

**TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION**

Veridian
Calspan Operations
Buffalo, New York 14225

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

NASS RABSS CASE NO. 1998-12-804E

RABSS VEHICLE - 1998 BUICK LeSABRE CUSTOM

LOCATION - STATE OF MICHIGAN

CRASH DATE - SEPTEMBER, 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. <i>Report No.</i> 98-12-804E	2. <i>Government Accession No.</i>	3. <i>Recipient's Catalog No.</i>	
4. <i>Title and Subtitle</i> Redesigned Air Bag Special Study (RABSS) RABSS Vehicle - 1998 Buick LeSabre Custom Location - State of Michigan		5. <i>Report Date:</i> November, 1999	
		6. <i>Performing Organization Code</i>	
7. <i>Author(s)</i> Crash Research Section		8. <i>Performing Organization Report No.</i>	
9. <i>Performing Organization Name and Address</i> Transportation Sciences Crash Research Section Veridian Engineering (Calspan Operations) P.O. Box 400 Buffalo, New York 14225		10. <i>Work Unit No.</i> C01115.0238.(0000-0009)	
		11. <i>Contract or Grant No.</i> DTNH22-94-D-07058	
12. <i>Sponsoring Agency Name and Address</i> U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		13. <i>Type of Report and Period Covered</i> Technical Summary Report Crash Date: September, 1998	
		14. <i>Sponsoring Agency Code</i>	
15. <i>Supplementary Notes</i> NASS investigation of a frontal collision (into a fixed object) that involved a 1998 Buick LeSabre Custom with redesigned frontal air bags.			
16. <i>Abstract</i> This investigation focused on a single vehicle crash involving a 1998 Buick LeSabre Custom 4-door sedan. The Buick LeSabre was equipped with redesigned frontal air bags that deployed as a result of a frontal collision with a guardrail. The driver was operating the vehicle westbound on a highway on-ramp and negotiating a right curve when she apparently had fallen asleep following an all night study session and allowed the vehicle to depart the left (south) pavement edge. As the vehicle exited the south pavement edge the front left area struck a W-beam guardrail resulting in minor damage. The vehicle subsequently rotated counterclockwise as the right rear area struck the guardrail a second time resulting in minor damage. The Buick came to rest on the south shoulder facing northeast. The 45 year old female driver of the Buick LeSabre was unrestrained (3-point manual lap and shoulder belt system available) and presumed to be seated in an upright posture. At first impact with the guardrail, she initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of her forearms resulting in bilateral contusions. The redesigned driver air bag provided restraint against contact to the steering wheel hub/rim, and helped to prevent serious injury. The driver of the Buick reported a history of diabetic seizures and was transported to a trauma center where she was admitted for one day.			
17. <i>Key Words</i> Redesigned frontal air bag system Collision Deformation Classification (CDC): 12-FDEW-1 Yielding object (out of scope) Bilateral anterior forearm contusion		18. <i>Distribution Statement</i> General Public	
19. <i>Security Classif. (of this report)</i> Unclassified	20. <i>Security Classif. (of this page)</i> Unclassified	21. <i>No. of Pages</i> 5	22. <i>Price</i>

TABLE OF CONTENTS

BACKGROUND 1

SUMMARY

 Crash Site 1

 Pre-Crash 1

 Crash 2

 Post-Crash 2

RABSS VEHICLE 2

VEHICLE DAMAGE

 Exterior Damage 3

 Interior Damage 3

REDESIGNED AIR BAG SYSTEM 3

DRIVER DEMOGRAPHICS 4

 Driver Injuries 4

 Driver Kinematics 4

NASS SCENE DIAGRAM 5

**REDESIGNED AIR BAG SPECIAL STUDY (RABSS)
SCI TECHNICAL SUMMARY REPORT
NASS RABSS CASE NO. 1998-12-804E
RABSS VEHICLE - 1998 BUICK LeSABRE CUSTOM
CRASH DATE - SEPTEMBER, 1998**

BACKGROUND

This investigation focused on a single vehicle crash involving a 1998 Buick LeSabre Custom 4-door sedan. The Buick LeSabre was equipped with redesigned frontal air bags that deployed as a result of a frontal collision with a guardrail. The driver was operating the vehicle westbound on a highway on-ramp and negotiating a right curve when she apparently had fallen asleep following an all night study session and allowed the vehicle to depart the left (south) pavement edge. As the vehicle exited the south pavement edge the front left area struck a W-beam guardrail resulting in minor damage. The vehicle subsequently rotated counterclockwise as the right rear area struck the guardrail a second time resulting in minor damage. The Buick came to rest on the south shoulder facing northeast. The 45 year old female driver of the Buick LeSabre was unrestrained (3-point manual lap and shoulder belt system available) and presumed to be seated in an upright posture. At first impact with the guardrail, she initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of her forearms resulting in bilateral contusions. The redesigned driver air bag provided restraint against contact to the steering wheel hub/rim, and helped to prevent serious injury. The driver of the Buick reported a history of diabetic seizures and was transported to a trauma center where she was admitted for one day.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as case number 98-12-804E 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 single vehicle crash occurred during the morning hours of September, 1998. At the time of the crash, it was dawn with fog conditions as the roads were dry. The crash occurred off the south pavement edge of a (level) asphalt two lane highway on-ramp (**see Figure 7 - page 5**) which curved right for westbound traffic. The roadside environment included paved shoulders and a W-beam guardrail located approximately 3.0 meters (9.8 feet) off the south pavement edge. 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 female driver of the 1998 Buick LeSabre was operating the vehicle westbound on the highway entrance ramp (**Figure 1**) and negotiating a right curve in fog conditions. She apparently had fallen asleep following an all night study session for school and allowed the vehicle to continue in a forward tracking motion. The Buick subsequently departed the left (south) pavement edge. The driver

stated during the NASS interview that she was in fact, attentive to the driving task and lost control of the vehicle because she was in a hurry, however, the surrounding evidence confirms initial statements to the investigating officer that she may have fallen asleep.



Figure 1. Westbound approach for the 1998 Buick LeSabre Custom.



Figure 2. Struck guardrail.

Crash

As the Buick LeSabre exited the south pavement edge of the two lane highway entrance ramp, the front left area struck a W-beam guardrail (**Figure 2**) resulting in minor damage. The impact induced deceleration was sufficient to deploy the Buick's redesigned frontal air bag system. Although the guardrail was classified as a yielding object (out of scope), the damage algorithm of the WinSMASH program computed a (barrier equivalent) velocity change of 15.7 km/h (9.8 mph). The specific longitudinal component was -15.4 km/h (-9.6 mph). The Collision Deformation Classification (CDC) for this impact to the Buick LeSabre was 12-FDEW-1. Contact damage continued down the left side surface as the vehicle initiated a counterclockwise rotation which subsequently engaged the entire front end width. At this point, the right rear area impacted the guardrail a second time resulting in minor damage. The CDC for this impact to the Buick was 03-RBEE-1. The Buick came to rest on the south shoulder facing northeast.

Post-Crash

The driver exited the vehicle under her own power. Treatment was rendered at the scene by emergency medical technicians (EMT). After reporting a history of diabetic seizures, she was transported by ambulance to a trauma center and admitted for one day. The vehicle was towed from the scene.

RABSS VEHICLE

The 1998 Buick LeSabre Custom was identified by the Vehicle Identification Number (VIN): 1G4HP52K2WH (production sequence deleted). *Next Generation Air Bag* identification labels were affixed to each front window glazing. The vehicle was a 4-door sedan equipped with front wheel drive and a 3.8 liter, V-6 engine. The vehicle's odometer reading was 10,889 km (6,766 miles) at the time of the crash. The police report did not specify the owner of the vehicle. The seating was configured with

front (split) and rear benches. 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 1998 Buick LeSabre Custom sustained minor frontal damage as a result of the impact with the guardrail (**Figure 3**). The direct contact damage encompassed the entire front end width resulting in a combined direct and induced damage length (Field L) of 145.0 cm (57.1 in). Six crush measurements were documented at the level of the bumper: C1= 9.0 cm (3.5 in), C2= 7.0 cm (2.8 in), C3= 7.0 cm (2.8 in), C4= 9.0 cm (3.5 in), C5= 7.0 cm (2.8 in), C6= 7.0 cm (2.8 in). Damage was documented along the left side surface of the Buick from sustained contact with the guardrail prior to spinout. Damage was also noted to the right rear area attributed to the second guardrail impact. The windshield was undamaged.



Figure 3. Frontal damage to the 1998 Buick LeSabre Custom.

Interior Damage

Interior damage to the Buick LeSabre identified through the NASS vehicle inspection was minimal and was attributed to occupant contact (**Figure 4**). A scuff mark was documented to the left sunvisor. The center armrest was slightly displaced to the right with the cup holder deformed. The ashtray was out of place. No deformation was identified to the knee bolster (padded type) or steering wheel hub/rim. No intrusions were found in the vehicle.

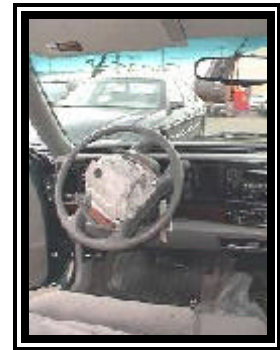


Figure 4. Interior view.

REDESIGNED AIR BAG SYSTEM

The 1998 Buick LeSabre Custom 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. Air bag warning labels were affixed to each sun visor. 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 13.0 cm (5.1 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, oil/dirt transfers were documented along the front lower and rear upper sections of the air bag. The NASS researcher measured the diameter of the driver air bag at 66.0 cm (26.0 in) in its deflated state (**Figure 5**). No internal tether straps were present. The bag was vented by two ports located at the 3 o'clock and 9 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 top aspect. There was no contact evidence 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

55.0 cm (21.7 in) in width and 70.0 cm (27.6 in) in height in its deflated state (**Figure 6**). No internal tether straps were present. The bag was vented by two ports located at the 3 o'clock and 9 o'clock sectors on the side aspect of the air bag. No cutoff switch was reported for the front right redesigned passenger air bag.



Figure 5. 1998 Buick LeSabre redesigned driver air bag.



Figure 6. 1998 Buick LeSabre redesigned passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex: 45 year old female
 Height: 175 cm (69 in)
 Weight: 61 kg (135 lb)
 Seat Track Position: Full rearward position
 Manual Restraint Use: None
 Usage Source: NASS vehicle inspection, driver interview, medical report
 Eyeware: None
 Type of Medical Treatment: Transported to a local hospital and admitted (one day)

Driver Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
Contusion bilateral anterior forearms	Minor (790402.1,3)	Front left air bag

Driver Kinematics

The 45 year old female driver of the 1998 Buick LeSabre had fallen asleep and was presumed to be seated in an upright posture with her hands at or in close proximity to the initial 10 o'clock and 2 o'clock positions on the steering wheel rim. The seat back was slightly reclined and the seat track was adjusted to the full rearward position. The police report noted that she was unrestrained, further evidenced by the NASS interview.

At first impact with the guardrail, the driver initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of her forearms resulting

in bilateral contusions. This mechanism was evidenced by the pre-crash placement of the hands relative to the inflated diameter of the air bag. The redesigned driver air bag provided restraint against contact to the steering wheel hub/rim, and thus, helped to prevent serious injury. As the vehicle struck the guardrail a second time, the driver initiated a lateral trajectory in response to the 3 o'clock impact force and loaded the center armrest, evidenced by the displacement of this component; but no injury was reported. The driver was transported to a trauma center for evaluation and admitted for one day.

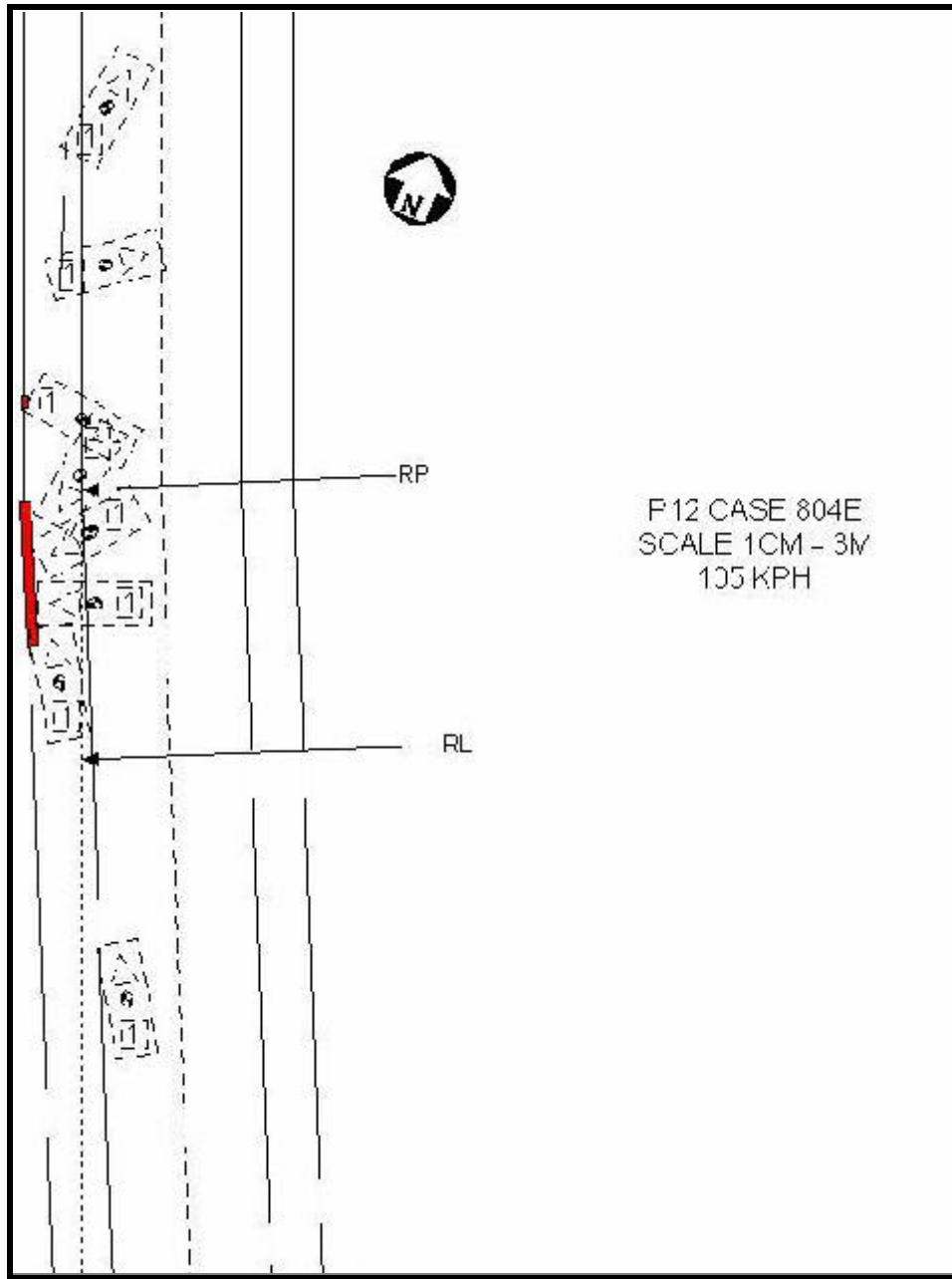


Figure 7. NASS Scene Diagram.