TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION

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

NASS RABSS CASE NO. 1998-12-807G

RABSS VEHICLE - 1998 CHEVROLET S-10 PICKUP TRUCK

LOCATION - STATE OF MICHIGAN

CRASH DATE - OCTOBER, 1998

Contract No. DTNH22-94-D-07058

Prepared for:

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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. *Abstract* This investigation focused on a two vehicle crash involving a 1998 Chevrolet S-10 extended cab pickup truck (subject vehicle) and a 1990 Ford F-250 super cab pickup truck . The Chevrolet pickup was equipped with a redesigned frontal air bag system that included a cutoff switch for the passenger air bag. The switch was in the off position, therefore, only the driver air bag deployed as a result of a rear-end collision with the Ford pickup. The driver of the Chevrolet pickup was operating the vehicle westbound on a four lane divided highway when he failed to notice traffic slowing ahead. Upon recognition of the impending harmful event, he steered left as the front right area struck the rear left area of the Ford pickup. Impact resulted in moderate damage to the Chevrolet pickup truck. The 33 year old male driver of the Chevrolet pickup 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 full rearward position. At impact, he 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 a contusion to the left shoulder. The redesigned air bag provided additional protection to the driver which helped to prevent potential injury. He also sustained a contusion to the right knee from contact to the knee bolster. The driver of the Chevrolet pickup refused medical treatment. The driver of the Ford pickup was reported by police as uninjured.			
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BACKGROUND

This investigation focused on a two vehicle crash involving a 1998 Chevrolet S-10 extended cab pickup truck (subject vehicle) and a 1990 Ford F-250 super cab pickup truck . The Chevrolet pickup was equipped with a redesigned frontal air bag system that included a cutoff switch for the passenger air bag. The switch was in the off position, therefore, only the driver air bag deployed as a result of a rear-end collision with the Ford pickup. The driver of the Chevrolet pickup was operating the vehicle westbound on a four lane divided highway when he failed to notice traffic slowing ahead. Upon recognition of the impending harmful event, he steered left as the front right area struck the rear left area of the Ford pickup. Impact resulted in moderate damage to the Chevrolet pickup truck. The 33 year old male driver of the Chevrolet pickup 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 full rearward position. At impact, he 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 a contusion to the left shoulder. The redesigned air bag provided additional protection to the driver which helped to prevent potential injury. He also sustained a contusion to the right knee from contact to the knee bolster. The driver of the Chevrolet pickup refused medical treatment. The driver of the Ford pickup was reported by police as uninjured.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as case number 98-12-807G 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/Calspan the task of case review and final report preparation.

SUMMARY

Crash Site

This two vehicle crash occurred during the afternoon hours of October, 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 four lane east/west (level) asphalt interstate highway **(see Figure 8 - page 5)** which was divided by W-beam median guardrails. The police report stated that the outboard (westbound) lane was closed due to construction improvements. A bridge was documented just west of the crash site which was bordered by raised abutments. No traffic control was present at the scene which had a posted speed limit of 105 km/h (65 mph).

Pre-Crash

The 45 year old male driver of the 1990 Ford pickup was operating the vehicle westbound in the inboard lane when he decelerated due to traffic congestion ahead. He observed the Chevrolet pickup

approach from behind at a high rate of speed and released the brakes in avoidance. The 33 year old male driver of the 1998 Chevrolet pickup was operating the vehicle westbound (behind the Ford) in the inboard lane **(Figure 1)** at a driver reported speed of 72 km/h (45 mph). The driver stated during the NASS interview that he was looking at eastbound traffic when he failed to notice traffic slowing ahead. Upon recognition of the impending harmful event, he steered left in avoidance (no braking reported).

Figure 1. Westbound approach for the 1998 Chevrolet S-10 pickup truck.

Crash

As the Chevrolet pickup approached the Ford pickup, the front right area struck the rear left area of the Ford pickup. Impact resulted in moderate damage to the Chevrolet pickup. The vehicles crushed to maximum engagement as the Ford pickup overrode the Chevrolet pickup which allowed the structure under the bumper to engage the bumper on the Chevrolet. The impact induced deceleration was sufficient to deploy the Chevrolet's redesigned frontal air bag system. Although the NASS case file classified the collision as a sideswipe type impact (out of scope), the (missing vehicle) damage algorithm of the WinSMASH program computed velocity changes of 23.9 km/h (14.9 mph) for the subject vehicle and 26.1 km/h (16.2 mph) for the struck Ford. Specific longitudinal components were -23.5 km/h (-14.6 mph) and 26.1 km/h (16.2 mph). The Collision Deformation Classification (CDC) for this impact to the Chevrolet S-10 pickup truck was 12-FREE-7. At this point, the Chevrolet was redirected towards the south shoulder where it came to rest facing northwest. The Ford pickup traveled onto the north shoulder where it impacted the guardrail coming to rest facing northwest.

Post-Crash

The driver of the Chevrolet pickup exited the vehicle under his own power. The exit status of the Ford driver was unknown. No ambulance was summoned to the crash site. The Chevrolet pickup was towed from the scene while the Ford pickup was driven from the scene.

RABSS VEHICLE

The 1998 Chevrolet S-10 pickup truck was identified by the Vehicle Identification Number (VIN): 1GCCS1948WK (production sequence deleted). The vehicle was an extended cab pickup equipped with rear wheel drive and a 2.2 liter, 4 cylinder 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 a front split bench (with folding backs) and rear side facing seats. The driver reported no previous crashes or maintenance on the air bag system (original equipment). A cutoff switch for the passenger air bag was located on the center instrument panel. No cell phone was present or in-use at the time of the collision.

VEHICLE DAMAGE

Exterior Damage

The 1998 Chevrolet S-10 pickup sustained moderate frontal damage as a result of the impact with the Ford pickup truck **(Figures 2 & 3)**. The direct contact damage began at the front right bumper corner

and extended 14.0 cm (5.5 in) inboard. The impact deformed the full frontal width resulting in a combined direct and induced damage length (Field L) of 142.0 cm (56.0 in). Six crush measurements were documented at the level of the bumper: C1= 0 cm, C2= 2.0 cm (0.8 in), C3= 5.0 cm (2.0 in), C4= 6.0 cm (2.4 in), C5= 12.0 cm (4.7 in), C6= 29.0 cm (11.4 in). A secondary profile was taken at the radiator support level to capture the underride damage resulting in an *averaged profile* of: C1= 0 cm, C2= 2.0 cm (0.8 in), C3= 5.0 cm (2.0 in), C4= 13.0 cm (5.1 in), C5= 23.0 cm (9.1 in), C6= 41.0 cm (16.1 in). The hood was displaced rearward which impacted the windshield resulting in multiple component intrusions into the passenger compartment. Contact damage was documented rearward along the right side surface which measured 187.0 cm (73.6 in). This damage pattern deflated the right front tire and produced significant buckling at the right door (with tempered glazing disintegration), roof, header and A-pillar area. Post-crash damage was noted to the left door from a forced opening.

Figure 2. Frontal damage to the 1998 Chevrolet S-10 pickup truck.

Figure 3. Rearward extent of the impact damage.

Interior Damage

Interior damage to the Chevrolet pickup identified through the NASS vehicle inspection was moderate and was attributed to component intrusions **(Figure 4)**. Occupant contact points were minimal as a scuff/skin transfer was documented to the left knee bolster (rigid plastic type). Longitudinal intrusions into the front right passenger space included 42.0 cm (16.5 in) of instrument panel, 30.0 cm (11.8 in) of windshield, 29.0 cm (11.4 in) of toepan and 9.0 cm (3.5 in) of header intrusions. Longitudinal intrusions into the center passenger space included 28.0 cm (11.0 in) of instrument panel, 22.0 cm (8.7 in) of windshield and 5.0 cm (2.0 in) of header intrusions. Lastly, a longitudinal instrument panel intrusion of 15.0 cm (5.9 in) was documented to the front left space.

Figure 4. Interior view.

REDESIGNED AIR BAG SYSTEM

The 1998 Chevrolet S-10 pickup was equipped with redesigned frontal air bags for the driver and front right passenger positions. The driver air bag had deployed as a result of the crash while the passenger air bag was deactivated by the cutoff switch located on the center instrument panel **(Figures 5 & 6)**. 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 10.0 cm (3.9 in) in width and 9.0 cm (3.5 in) in height. Although no contact evidence was identified on the exterior surface of the module cover flaps, a smudge and skin oil transfer were documented to the right upper quadrant of the air bag. The NASS researcher measured the diameter of the driver air bag at 64.0 cm (25.2 in) in its deflated state **(Figure 7)**. The bag was tethered by two internal straps and vented by two ports located at the 10 o'clock and 2 o'clock sectors on the rear aspect of the air bag.

Figure 5. Redesigned passenger air bag cutoff switch (off).

Figure 6. Front right passenger space.

Figure 7. 1998 Chevrolet S-10 redesigned driver air bag.

DRIVER DEMOGRAPHICS

Age/Sex:	33 year old male
Height:	180 cm (71 in)
Weight:	100 kg (220 lb)
Seat Track Position:	Full rearward position
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	NASS vehicle inspection, driver interview
Eyeware:	Prescription glasses
Type of Medical Treatment:	None

Driver Injuries

Injury	*Severity (AIS 90)*	*Injury Mechanism*
Contusion left shoulder	Minor (790402.1,2)	Shoulder belt webbing
Laceration anterior right forearm	Minor (790600.1,1)	Flying glass
Contusion right knee	Minor (890402.1,1)	Knee bolster

Driver Kinematics

The 33 year old male driver of the 1998 Chevrolet S-10 pickup was properly restrained by the 3-point lap and shoulder belt system, seated in an upright posture with his right hand placed at the 12 o'clock position on the steering wheel rim. The police report noted that he was belted, further evidenced by the lack of significant injury and contact points within the vehicle. The seat back was slightly reclined with the seat track adjusted to the full rearward position.

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 a contusion to the left shoulder. Driver loading of the redesigned air bag was evidenced by the smudge and skin oil transfer documented to the right upper quadrant of the air bag. He also sustained superficial lacerations to the anterior aspect of the right forearm from flying glass, evidenced by the nature of the injury sustained relative to the pre-crash placement of the right arm on the steering wheel rim which exposed the anterior aspect to flying glass from the right side tempered glazing. The combination of restraint options provided protection against further contact to the steering wheel hub/rim and windshield. The driver was not transported for treatment.

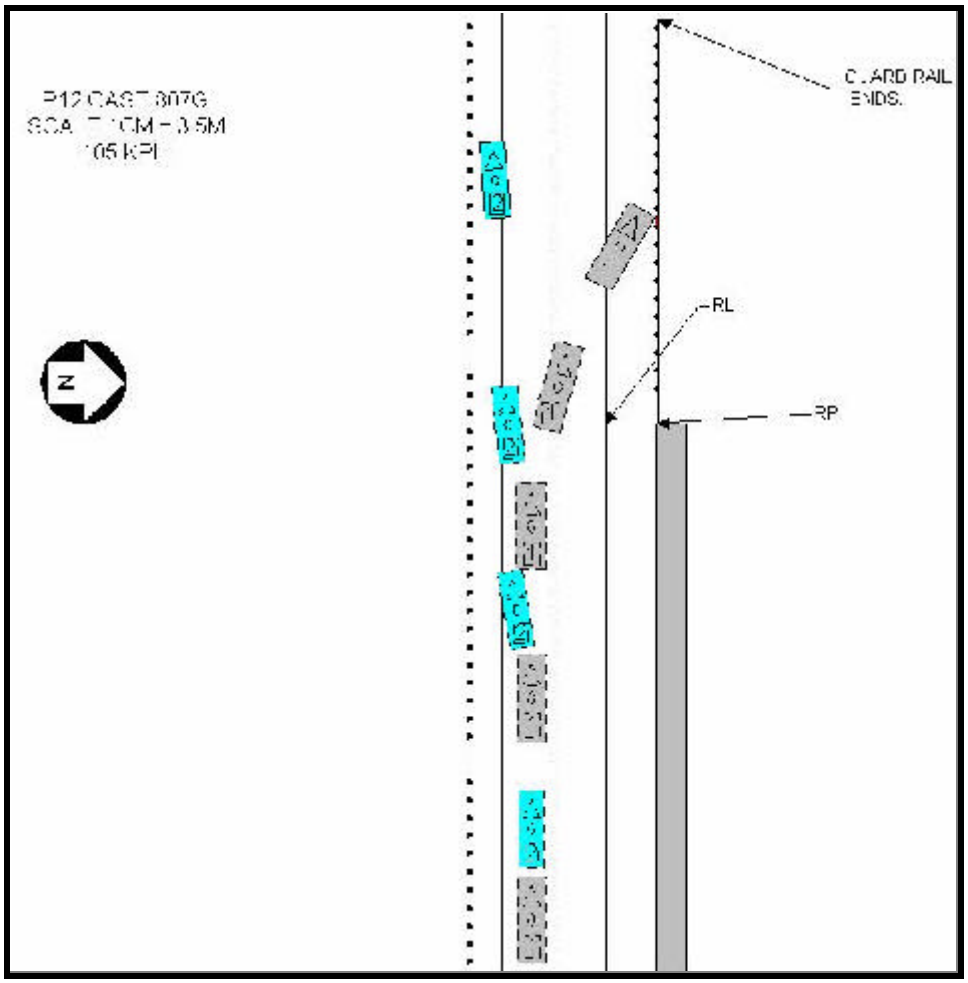

Figure 8. NASS Scene Diagram.