

CRASH DATA RESEARCH CENTER

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

NASS CDS CASE NO. 1999-43-067J

RABSS VEHICLE - 1998 CHEVROLET C-1500 PICKUP TRUCK

LOCATION - STATE OF NORTH CAROLINA

CRASH DATE - APRIL, 1999

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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16. <i>Abstract</i> <p>This investigation focused on a two vehicle crash involving a 1998 Chevrolet C-1500 pickup truck (subject vehicle) and a 1995 Ford Ranger pickup truck. The Chevrolet pickup truck was equipped with redesigned frontal air bags for the driver and front right passenger positions which deployed as a result of an offset frontal collision with the Ford Ranger. The driver of the Ford Ranger was operating the vehicle southbound when he failed to observe the northbound Chevrolet pickup truck as he attempted to turn left (east) at an urban 4-leg intersection. As the Ford Ranger crossed the northbound lanes of the intersection, the front right area was impacted by the front left area of the Chevrolet pickup truck resulting in moderate damage to both vehicles. At impact, the restrained 24 year old female driver of the 1998 Chevrolet C-1500 pickup truck initiated a forward and slightly lateral trajectory in response to the 11 o'clock impact force and loaded the manual restraint, knee bolster and deployed redesigned driver air bag. Loading of the manual restraint resulted in contusions to the pelvis and abdomen. Contact to the knee bolster resulted in bilateral contusions to the shins. At impact, the restrained 28 year old male front right passenger of the Chevrolet initiated a forward and slightly lateral trajectory in response to the 11 o'clock impact force and loaded the manual restraint, glove compartment door and deployed redesigned passenger air bag. Contact to the deployed passenger air bag resulted in a chin abrasion while loading to the glove compartment door resulted in an abrasion/contusion to the left knee. Both occupants of the Chevrolet were transported to the emergency room of a local trauma center for treatment and released.</p>			
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BACKGROUND

This investigation focused on a two vehicle crash involving a 1998 Chevrolet C-1500 pickup truck (subject vehicle) and a 1995 Ford Ranger pickup truck. The Chevrolet pickup truck was equipped with redesigned frontal air bags for the driver and front right passenger positions which deployed as a result of an offset frontal collision with the Ford Ranger. The driver of the Ford Ranger was operating the vehicle southbound when he failed to observe the northbound Chevrolet pickup truck as he attempted to turn left (east) at an urban 4-leg intersection. As the Ford Ranger crossed the northbound lanes of the intersection, the front right area was impacted by the front left area of the Chevrolet pickup truck resulting in moderate damage to both vehicles. At impact, the restrained 24 year old female driver of the 1998 Chevrolet C-1500 pickup truck initiated a forward and slightly lateral trajectory in response to the 11 o'clock impact force and loaded the manual restraint, knee bolster and deployed redesigned driver air bag. Loading of the manual restraint resulted in contusions to the pelvis and abdomen. Contact to the knee bolster resulted in bilateral contusions to the shins. At impact, the restrained 28 year old male front right passenger of the Chevrolet initiated a forward and slightly lateral trajectory in response to the 11 o'clock impact force and loaded the manual restraint, glove compartment door and deployed redesigned passenger air bag. Contact to the deployed passenger air bag resulted in a chin abrasion while loading to the glove compartment door resulted in an abrasion/contusion to the left knee. Both occupants of the Chevrolet were transported 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 CDS case number 1999-43-067J 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 April, 1999. 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 northbound lanes of a multi-lane (asphalt) urban 4-leg intersection (see **Figure 7 - page 7**) with a positive grade for northbound traffic. The north and south sectors of the intersection were divided by a raised curb median and consisted of two left turn lanes, two through lanes and a channelized right turn lane. Traffic control through the intersection was controlled by an overhead signal system in green phase for north/southbound traffic. The posted speed limit at the crash site was 72 km/h (45 mph).

Pre-Crash

The 16 year old male driver of the 1995 Ford Ranger pickup truck was operating the vehicle southbound (**Figure 1**) when he entered the outboard left turn lane to proceed east at the 4-leg

intersection. As the vehicle approached the intersection, the driver reportedly stopped and initiated the left turn at a (driver reported) speed of 24 km/h (15 mph) and across the path of the northbound Chevrolet. The driver reported no avoidance maneuvers in anticipation of the impending crash. The rear bed area was occupied by an unrestrained 17 year old male and 15 year old female.

The 24 year old female driver of the 1998 Chevrolet C-1500 pickup truck was operating the vehicle northbound in the outboard lane (**Figure 2**) when she proceeded straight through the 4-leg intersection at a (driver reported) speed of 64 km/h (40 mph) and observed the Ford pickup truck cross her path of travel. The driver reported no avoidance maneuvers in anticipation of the impending crash.



Figure 1. Southbound approach for the 1995 Ford Ranger pickup truck.



Figure 2. Northbound approach for the 1998 Chevrolet C-1500 pickup truck.

Crash

As the Ford Ranger crossed the northbound lanes of the 4-leg intersection, the front right area was impacted by the front left area of the Chevrolet resulting in moderate damage to both vehicles. Although the impact was classified as out-of-scope (invalidated due to a brush guard attached to the front end structure of the Chevrolet), the WinSMASH reconstruction program computed *SCI revised* velocity changes of 28.9 km/h (18.0 mph) for the subject vehicle and 36.1 km/h (22.4 mph) for the struck Ford. Respective longitudinal components were -27.1 km/h (-16.8 mph) and -27.6 km/h (-17.2 mph). The impact induced deceleration was sufficient to deploy the air bag systems in each vehicle. Both vehicles came to rest in the southeast sector of the intersection with the Chevrolet facing northeast and the Ford facing southeast.

Post-Crash

The driver of the Chevrolet exited the vehicle with some assistance from rescue personnel as the front right passenger exited under his own power. The driver of the Ford also exited the vehicle under his own power as the occupants in the truck bed were removed by rescue personnel in an unconscious state. The Chevrolet occupants (and Ford driver) were transported by ambulance to the emergency room of a local trauma center for treatment and released. The 17 year old male and 15 year old female passengers seated in the truck bed of the Ford were transported by ambulance to a local trauma center and admitted for 5 days and 16 days, respectively. Both vehicles were towed from the crash site due to disabling damage.

RABSS VEHICLE

The 1998 Chevrolet C-1500 was identified by the vehicle identification number (VIN): 1GCEK14R5WZ (production number deleted). The vehicle was a conventional cab pickup truck equipped with four-wheel drive and a 5.7 liter, V-8 engine. The police report listed the passenger as the owner of the vehicle. At the time of the crash, the odometer had recorded 15,561 km (9,669 miles). The seating was configured with a split bench seat (with folding backs). The driver reported no previous crashes or maintenance on the Chevrolet's frontal air bag system. A cell phone was present (unknown if in use) at the time of the collision.

VEHICLE DAMAGE

Exterior

The 1998 Chevrolet C-1500 pickup truck sustained moderate frontal damage as a result of the impact with the Ford Ranger pickup truck (**Figure 3**). The *SCI revised* direct contact damage began at the front left bumper corner and extended 119.0 cm (46.9 in) inboard. The impact deformed the entire front end width resulting in a combined direct and induced damage length (Field L) of 170.0 cm (66.9 in). Six crush measurements were documented at the level of the bumper: C1= 24.0 cm (9.4 in), C2= 31.0 cm (12.2 in), C3= 41.0 cm (16.1 in), C4= 22.0 cm (8.7 in), C5= 17.0 cm (6.7 in), C6= 17.0 cm (6.7 in). The *SCI revised* Collision Deformation Classification (CDC) for this impact to the Chevrolet was 11-FYEW-2 with a principal direction of force of (-)20 degrees. The left fender was displaced rearward which restricted the left front wheel/tire (not deflated). The hood was deformed rearward from the impact force. Reduction in the right side wheelbase measured 7.0 cm (2.8 in). The windshield and tempered glazings remained undamaged. A chrome brush guard was attached to the front end structure which invalidated the WinSMASH program stiffness coefficient for this vehicle size.



Figure 3. Front left damage to the 1998 Chevrolet C-1500 pickup truck.

The 1995 Ford Ranger pickup truck sustained moderate frontal damage as a result of the impact with the Chevrolet pickup truck (**Figure 4**). The *SCI revised* direct contact damage began at the front right bumper corner and extended 88.0 cm (34.6 in) inboard. The impact deformed the entire front end width resulting in a combined direct and induced damage length (Field L) of 110.0 cm (43.3 in). Six crush measurements were documented at the level of the bumper: C1= 0 cm, C2= 16.0 cm (6.3 in), C3= 46.0 cm (18.1 in), C4= 48.0 cm (18.9 in), C5= 47.0 cm (18.5 in), C6= 64.0 cm (25.2 in). The *SCI revised* CDC for this impact to the Ford was 81-FZEW-3 with a principal direction of force of (+)40 degrees (principal direction of force incremented by "80" to reflect end structure shift to the left). Shifting of the end structure laterally displaced the left fender and jammed the left door. The left front tire was deflated (not restricted). Bed to cab contact was noted on the right side. The right fender was displaced rearward which restricted/deflated the right front wheel/tire and jammed the right door. Reduction in the left side



Figure 4. Front right damage to the 1995 Ford Ranger pickup truck.

wheelbase measured 3.0 cm (1.2 in) as elongation of the right side wheelbase measured 2.0 cm (0.8 in). The windshield was fractured from exterior impact forces as the back light glazing was disintegrated by (bed seated) occupant contact.

Interior

Interior damage to the Chevrolet pickup identified through the vehicle inspection was minimal and was attributed to occupant contact. Scuff marks and indentations were documented on the left and right knee bolster with the glove compartment door out-of-place. An indentation was also identified on the right mid-instrument panel. No component intrusions were identified in the vehicle.

REDESIGNED AIR BAG SYSTEM

The 1998 Chevrolet C-1500 pickup truck was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags 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 10.5 cm (4.1 in) in width and 8.0 cm (3.1 in) in height. Although no contact evidence was identified on the exterior surface of the module cover flaps, black vinyl transfers were noted across the face of the bag from expansion within the module. The NASS researcher measured the diameter of the driver air bag at 65.0 cm (25.6 in) in its deflated state (**Figure 5**). The bag was tethered by two 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 horizontally oriented flap tear seam (H-configuration). No contact evidence was identified on the air bag or exterior surface of the module cover flaps. The cover flaps were rectangular and nearly symmetrical in shape as the upper flap measured 18.0 cm (7.1 in) in width and 6.0 cm (2.4 in) in height as the lower flap measured 18.0 cm (7.1 in) in width and 4.0 cm (1.6 in) in height. The NASS researcher measured the passenger air bag at 45.0 cm (17.7 in) in width and 60.0 cm (23.6 in) in height in its deflated state (**Figure 6**). 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 internal tether straps were present. The vehicle was also equipped with a passenger air bag cutoff switch which was set to the "on" position.



Figure 5. 1998 Chevrolet C-1500 pickup truck deployed redesigned driver air bag.



Figure 6. 1998 Chevrolet C-1500 pickup truck deployed redesigned passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex: 24 year old female
Height: 160 cm (63 in)
Weight: 64 kg (142 lb)
Seat Track Position: Mid-to-forward 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 the emergency room of a local trauma center for treatment and released.

Driver Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
*Strain lower lumbar spine	Minor (640678.1,8)	Seat back
*Contusion abdomen	Minor (590402.1,8)	Lap belt webbing
*Contusion bilateral pelvis	Minor (890402.1,3)	Lap belt webbing
+Abrasion right thigh	Minor (890202.1,1)	Steering wheel rim
*Contusion bilateral shins	Minor (890402.1,3)	Knee bolster

sources-ER report/interviewee+*

Driver Kinematics

The 24 year old female driver of the 1998 Chevrolet C-1500 pickup truck 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-forward position. The driver stated she was belted, further evidenced by the lack of significant interior contacts and injury as a result of this moderate severity crash. At impact, she initiated a forward and slightly lateral trajectory in response to the 11 o'clock impact force and loaded the manual restraint, knee bolster and deployed redesigned driver air bag. Loading of the manual restraint resulted in contusions to the abdomen and bilateral pelvis. Contact to the knee bolster resulted in bilateral contusions to the shins as evidenced by the scuff marks and indentations documented to this component. Her right anterior thigh struck the lower (outer) portion of the steering wheel rim resulting in a contusion. This injury mechanism was evidenced by the location of the injury relative to the driver's stated pre-crash seat track position and mid-to-lower steering column tilt angle. She also sustained a lumbar strain which was a result of the occupant rebound into the seat back. Following the crash, she exited the vehicle with some assistance from rescue personnel and was subsequently transported by ambulance to the emergency room of a local trauma center for treatment and released. The redesigned air bag provided additional protection against further contact to the steering wheel hub/rim, and potential serious injury.

FRONT RIGHT PASSENGER DEMOGRAPHICS

Age/Sex: 28 year old male
Height: 173 cm (68 in)
Weight: 79 kg (175 lb)
Seat Track Position: Middle position
Manual Restraint Use: 3-point lap and shoulder belt system
Usage Source: Vehicle inspection, driver interview, police report
Eyeware: None
Type of Medical Treatment: Transported to the emergency room of a local trauma center for treatment and released.

Front Right Passenger Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
*Abrasion chin	Minor (290202.1,8)	Passenger air bag
*Contusion right thumb	Minor (790402.1,1)	Right instrument panel
*Sprain right thumb (“jammed”)	Minor (750402.1,1)	Right instrument panel
*Contusion left knee	Minor (890402.1,2)	Glove compartment door
+Abrasion left knee	Minor (890202.1,2)	Glove compartment door

sources-ER report/EMS report+*

Front Right Passenger Kinematics

The 28 year old male front right passenger of the 1998 Chevrolet C-1500 pickup truck 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 middle position. The driver stated the passenger was belted, further evidenced by the lack of significant interior contacts and injury as a result of this moderate severity crash. At impact, he initiated a forward and slightly lateral trajectory in response to the 11 o’clock impact force and loaded the manual restraint, glove compartment door and deployed redesigned passenger air bag. Loading of the glove compartment door resulted in a contusion and abrasion to the left knee, evidenced by the scuff mark and displacement documented to this component. Contact to the deployed passenger air bag resulted in a chin abrasion. The passenger reportedly jammed his right thumb against the right instrument panel, which resulted in a contusion and sprain. This injury mechanism was evidenced by the small indentation identified to the right mid-instrument panel area (just above the glove compartment door). Following the crash, the front right passenger exited the vehicle under his own power and was subsequently transported by ambulance to the emergency room of a local trauma center for treatment and released. The redesigned passenger air bag provided additional protection against further contact to frontal components, and potential serious injury.

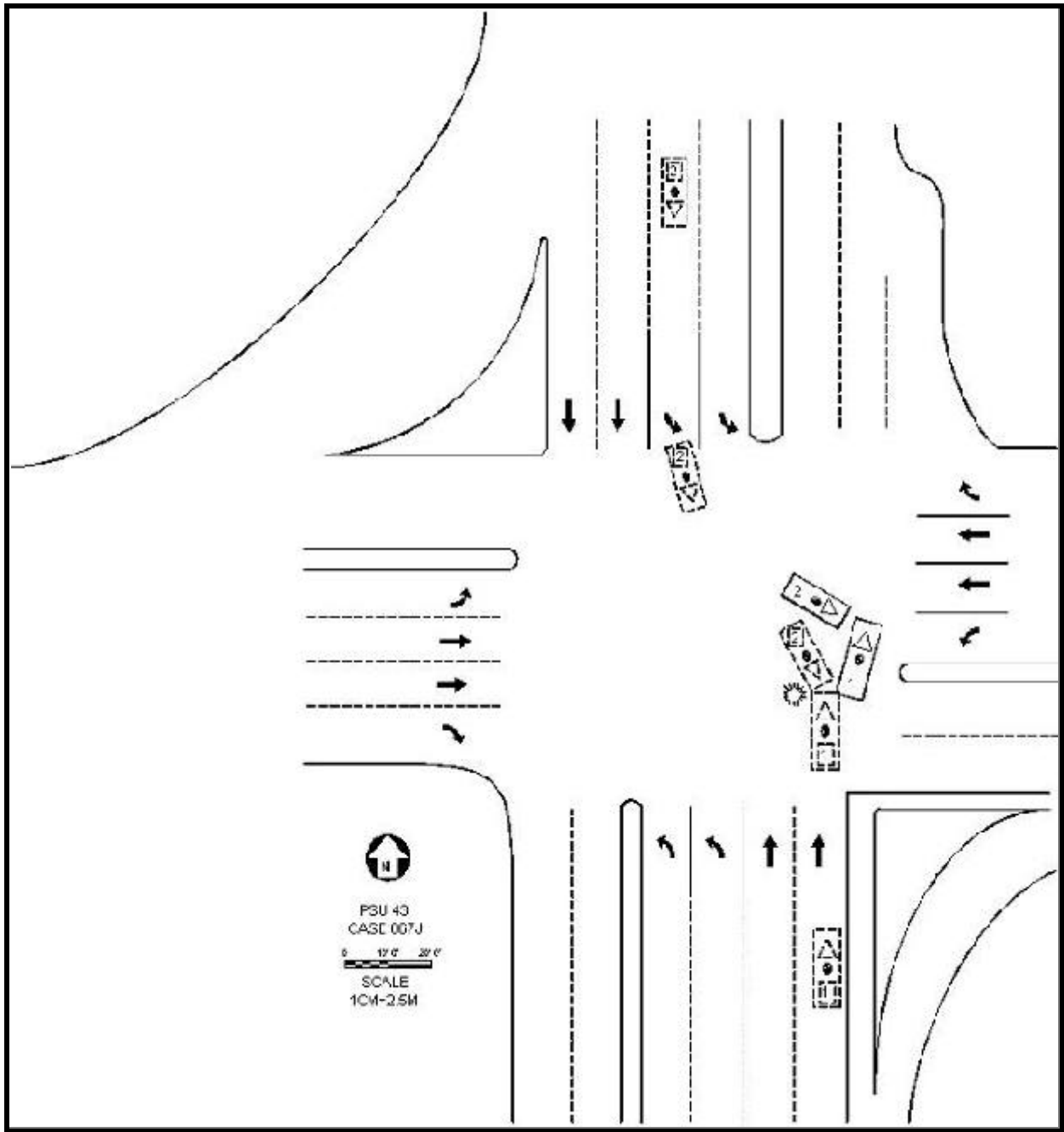


Figure 7. NASS Scene Diagram.