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. 1998-09-108E

RABSS VEHICLE - 1998 CHEVROLET S-10 BLAZER LS

LOCATION - STATE OF MARYLAND

CRASH DATE - OCTOBER, 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.* 98-09-108E	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* Redesigned Air Bag Special Study (RABSS) RABSS Vehicle - 1998 Chevrolet S-10 Blazer LS sport utility vehicle 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: October, 1998 14. *Sponsoring Agency Code*	
15. *Supplementary Notes* NASS investigation of a right angle collision that involved a 1998 Chevrolet S-10 Blazer LS 2-door sport utility vehicle equipped with redesigned frontal air bags.			
16. *Abstract* This investigation focused on a two vehicle crash involving a 1998 Chevrolet S-10 Blazer LS 2-door sport utility vehicle (subject vehicle) and a 1991 Ford Mustang LX 2-door hatchback. The Chevrolet Blazer 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 Mustang. The Chevrolet driver was operating the vehicle southbound on a multi-lane urban roadway when he failed to observe the red overhead traffic signal or westbound Ford as he proceeded straight through a 4-leg intersection. As the Chevrolet entered the intersection, the frontal area impacted the right passenger area of the Ford resulting in severe damage to both vehicles. The restrained 25 year old male driver of the Chevrolet Blazer initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Loading of the manual restraint resulted in abrasions/contusions across the chest wall. He also sustained an abrasion of the right anterior thigh from contact to the center instrument panel. The Chevrolet driver was transported by ambulance to a local hospital for treatment and released.			
17. *Key Words* Redesigned frontal air bag system Collision Deformation Classification (CDC): 12-FDEW-3 Proper use of the manual belt system Chest wall 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* 6	22. *Price*

TABLE OF CONTENTS

REDESIGNED AIR BAG SPECIAL STUDY (RABSS)
SCI TECHNICAL SUMMARY REPORT
NASS CDS CASE NO. 1998-09-108E
RABSS VEHICLE - 1998 CHEVROLET S-10 BLAZER LS
CRASH DATE - OCTOBER, 1998

BACKGROUND

This investigation focused on a two vehicle crash involving a 1998 Chevrolet S-10 Blazer LS 2-door sport utility vehicle (subject vehicle) and a 1991 Ford Mustang LX 2-door hatchback. The Chevrolet Blazer 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 Mustang. The Chevrolet driver was operating the vehicle southbound on a multi-lane urban roadway when he failed to observe the red overhead traffic signal or westbound Ford as he proceeded straight through a 4-leg intersection. As the Chevrolet entered the intersection, the frontal area impacted the right passenger area of the Ford resulting in severe damage to both vehicles. The restrained 25 year old male driver of the Chevrolet Blazer initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Loading of the manual restraint resulted in abrasions/contusions across the chest wall. He also sustained an abrasion of the right anterior thigh from contact to the center instrument panel. The Chevrolet driver was transported by ambulance 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 98-09-108E 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 early morning hours of October, 1998. At the time of the crash, it was dark (street lighted) with no adverse conditions as the roads were dry. The crash occurred in the southbound lanes of a straight and level 4-leg asphalt intersection **(see Figure 9 - page 6)**. The north/southbound lanes were divided by a narrow grass median with a W-beam guardrail barrier. Traffic was controlled by an overhead signal system in green (dedicated arrow) phase for westbound (turning) traffic flow. The posted speed limit at the crash site was 89 km/h (55 mph).

Pre-Crash

The 25 year old male driver of the 1998 Chevrolet S-10 Blazer was operating the vehicle southbound **(Figure 1)** in the outboard lane of the seven lane divided roadway when he failed to observe the red overhead traffic signal or westbound Ford as he proceeded straight through the 4-leg intersection. The 28 year old male driver of the 1991 Ford Mustang LX was operating the vehicle northbound **(Figure 2)** on the inboard lane of the seven lane divided roadway when he proceeded to turn left (west) at the 4-leg intersection. The NASS researcher reported no brake marks at the scene indicative of driver avoidance maneuvers.

Figure 1. Southbound approach for the 1998 Chevrolet S-10 Blazer.

Figure 2. Northbound approach for the 1991 Ford Mustang LX.

Crash

As the Chevrolet Blazer entered the 4-leg urban intersection, the frontal area impacted the right passenger area of the Ford Mustang resulting in severe damage to both vehicles. The WinSMASH program computed velocity changes of 49.1 km/h (30.5 mph) for the subject vehicle and 67.4 km/h (41.9 mph) for the struck Ford. Respective longitudinal components were -48.4 km/h (-30.1 mph) and -17.4 km/h (-10.8 mph). The impact induced deceleration was sufficient to deploy the Chevrolet's redesigned frontal air bag system. At this point, the Ford rotated counterclockwise as the right rear side surface area struck (sideslapped) the left passenger area of the Chevrolet resulting in moderate damage to both vehicles. The WinSMASH program computed velocity changes of 5.5 km/h (2.2 mph) for the subject vehicle and 7.5 km/h (4.7 mph) for the striking Ford. Respective latitudinal components were 5.5 km/h (2.2 mph) and -7.5 km/h (-4.7 mph). The Chevrolet came to rest in the southwest sector of the intersection facing north. The Ford continued in a southwesterly direction and subsequently departed the west pavement edge of the southbound lanes where the left front side surface struck a small diameter signpost resulting in minor damage. The Ford came to rest off the west pavement edge in close proximity to the final point of impact facing northwest.

Post-Crash

The exit status of both drivers were unknown. Treatment was rendered at the scene by fire department personnel and emergency medical technicians (EMTs). Both drivers were 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 S-10 Blazer LS was manufactured on 8/98 and identified by the Vehicle Identification Number (VIN): 1GNCT18W5WK (production sequence deleted). The vehicle was a 2-door sport utility vehicle equipped with 4-wheel drive and a 4.3 liter, V-6 engine. The vehicle's odometer reading was unknown 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 split bench seats (with folding backs). The NASS interview was not obtained, therefore, previous crashes or maintenance on the air bag system were unknown.

VEHICLE DAMAGE

Exterior Damage

Figure 3. Frontal damage to the 1998 Chevrolet S-10 Blazer.

The 1998 Chevrolet S-10 Blazer sport utility vehicle sustained severe frontal damage as a result of the impact with the Ford Mustang **(Figure 3)**. The direct contact damage encompassed the entire frontal width resulting in a combined direct and induced damage length (Field L) of 137.0 cm (53.9 in). Six crush measurements were documented at the level of the bumper: C1= 24.0 cm (9.4 in), C2= 22.0 cm (8.7 in), C3= 35.0 cm (13.8 in), C4= 43.0 cm (16.9 in), C5= 51.0 cm (20.1 in), C6= 52.0 cm (20.5 in). The Collision Deformation Classification (CDC) for this initial impact to the Chevrolet was 12-FDEW-3 with a principal direction of force of (-)10 degrees. The grille and headlight assemblies fractured and separated from the vehicle during the collision sequence. The hood was deformed up and rearward from engagement against the side surface of the Ford. Both fenders were displaced rearward which restricted/deflated the front wheels/tires and jammed the left door. Induced buckling was noted to the roof area at the left and right B-pillar. Reduction in the right side wheelbase measured 9.0 cm (3.5 in). The windshield was fractured from exterior impact forces (only).

Direct contact damage was also identified along the left side surface attributed to the secondary (sideslap) impact. The direct contact damage began 64.0 cm (25.2 in) forward of the left rear axle and extended 240.0 cm (94.5 in) forward. The combined direct and induced damage length (Field L) began 43.0 cm (16.9 in) forward of the left rear axle and extended 262.0 cm (103.1 in) forward. Six crush measurements were documented at the level of the mid-door: C1= 1.0 cm (0.4 in), C2= 1.0 cm (0.4 in), C3= 6.0 cm (2.4 in), C4= 3.0 cm (1.2 in), C5= 0 cm, C6= 1.0 cm (0.4 in). The Collision Deformation Classification (CDC) for this second and final impact to the Chevrolet was 09-LYEW-1 with a principal direction of force of (-)90 degrees. The left front door window glazing was disintegrated by the impact force.

Figure 4. Right side surface damage to the 1991 Ford Mustang LX.

The 1991 Ford Mustang LX 2-door hatchback sustained severe right side surface damage as a result of the impact with the Chevrolet Blazer **(Figure 4)**. The direct contact damage began at the front right bumper corner and extended 182.0 cm (71.7 in) rearward. The combined direct and induced damage length (Field L) began at the front right bumper corner and extended 256.0 cm (100.8 in) rearward. A maximum crush value of 79.0 cm (31.1 in) was identified at the C4 position. The CDC for this initial impact to the Ford was 63-RYEW-5 with a principal direction of force of (+)80 degrees (principal direction of force incremented to reflect structural bowing). Extensive deformation produced induced buckling (and interior component intrusion) of the roof and associated right B and C-pillars. Structural vehicle bowing also produced induced contact damage to the left side surface. The right front wheel/tire was restricted (not deflated). The windshield was fractured by exterior impact forces. All right side tempered glazing was disintegrated which resulted in integrity loss at the right door window area. Reduction in the right side wheelbase measured 52.0 cm (20.5 in) while the left side wheelbase was elongated 21.0 cm (8.3 in).

Post-crash (rescue) extrication damage was noted to the right door.

Direct contact damage was also documented along the right rear area attributed to the secondary (sideslap) impact. The direct contact damage began at the rear right bumper corner and extended forward 38.0 cm (15.0 in). A maximum crush value of 2.0 cm (0.8 in) was identified at the C2 position. The CDC for this second impact to the Ford was 03-RBEE-1 with a principal direction of force of (+)90 degrees. Although the collision dynamics would place the third and final (signpost) impact along the left fender area, a specific location of direct contact damage could not be found.

Interior Damage

Damage to the interior surfaces of the Chevrolet Blazer were minimal and attributed to component intrusions and occupant contact. Scuff marks were identified on the left door panel, knee bolster and lower center instrument panel area. A scuff mark was also documented on the steering column with the cover panel out-of-place. The rear view mirror and floor mounted console were fractured and displaced to the right. Deformation to the upper portion of the steering wheel rim measured 1.0 cm (0.4 in). Longitudinal intrusions involved 3.0 cm (1.2 in) of front left and 7.0 cm (2.8 in) of front right toepan intrusion.

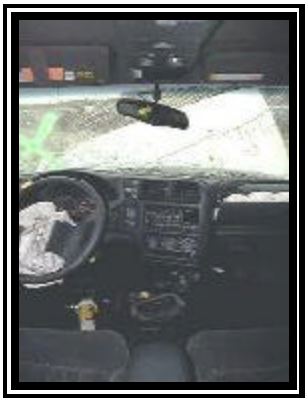

Figure 5. Interior view.

REDESIGNED AIR BAG SYSTEM

The 1998 Chevrolet S-10 Blazer LS 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 8.5 cm (3.3 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 smudge mark was documented on the upper right quadrant of the air bag face **(Figure 7)**. The NASS researcher measured the diameter of the driver air bag at 72.0 cm (28.3 in) in its deflated state **(Figure 6)**. The bag was tethered by four internal straps and vented by two ports located at the 11 o'clock and 1 o'clock sectors on the rear aspect of the air bag.

The front right passenger air bag deployed from the right mid-instrument panel area with a single cover flap design hinged at the bottom 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 13.0 cm (5.1 in) in height. The NASS researcher measured the passenger air bag at 57.0 cm (22.4 in) in width and 122.0 cm (48.0 in) in height in its deflated state **(Figure 8)**. 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 side aspect of the air bag. No cutoff switch was found for the front right air bag.

Figure 6. 1998 Chevrolet S-10 Blazer redesigned driver air bag.

Figure 7. Smudge mark to the upper right quadrant of the driver air bag face.

Figure 8. 1998 Chevrolet S-10 Blazer redesigned passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex:	25 year old male
Height:	175 cm (69 in)
Weight:	73 kg (161 lb)
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
Eyeware:	Unknown
Type of Medical Treatment:	Transported to a local hospital and released

Driver Injuries

Injury	*Severity (AIS 90)*	*Injury Mechanism*
Chest abrasion	Minor (490202.1,0)	Shoulder belt webbing
Chest contusion	Minor (490402.1,0)	Shoulder belt webbing
Right anterior thigh abrasion (proximal to knee)	Minor (890202.1,1)	Center instrument panel

Driver Kinematics

The 25 year old male driver of the 1998 Chevrolet S-10 Blazer 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. 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 and loaded the manual restraint and deployed redesigned driver air bag. Loading of the manual restraint resulted in abrasions/contusions across the chest wall. Loading of the deployed driver air bag was confirmed by the smudge mark identified at the upper right quadrant of the air bag face. He also sustained an abrasion of the

right anterior thigh from contact to the center instrument panel as evidenced by the scuff mark documented to this component. 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.

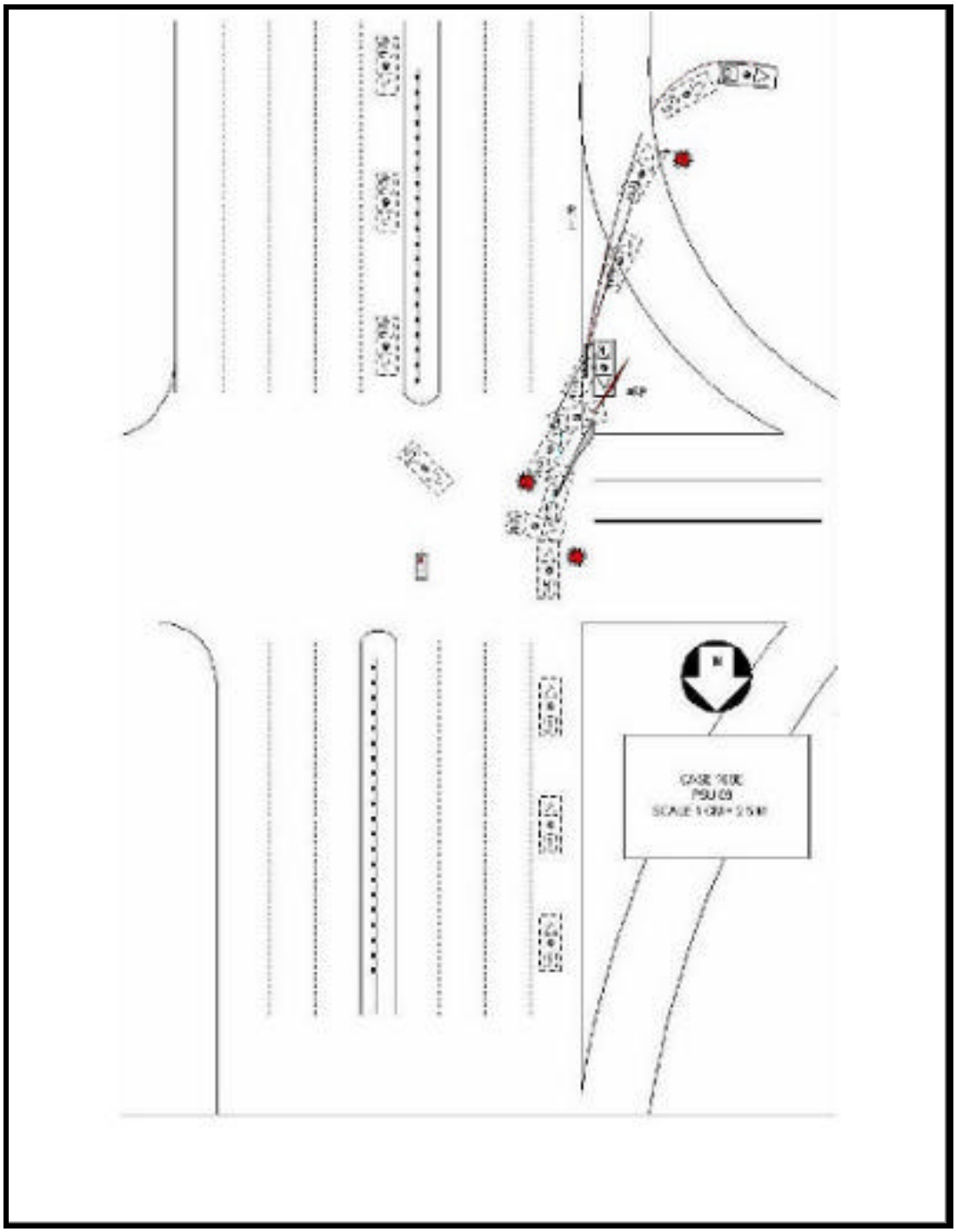

Figure 9. NASS Scene Diagram.