

**TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION**

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

NASS RABSS CASE NO. 1998-08-803F

RABSS VEHICLE - 1998 CHEVROLET LUMINA LS

LOCATION - STATE OF PENNSYLVANIA

CRASH DATE - SEPTEMBER, 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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16. <i>Abstract</i> <p>This investigation focused on a two-vehicle crash involving a 1998 Chevrolet Lumina LS 4-door sedan (subject vehicle) and a 1993 Pontiac Sunbird 4-door sedan. The Chevrolet Lumina was equipped with redesigned frontal air bags that deployed as a result of a right angle collision with the Pontiac Sunbird. The Sunbird was eastbound and attempted to turn left (north) at a 3-leg intersection when it crossed into the path of the southbound Lumina. As the Sunbird turned left and crossed the southbound lane the front right area of the Lumina struck the left front area of the Sunbird. Impact resulted in moderate damage to both vehicles. At this point, the Sunbird rotated clockwise and sideslapped the Lumina resulting in superficial side damage to both vehicles. Both vehicles came to rest in the south sector of the intersection with the Lumina facing southeast and the Sunbird facing southwest. The 52 year old male driver of the Chevrolet Lumina was properly restrained by the 3-point manual lap and shoulder belt system and initiated a forward trajectory in response to the 12 o'clock impact force. He loaded the manual restraint and deployed air bag which resulted in (unspecified) abrasions to both arms. The driver refused transport to a local hospital for treatment. The 15 year old female front right passenger was properly restrained by the 3-point manual lap and shoulder belt system and initiated a forward trajectory in response to the 12 o'clock impact force. She loaded the manual restraint and deployed air bag resulting in an abrasion to the chin and (unspecified) abrasions to both legs. The front right passenger also refused transport to a local hospital for treatment. The rear left and rear right seating positions were occupied by 9 year old and 43 year old females who were also properly restrained by the 3-point manual lap and shoulder belt systems and were uninjured in the collision. The driver of the Pontiac Sunbird was transported to a local hospital for treatment with an (unspecified) complaint of pain to the head.</p>			
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**REDESIGNED AIR BAG SPECIAL STUDY (RABSS)
SCI TECHNICAL SUMMARY REPORT
NASS RABSS CASE NO. 1998-08-803F
RABSS VEHICLE - 1998 CHEVROLET LUMINA LS
CRASH DATE - SEPTEMBER, 1998**

BACKGROUND

This investigation focused on a two-vehicle crash involving a 1998 Chevrolet Lumina LS 4-door sedan (subject vehicle) and a 1993 Pontiac Sunbird 4-door sedan. The Chevrolet Lumina was equipped with redesigned frontal air bags that deployed as a result of a right angle collision with the Pontiac Sunbird. The Sunbird was eastbound and attempted to turn left (north) at a 3-leg intersection when it crossed into the path of the southbound Lumina. As the Sunbird turned left and crossed the southbound lane the front right area of the Lumina struck the left front area of the Sunbird. Impact resulted in moderate damage to both vehicles. At this point, the Sunbird rotated clockwise and sideslapped the Lumina resulting in superficial side damage to both vehicles. Both vehicles came to rest in the south sector of the intersection with the Lumina facing southeast and the Sunbird facing southwest. The 52 year old male driver of the Chevrolet Lumina was properly restrained by the 3-point manual lap and shoulder belt system and initiated a forward trajectory in response to the 12 o'clock impact force. He loaded the manual restraint and deployed air bag which resulted in (unspecified) abrasions to both arms. The driver refused transport to a local hospital for treatment. The 15 year old female front right passenger was properly restrained by the 3-point manual lap and shoulder belt system and initiated a forward trajectory in response to the 12 o'clock impact force. She loaded the manual restraint and deployed air bag resulting in an abrasion to the chin and (unspecified) abrasions to both legs. The front right passenger also refused transport to a local hospital for treatment. The rear left and rear right seating positions were occupied by 9 year old and 43 year old females who were also properly restrained by the 3-point manual lap and shoulder belt systems and were uninjured in the collision. The driver of the Pontiac Sunbird was transported to a local hospital for treatment with an (unspecified) complaint of pain to the head.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as case number 98-08-803F for the Redesigned Air Bag Special Study. The Field Operations Branch 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 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 southbound lane of an north/south two lane asphalt roadway (see **Figure 11 - page 7**). Traffic control at the scene included stop signs for eastbound traffic. The speed limit at the crash scene was 56 km/h (35 mph) for north/southbound traffic and 40 km/h (25 mph) for east/westbound traffic.



Figure 1. Southbound approach for the 1998 Chevrolet Lumina LS.



Figure 2. Eastbound approach for the 1993 Pontiac Sunbird.

Pre-Crash

The 52 year old male driver of the 1998 Chevrolet Lumina was operating the vehicle southbound (**Figure 1**) and proceeding straight when he observed the Pontiac Sunbird turn left (north) across his lane of travel. Upon recognition of the impending harmful event, the driver braked (13.0 meters (42.7 ft) of pre-impact skid marks documented at the crash site) and steered right in avoidance remaining in the southbound travel lane prior to the collision. The 1993 Pontiac Sunbird was driven by a 76 year old male who was operating the vehicle eastbound (**Figure 2**) when he stopped at the stop sign and proceeded to turn left (north).

Crash

As the Pontiac Sunbird entered the southbound lane of the two lane roadway, the front right area of the Lumina struck the left front side of the Sunbird. The impact induced deceleration was sufficient to deploy the Lumina's redesigned frontal air bag system. The (revised) damage algorithm of the WinSMASH program computed velocity changes of 15.5 km/h (9.6 mph) for the subject vehicle and 22.2 km/h (13.8 mph) for the struck Sunbird. The specific longitudinal components were -15.2 km/h (-9.4 mph) (results somewhat low) and -11.1 km/h (-6.9 mph). The Collision Deformation Classification (CDC) for this impact to the Chevrolet Lumina was 12-FZEW-1 and 10-LFEW-2 for the Pontiac Sunbird. During the impact sequence, the Sunbird rotated clockwise and sideslapped the Lumina resulting in superficial side damage to both vehicles. The Collision Deformation Classification (CDC) for this secondary impact to the Lumina was 03-R999-9 (unknowns represented by 9's) and 09-LZEW-1 for the Sunbird. Both vehicles came to rest in the south sector of the intersection with the Lumina facing southeast and the Sunbird facing southwest.

Post-Crash

All occupants exited their respective vehicles under their own power. Treatment was rendered at the scene by emergency medical technicians (EMT's). The front occupants of the Chevrolet Lumina refused transport to a local hospital for treatment as the rear occupants were uninjured. The driver of the Pontiac Sunbird was transported to a local hospital for treatment and released. Both vehicles were towed from the scene.

RABSS VEHICLE

The 1998 Chevrolet Lumina LS was identified by the Vehicle Identification Number (VIN): 2G1WL52M8W1 (production sequence deleted). The vehicle was a 4-door sedan equipped with front wheel drive and a 3.1 liter, V-6 engine. The vehicle’s odometer reading was 24,563 km (15,263 miles) at the time of the crash. The police report listed the driver’s employer as the owner of the vehicle. The seating was configured with a front split bench (with separate backs) and a rear bench. 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 Chevrolet Lumina sustained moderate frontal damage as a result of the impact with the Pontiac Sunbird (Figure 3 & 4). The direct contact damage began at the front right bumper corner and extended 95.0 cm (37.4 in) inboard. The impact deformed the full frontal width resulting in a combined direct and induced damage length (Field L) of 129.0 cm (50.8 in). Six (revised) crush measurements were documented at the level of the reinforcement bar: C1= 0 cm, C2= 10.0 cm (3.9 in), C3= 20.0 cm (7.9 in), C4= 18.0 cm (7.1 in), C5= 8.0 cm (3.1 in), C6= 1.0 cm (0.4 in). Damage was noted to the hood which was displaced rearward from the impact force. The bumper fascia separated from the reinforcement bar. The windshield was fractured from exterior forces and the (interior) front right passenger air bag module cover flap. No wheels were restricted or flat. The location of the sideslap damage to the right side was not obtained by the NASS researcher.



Figure 3. Frontal damage to the 1998 Chevrolet Lumina LS.



Figure 4. Angled view of the frontal damage.

The Pontiac Sunbird sustained moderate left side damage as a result of the impact with the Chevrolet Lumina (Figure 5 & 6). The (initial) direct contact damage began at the left front corner and extended 142.0 cm (55.9 in) rearward. Damage was noted to the left fender and wheel/rim along with induced damage to the left front door panel. Post-crash damage was also noted to the left front door from a



Figure 5. Left side damage to the 1993 Pontiac Sunbird.



Figure 6. Angled view of the left side damage.

forced opening. Superficial sideslap damage (scratching only) was documented to the left side which began 98.0 cm (38.6 in) forward of the left rear axle and extended 43.0 cm (16.9 in) rearward.

Interior Damage

Interior damage to the Chevrolet Lumina identified through the NASS vehicle inspection was minimal and was attributed to occupant contact (**Figure 7 & 8**). A smudge mark was documented to the upper left quadrant of the passenger air bag. Scuff marks were noted to the glove compartment door, front right door panel, front left seat back and front right seat back. The windshield was fractured from the front right passenger air bag module cover flap. No intrusion of interior components were found in the vehicle. No steering wheel rim deformation was noted which was placed at the full up position. No deformation was documented to the left knee bolster (rigid plastic type) or front seat backs (from rear occupant loading).



Figure 7. Interior view of the 1998 Chevrolet Lumina LS.



Figure 8. Interior view of the 1998 Chevrolet Lumina LS.

REDESIGNED AIR BAG SYSTEM

The 1998 Chevrolet Lumina 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). There was no contact evidence on the air bag or exterior surface of the module cover flaps. The flaps were symmetrical in shape with a width of 11.0 cm (4.3 in) and a height of 8.0 cm (3.1 in). The NASS researcher measured the diameter of the driver air bag at 52.0 cm (20.5 in) in its deflated state (**Figure 9**). No internal tether straps were present. The bag was vented by two ports located at the 9 o'clock and 3 o'clock (centered) sectors on the rear aspect of the air bag.



Figure 9. 1998 Chevrolet Lumina redesigned driver air bag.

The front right passenger air bag deployed from a top mount module in the right instrument panel with a single cover flap design hinged at the forward aspect. There was no contact evidence on the air bag or module cover flap which opened in an upward direction toward the windshield (windshield fractured from the module cover flap). The cover flap was asymmetrical in shape and measured 40.0 cm (15.7

in) in width and 26.0 cm (10.2 in) in height along the left edge of the flap and 23.0 cm (9.1 in) along the right edge. The NASS researcher measured the passenger air bag at 64.0 cm (25.2 in) in width and 56.0 cm (22.0 in) in height in its deflated state (**Figure 10**). 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 side aspect of the air bag. No cutoff switch was reported for the front right air bag.

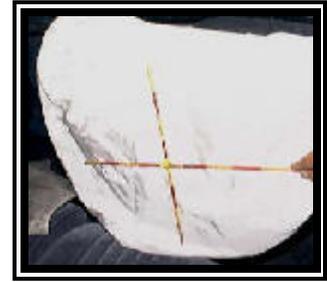


Figure 10. 1998 Chevrolet Lumina redesigned passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex: 52 year old male
 Height: 170 cm (67 in)
 Weight: 77 kg (170 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
 Eyeware: None
 Type of Medical Treatment: None

Driver Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
Abrasion arms (unspecified)	Minor (790202.1,3)	Unknown

Driver Kinematics

The 52 year old male driver of the Chevrolet Lumina was seated in an upright posture with the seat back slightly reclined and the seat track adjusted to the mid-to-forward position. He was properly restrained by the 3-point manual lap and shoulder belt system with the anchorage adjustment placed to the full up position. The police report noted that the driver was belted, further evidenced by the lack of interior contacts and injury. At impact, he initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual belt and deployed redesigned driver air bag. The air bag provided additional restraint from contact to the steering wheel hub/rim. Although the police report listed (unspecified) abrasions sustained to both arms, the driver denied any injury during the NASS interview. He refused treatment at the scene and was not transported to a local hospital.

FRONT RIGHT PASSENGER DEMOGRAPHICS

Age/Sex: 15 year old female
 Height: 152 cm (60 in)
 Weight: 54 kg (120 lb)
 Seat Track Position: Forward most position
 Manual Restraint Usage: 3-point lap and shoulder belt system
 Usage Source: NASS vehicle inspection, driver interview
 Eyeware: Prescription glasses
 Type of Medical Treatment: None

Front Right Passenger Injuries

<i>Injury</i>	<i>Severity</i>	<i>Injury Mechanism</i>
Abrasion chin	Minor (290202.1,8)	Front right air bag
Abrasion legs (unspecified)	Minor (890202.1,3)	Front right air bag

Front Right Passenger Kinematics

The 15 year old female passenger was seated in the front right position of the Chevrolet Lumina. She was properly restrained by the 3-point manual lap and shoulder belt system (anchorage adjustment placed to the full down position), seated in an upright posture with the seat back slightly reclined and the seat track adjusted to the forward position. The police report noted that the passenger was belted, further evidenced by the lack of substantial interior contacts and injury. At impact, she initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual restraint and deployed redesigned passenger air bag. She sustained a minor abrasion to the chin from contact to the deployed air bag as evidenced by the smudge mark to the upper left quadrant of the bag. She also sustained (unspecified) abrasions to the legs which was probably a result of contact by the air bag, evidenced by the occupant's height relative to the rearward extent of the deployed air bag. The air bag provided additional restraint from contact to the upper/mid-instrument panel. The front right passenger refused treatment and was not transported to a local hospital.

REAR OCCUPANT DEMOGRAPHICS

The 9 year old female passenger was seated in the rear left position in an upright posture and properly restrained by the 3-point lap and shoulder belt system. The police report noted that the passenger was belted, further evidenced by the lack of substantial interior contacts and injury. At impact, she initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual restraint. The passenger was not injured in the collision nor transported to a local hospital for evaluation.

The 43 year old female was seated in the rear right position in an upright posture and properly restrained by the 3-point manual lap and shoulder belt system. The police report noted that the passenger was belted, further evidenced by the lack of interior contacts and injury. At impact, she initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual restraint. Her lower extremities probably contacted the front right seat back as evidenced by the scuff marks to the rear aspect of the seat back, but no injuries were reported as a result of this contact. The passenger was not transported to a local hospital for treatment.

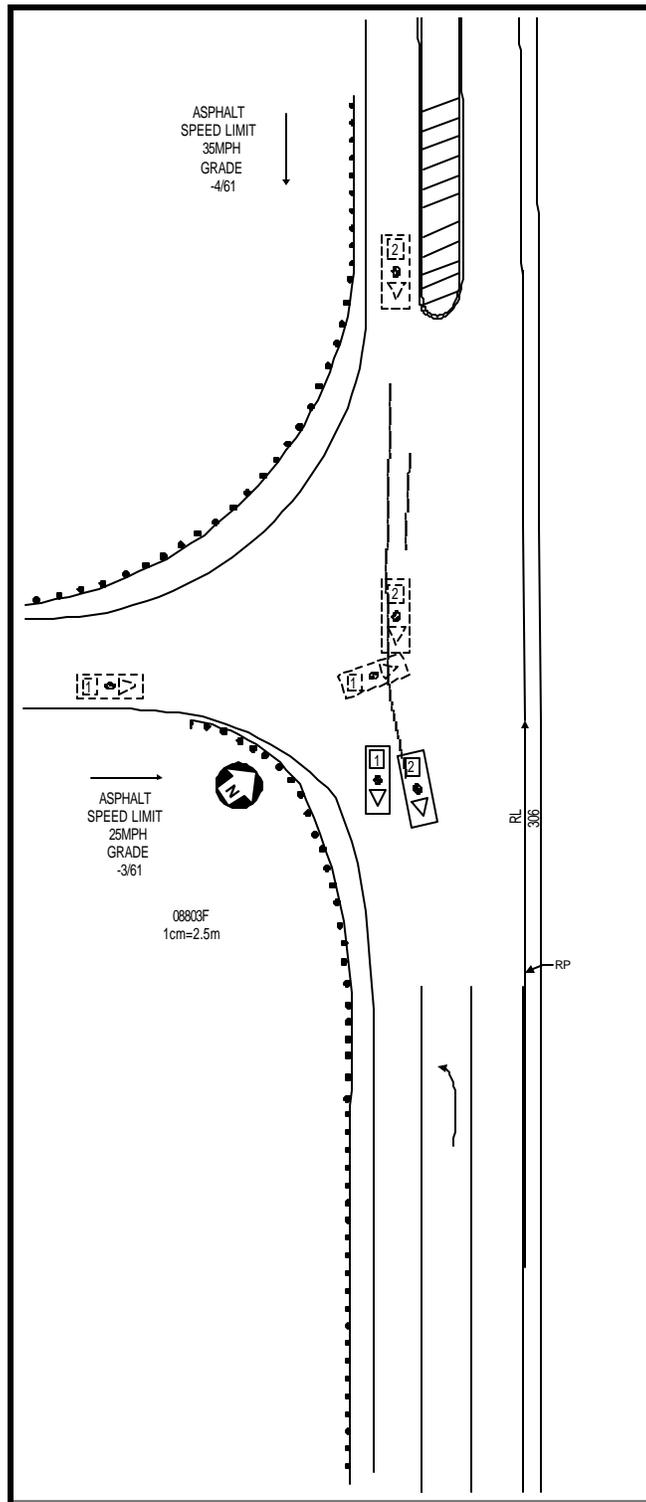


Figure 11. NASS Scene Diagram