

**TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION**

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

NASS CDS CASE NO. 1998-13-161E

RABSS VEHICLE - 1998 CHEVROLET S-10 PICKUP TRUCK

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 two vehicle crash involving a 1998 Chevrolet S-10 pickup truck (subject vehicle) and a 1990 Jeep Cherokee 2-door sport utility vehicle. The Chevrolet pickup was equipped with redesigned frontal air bags for the driver and right passenger positions. The Chevrolet was also equipped with a cutoff switch for the front right passenger air bag which was set to the "off" position. The driver frontal air bag deployed as a result of a right angle collision with the Jeep Cherokee. The driver of the Jeep was operating the vehicle eastbound when she failed to observe the southbound Chevrolet as she proceeded straight through a 4-leg intersection. As the Jeep entered the intersection, the left passenger area was struck by the frontal area of the Chevrolet resulting in moderate damage to both vehicles. The unrestrained 25 year old male driver of the Chevrolet pickup truck initiated a forward trajectory in response to the 1 o'clock impact force and loaded the knee bolster and deployed redesigned driver air bag. Loading of the knee bolster resulted in a contusion to the right knee with no other injury reported. The unrestrained 25 year old front right passenger initiated a forward trajectory in response to the 1 o'clock impact force and struck the windshield which resulted in contusions/abrasions to the forehead and scalp. Both occupants of the Chevrolet S-10 pickup were transported by ambulance to a local hospital for treatment and released.</p>			
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CRASH DATE - AUGUST, 1998**

BACKGROUND

This investigation focused on a two vehicle crash involving a 1998 Chevrolet S-10 pickup truck (subject vehicle) and a 1990 Jeep Cherokee 2-door sport utility vehicle. The Chevrolet pickup was equipped with redesigned frontal air bags for the driver and right passenger positions. The Chevrolet was also equipped with a cutoff switch for the front right passenger air bag which was set to the “off” position. The driver frontal air bag deployed as a result of a right angle collision with the Jeep Cherokee. The driver of the Jeep was operating the vehicle eastbound when she failed to observe the southbound Chevrolet as she proceeded straight through a 4-leg intersection. As the Jeep entered the intersection, the left passenger area was struck by the frontal area of the Chevrolet resulting in moderate damage to both vehicles. The unrestrained 25 year old male driver of the Chevrolet pickup truck initiated a forward trajectory in response to the 1 o’clock impact force and loaded the knee bolster and deployed redesigned driver air bag. Loading of the knee bolster resulted in a contusion to the right knee with no other injury reported. The unrestrained 25 year old front right passenger initiated a forward trajectory in response to the 1 o’clock impact force and struck the windshield which resulted in contusions/abrasions to the forehead and scalp. Both occupants of the Chevrolet S-10 pickup were 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 98-13-161E 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 evening hours of August, 1998. At the time of the crash, it was dark (street not lighted) with no adverse conditions as the roads were dry. The crash occurred in a straight and level 4-leg asphalt intersection (**see Figure 7 - page 6**). Traffic flow through the intersection was controlled by stop signs for east/westbound traffic. The posted speed limit at the crash site was 89 km/h (55 mph).

Pre-Crash

The 21 year old female driver of the 1990 Jeep Cherokee was operating the vehicle eastbound on approach to the 4-leg intersection (**Figure 1**) when she stopped at the stop sign and proceeded straight at a (driver reported) speed of 16 km/h (10 mph). The Jeep driver reported to police that she thought she was at a 4-way stop and had the right-of-way through the intersection. The front right seating position of the Jeep was occupied by a 23 year old male with the rear left and right seating positions

occupied by a 20 year old female and 22 year old male, respectively. The 25 year old male driver of the 1998 Chevrolet S-10 pickup was operating the vehicle southbound (**Figure 2**) at a (driver reported) speed of 80 km/h (50 mph) when he entered the intersection and observed the eastbound Jeep cross his path of travel. Upon recognition of the impending harmful event, the driver braked in avoidance remaining in the southbound lane prior to the collision. The front right seating position of the Chevrolet was occupied by a 25 year old male.

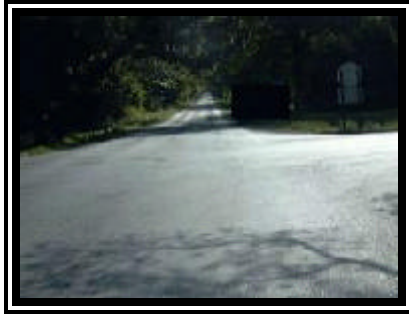


Figure 1. Eastbound approach for the 1990 Jeep Cherokee.



Figure 2. Southbound approach for the 1998 Chevrolet S-10 pickup truck.

Crash

As the Jeep entered the 4-leg intersection, the left passenger area was struck by the frontal area of the Chevrolet resulting in moderate damage to both vehicles. The damage algorithm of the WinSMASH program computed velocity changes of 29.1 km/h (18.1 mph) for the subject vehicle and 29.4 km/h (18.3 mph) for the struck Jeep. Respective longitudinal components were -25.2 km/h (-15.7 mph) and -14.7 km/h (-9.1 mph). The impact induced deceleration was sufficient to deploy the Chevrolet's redesigned driver frontal air bag system. Both vehicles came to rest in the southeast sector of the intersection facing southeast. A secondary (sideslap) impact was coded in the NASS case file, however (unlikely), this could not be verified through case image data.

Post-Crash

Both occupants of the Chevrolet pickup exited the vehicle under their own power. The driver of the Jeep was removed from the vehicle by rescue personnel due to perceived serious injuries as the passengers exited the vehicle under their own power. Treatment was rendered at the scene by fire department personnel and emergency medical technicians (EMTs). Both occupants of the Chevrolet were transported by ambulance to a local hospital for treatment and released. The driver of the Jeep was transported by ambulance to a local hospital for treatment and released as the passengers refused treatment. Both vehicles were towed from the scene due to disabling damage.

RABSS VEHICLE

The 1998 Chevrolet S-10 was identified by the Vehicle Identification Number (VIN): 1GCCS1447WK (production sequence deleted). The vehicle was a regular cab pickup truck equipped with rear wheel drive and a 2.2 liter, 4-cylinder engine. The vehicle's odometer reading was approximately 12,874 km (8,000 miles) at the time of the crash. The police report did not specify the owner of the vehicle. The seating was configured with a front (split) bench seat (with folding backs).

The driver reported no previous crashes or maintenance on the air bag system (original equipment). A cellular phone was present in the vehicle at the time of the collision (usage unknown).

VEHICLE DAMAGE

Exterior Damage

The 1998 Chevrolet S-10 pickup sustained moderate frontal damage as a result of the impact with the Jeep Cherokee (**Figures 3&4**). The direct contact damage encompassed the full frontal width resulting in a combined direct and induced damage length (Field L) of 148.0 cm (58.3 in). Six crush measurements were documented at the level of the bumper: C1= 37.0 cm (14.6 in), C2= 25.0 cm (9.8 in), C3= 25.0 cm (9.8 in), C4= 24.0 cm (9.4 in), C5= 22.0 cm (8.7 in), C6= 30.0 cm (11.8 in). The Collision Deformation Classification (CDC) for this impact to the Ford was 01-FDEW-2 with a principal direction of force of (+)30 degrees. The grille and left headlight assembly 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 Jeep. Both fenders were displaced rearward which restricted the front wheels/tires (not deflated). Reduction in the left side wheelbase measured 5.0 cm (2.0 in) while reduction in the right side wheelbase measured 2.0 cm (0.8 in). The windshield was fractured from (exterior) impact forces and (interior) occupant contact.



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



Figure 4. Oblique view of the 1998 Chevrolet pickup.

The 1990 Jeep Cherokee 2-door sport utility vehicle sustained moderate left side surface damage as a result of the impact with the Chevrolet pickup (**Figure 5**). The direct contact damage began 22.0 cm (8.7 in) aft of the left front axle and extended 155.0 cm (61.0 in) rearward. A maximum crush value of 44.0 cm (17.3 in) was documented just forward of the B-pillar. The (*SCI revised*) CDC for this impact to the Jeep was 10-LYEW-4 with a principal direction of force of (-)60 degrees. The windshield was fractured by exterior impact forces (only) as the left front window glazing was disintegrated by driver contact. Post-crash extrication damage was noted to the left door along with outward bowing of the upper window frame.

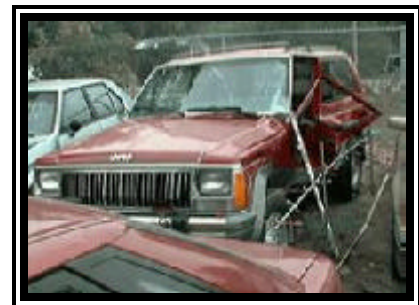


Figure 5. Left side surface damage to the 1990 Jeep Cherokee.

Interior Damage

Damage to the interior surfaces of the Chevrolet S-10 pickup truck were moderate and attributed to occupant contact. Scuff marks were documented on the left and right side knee bolsters (rigid plastic type). A spider-web type fracture pattern was identified on the right windshield along with hair strands to the sunvisor and header areas. No steering wheel rim deformation or component intrusions were found in the vehicle.

REDESIGNED AIR BAG SYSTEM

The 1998 Chevrolet S-10 was equipped with redesigned frontal air bags for the driver and front right passenger positions. The driver side air bag 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. No contact evidence was identified on the air bag or exterior surface of the module cover flaps. The NASS researcher measured the diameter of the driver air bag at 63.0 cm (24.8 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.



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

The front right passenger air bag module was mounted in the right mid-instrument panel area with a single cover flap design hinged at the top aspect. A cutoff switch was found on the center instrument panel area and was set to the “off” position.

DRIVER DEMOGRAPHICS

Age/Sex:	25 year old male
Height:	168 cm (66 in)
Weight:	91 kg (200 lb)
Seat Track Position:	Middle position
Manual Restraint Use:	None
Usage Source:	NASS vehicle inspection, driver interview, police report
Eyewear:	Contact lenses
Type of Medical Treatment:	Transported to a local hospital and released

Driver Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
Right knee contusion	Minor (890402.1,1)	Left knee bolster

Driver Kinematics

The unrestrained 25 year old male driver of the 1998 Chevrolet S-10 was seated in an upright posture with the seat track adjusted to the middle position. The driver stated during the NASS interview that he was not belted, further evidenced by the police report data. At impact, he initiated a forward trajectory in response to the 1 o'clock impact force and loaded the knee bolster and deployed redesigned driver air bag. Loading of the knee bolster resulted in a contusion to the right knee as evidenced by the deformation documented to this component. No other injury was reported. He was transported by ambulance to a local hospital for treatment and released. 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:	25 year old male
Height:	183 cm (72 in)
Weight:	95 kg (210 lb)
Seat Track Position:	Full rearward position
Manual Restraint Use:	None
Usage Source:	NASS vehicle inspection, driver interview, police report
Eyeware:	None
Type of Medical Treatment:	Transported to a local hospital and released

Front Right Passenger Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
Anterior scalp abrasion	Minor (190202.1,5)	Windshield
Anterior scalp contusion	Minor (190402.1,5)	Windshield
Forehead contusion	Minor (290402.1,7)	Windshield

Front Right Passenger Kinematics

The unrestrained 25 year old male front right passenger of the 1998 Chevrolet S-10 was seated in an upright posture with the seat track adjusted to the full rearward position. The driver stated during the NASS interview that the passenger was not belted, further evidenced by the interior contact pattern. At impact, he initiated a forward trajectory in response to the 1 o'clock impact force and struck the windshield which resulted in contusions/abrasions to the forehead and (anterior) scalp. This trajectory was evidenced by the spider-web type fracture pattern identified at the right upper windshield area relative to the kinematic response pattern. Loading of the right knee bolster was evidenced by the scuff marks documented to this component with no resulting injury reported. He was transported by ambulance to a local hospital for treatment and released.

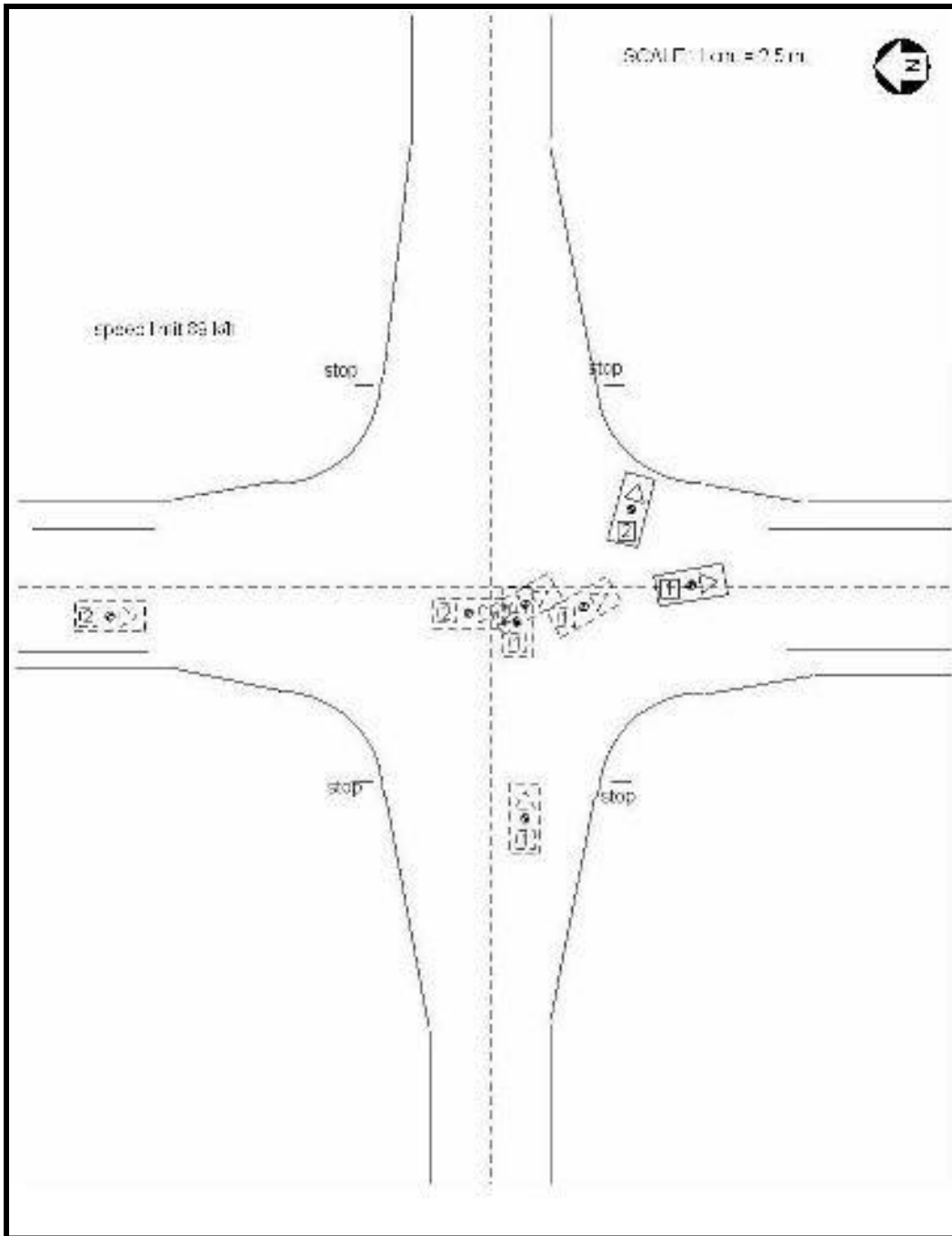


Figure 7. NASS Scene Diagram.