. *Work Unit No.* C01115.0262.(0000-0009) 11. *Contract or Grant No.* DTNH22-94-D-07058	
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		13. *Type of Report and Period Covered* Technical Summary Report Crash Date: September, 1998 14. *Sponsoring Agency Code*	
15. *Supplementary Notes* NASS investigation of an acute angle collision that involved a 1998 Chevrolet Cavalier 2-door coupe equipped with redesigned frontal air bags.			
16. *Abstract* This investigation focused on a two vehicle crash involving a 1998 Chevrolet Cavalier 2-door coupe (subject vehicle) and a 1991 Eagle Premier LX 4-door sedan. The Chevrolet Cavalier was equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of an acute angle collision with the Eagle Premier. The Eagle driver was operating the vehicle eastbound when she failed to observe the westbound Chevrolet as she turned left (north) at a 3-leg intersection. As the Eagle crossed the westbound lanes, the right rear side surface was impacted by the front right area of the Chevrolet resulting in moderate damage to both vehicles. The restrained 19 year old female driver of the Chevrolet Cavalier initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of her forearms resulting in bilateral abrasions and contusions. The Chevrolet driver was transported directly from the scene by private vehicle to the emergency room of a local trauma center for treatment and released.			
17. *Key Words* Redesigned frontal air bag system Collision Deformation Classification (CDC): 12-FZEW-1 Proper use of the manual belt system Bilateral anterior forearm abrasions/contusions		18. *Distribution Statement* General Public	
19. *Security Classif. (of this report)* Unclassified	20. *Security Classif. (of this page)* Unclassified	21. *No. of Pages* 5	22. *Price*

TABLE OF CONTENTS

REDESIGNED AIR BAG SPECIAL STUDY (RABSS)
SCI TECHNICAL SUMMARY REPORT
NASS RABSS CASE NO. 1998-12-803E
RABSS VEHICLE - 1998 CHEVROLET CAVALIER
CRASH DATE - SEPTEMBER, 1998

BACKGROUND

This investigation focused on a two vehicle crash involving a 1998 Chevrolet Cavalier 2-door coupe (subject vehicle) and a 1991 Eagle Premier LX 4-door sedan. The Chevrolet Cavalier was equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of an acute angle collision with the Eagle Premier. The Eagle driver was operating the vehicle eastbound when she failed to observe the westbound Chevrolet as she turned left (north) at a 3-leg intersection. As the Eagle crossed the westbound lanes, the right rear side surface was impacted by the front right area of the Chevrolet resulting in moderate damage to both vehicles. The restrained 19 year old female driver of the Chevrolet Cavalier initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of her forearms resulting in bilateral abrasions and contusions. The Chevrolet driver was transported directly from the scene by private vehicle to the emergency room of a local trauma center for treatment and released.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as case number 98-12-803E for 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 early evening hours of September, 1998. At the time of the crash, it was daylight with no adverse conditions as the roads were dry. The crash occurred in the inboard westbound lane of a straight and level 3-leg asphalt intersection **(see Figure 7 - page 5)** with a negative grade for eastbound traffic. Traffic was controlled by an overhead signal system in green phase for east/westbound traffic. The posted speed limit at the crash scene was 48 km/h (30 mph).

Pre-Crash

The 74 year old female driver of the 1991 Eagle Premier was operating the vehicle eastbound on the inboard lane of a five lane roadway **(Figure 1)** when she entered the center turn lane and proceeded to turn left (north) at the 3-leg intersection. The 19 year old female driver of the 1998 Chevrolet Cavalier was operating the vehicle westbound on the inboard lane **(Figure 2)** at a (driver reported) speed of 48 km/h (30 mph) when she observed the Eagle cross her path of travel. The Chevrolet driver reported no avoidance maneuvers in anticipation of the impending crash.

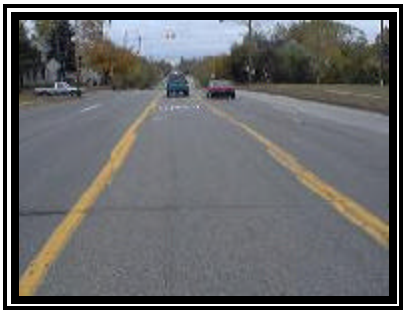

Figure 1. Eastbound approach for the 1991 Eagle Premier LX.

Figure 2. Westbound approach for the 1998 Chevrolet Cavalier.

Crash

As the Eagle Premier crossed the westbound inboard lane of the 3-leg urban intersection, the right rear side surface was impacted by the front right area of the Chevrolet resulting in moderate damage to both vehicles. The *(SCI revised)* damage algorithm of the WinSMASH program computed velocity changes of 14.6 km/h (9.1 mph) for the subject vehicle and 13.2 km/h (8.2 mph) for the struck Eagle. Respective longitudinal components were -14.4 km/h (-8.9 mph) and -4.5 km/h (-2.8 mph). The impact induced deceleration was sufficient to deploy the Chevrolet's redesigned frontal air bag system. At this point, the Eagle rotated clockwise and came to rest in the northwest sector of the intersection facing southeast. The Chevrolet was redirected in a northwesterly direction and came to rest alongside the north curbline facing northwest.

Post-Crash

The driver of the Chevrolet Cavalier exited the vehicle under her own power. The exit status of the Eagle driver was unknown, however, she was reported by police as uninjured. No ambulance was summoned to the crash site. The Chevrolet driver was transported by private vehicle to the emergency room of a local trauma center for treatment and released. Both vehicles were towed from the scene due to disabling damage.

RABSS VEHICLE

The 1998 Chevrolet Cavalier was identified by the Vehicle Identification Number (VIN): 1G1JC1240W7 (production sequence deleted). The vehicle was a 2-door coupe equipped with front wheel drive and a 2.2 liter, 4-cylinder engine. The vehicle's odometer reading was 18,020 km (11,197 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). 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

The 1998 Chevrolet Cavalier 2-door coupe sustained moderate frontal damage as a result of the impact with the Eagle Premier **(Figure 3)**. The *(SCI revised)* direct contact damage began at the front right bumper

corner and extended 80.0 cm (31.5 in) inboard. The impact deformed the full frontal width resulting in a combined direct and induced damage length (Field L) of 123.0 cm (48.4 in). Six crush measurements were documented at the level of the reinforcement bar *(partial bumper fascia separation)*: C1= 0 cm, C2= 0 cm, C3= 0 cm, C4= 2.0 cm (0.8 in), C5= 5.0 cm (2.0 in), C6= 6.0 cm (2.4 in). The Collision Deformation Classification (CDC) for this impact to the Chevrolet was 12-FZEW-1 with a principal direction of force of (-)10 degrees. The right fender was displaced rearward which restricted/deflated the right front wheel/tire. The hood was deformed up and rearward from engagement against the side surface of the Eagle. Reduction in the right side wheelbase measured 13.0 cm (5.1 in). The windshield was fractured from (exterior) impact forces and the (interior) front right air bag module cover flap. All tempered glazing remained undamaged.

Figure 3. Front right damage to the 1998 Chevrolet Cavalier.

Figure 4. Right rear side surface damage to the 1991 Eagle Premier LX.

The 1991 Eagle Premier LX 4-door sedan sustained moderate right rear side surface damage as a result of the impact with the Chevrolet Cavalier **(Figure 4)**. The direct contact damage began at the rear right bumper corner and extended 159.0 cm (62.6 in) forward. The *(SCI revised)* CDC for this impact to the Eagle was 02-RZEW-2 with a principal direction of force of (+)70 degrees. The right rear wheel/tire separated from the axle during the collision sequence. This allowed penetration of the Chevrolet into the vehicle's undercarriage resulting in a rupture of the plastic gas tank. All glazing remained undamaged.

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 with a vertically oriented flap tear seam (I-configuration). The flaps were symmetrical in shape and measured 11.0 cm (4.3 in) in width and 10.0 cm (3.9 in) in height. Although no contact evidence was identified on the exterior surface of the module cover flaps, a lipstick transfer was documented to the lower right quadrant of the air bag. The NASS researcher measured the diameter of the driver air bag at 60.0 cm (23.6 in) in its deflated state **(Figure 5)**. No internal tether 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 *(right mid-windshield area fractured by the module cover flap)*. 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 25.0 cm (9.8 in) in height. The NASS researcher measured the passenger air bag at 50.0 cm (19.7 in) in width and 80.0 cm (31.5 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:	19 year old female
Height:	173 cm (68 in)
Weight:	100 kg (220 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*
Bilateral contusions anterior forearms	Minor (790402.1,3)	Expanding front left air bag
Bilateral abrasions anterior forearms	Minor (790202.1,3)	Expanding front left air bag

Driver Kinematics

The 19 year old female driver of the 1998 Chevrolet Cavalier was properly 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. Her hands were placed at the 10 o'clock and 2 o'clock sectors on the steering wheel

rim. Belt usage was confirmed by the lack of significant interior contacts and injury. At impact, the driver initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of her forearms resulting in 5.0 cm (2.0 in) bilateral abrasions and contusions, evidenced by the size and location of the injury relative to the driver's stated pre-crash placement of the hands on the steering wheel rim. The driver reported during the NASS interview that these injuries resembled burns but were verified as abrasions/contusions during the emergency room visit. Contact to the deployed redesigned driver air bag was confirmed by the lipstick transfers documented to the lower right quadrant of the air bag. She was transported directly from the scene by private vehicle to the emergency room of a local trauma center for treatment and released.

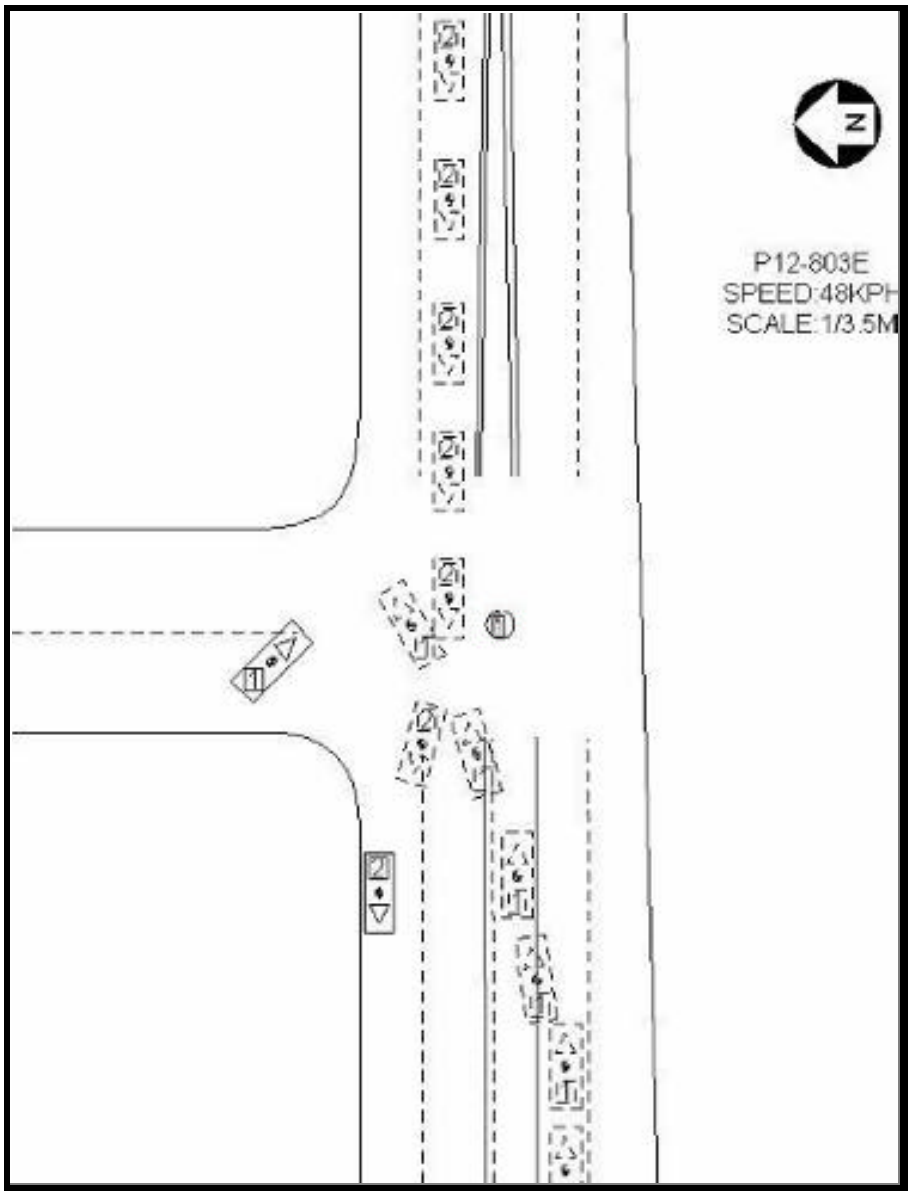

Figure 7. NASS Scene Diagram.