TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION

Calspan Corporation
Buffalo, New York 14225

CALSPAN ON-SITE DEPOWERED AIR BAG DEPLOYMENT INVESTIGATION

CALSPAN CASE NO. CA98-014

VEHICLE - 1998 LINCOLN NAVIGATOR

LOCATION - NEW YORK

CRASH DATE - MARCH, 1998

Contract No. DTNH22-94-07058

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, DC 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 be 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 of the involved vehicle(s) or their safety systems.

TECHNICAL REPORT STANDARD TITLE PAGE

1. *Report No.* CA98-014	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
		4. Weights	
5. *Title and Subtitle* Calspan On-site Depowered Air Bag Deployment Investigation Vehicle - 1998 Lincoln Navigator Location - New York		6. *Report Date*: April, 1998	
		7. *Performing Organization Code*	
8. *Author(s)* Crash Research Section		9. *Performing Organization Report No.*	
10. *Performing Organization Name and Address* Transportation Sciences Crash Research Section Calspan Corporation P.O. Box 400 Buffalo, New York 14225		11. *Work Unit No.* 1115 (8380-8389)	
		12. *Contract or Grant No.* DTNH22-94-D-07058	
13. *Sponsoring Agency Name and Address* U.S. Department of Transportation National Highway Traffic Safety Administration Washington, DC 20590		14. *Type of Report and Period Covered* Technical Report Crash Date: March, 1998	
		15. *Sponsoring Agency Code*	

16. *Supplementary Notes*:
This on-site investigation focused on the two-vehicle crash that involved a 1998 Lincoln Navigator and a 1991 Mazda MPV. The Lincoln was equipped with a Supplemental Restraint System that consisted of depowered driver and front passenger air bags that deployed as a result of the crash.

17. *Abstract*

The southbound 1998 Lincoln Navigator, 4-door full size sport utility vehicle was operated by a 35 year old male with a height of 178 cm (70") and weight of 90 kg (200 lb). The driver began to fall asleep as he approached a stopped southbound Mazda MPV. The driver of the Mazda had stopped for a southbound school bus, that had stopped to pickup students at a local residence. The overhead flashing red stop lights on the bus were activated as the driver of the Lincoln approached the Mazda.

The front of the Lincoln impacted the rear of the Mazda in a 12/06 o'clock impact configuration. A momentum calculation determined the delta V of the Lincoln was approximately 19 km/h (12 mph). As a result of the crash, the Navigator's depowered frontal air bag system deployed.

The driver of the Lincoln was unrestrained in the crash. His only codeable injury was a superficial abrasion (AIS 1) to the anterior aspect of his left forearm. The driver of the Mazda MPV did not report any injuries.

18. *Key Words* On-site investigation Supplemental Restraint System Depowered air bag deployment		19. *Distribution Statement* General Public	
20. *Security Classif. (of this report)* Unclassified	21. *Security Classif. (of this page)* Unclassified	22. *No. of Pages* 5	23. *Price*

TABLE OF CONTENTS

CALSPAN ON-SITE DEPOWERED AIR BAG DEPLOYMENT INVESTIGATION
VEHICLE: 1998 LINCOLN NAVIGATOR
CALSPAN CASE NO. CA98-014
LOCATION: NEW YORK
CRASH DATE: MARCH, 1998

BACKGROUND

This on-site investigation focused on the two-vehicle crash that involved a 1998 Lincoln Navigator and a 1991 Mazda MPV. The Lincoln was equipped with a Supplemental Restraint System that consisted of depowered driver and front passenger air bags that deployed as a result of the crash. The driver of the Lincoln was unrestrained in the crash. His only codeable injury was a superficial abrasion (AIS 1) to the anterior aspect of his left forearm. Calspan's Special Crash Investigation Team received notification of this depowered air bag deployment crash from the local County Sheriff's Department on March 18, 1998. The notification was forward to NHTSA and the crash was assigned as an on-site investigation due to its locality on the afternoon of the 18th.

SUMMARY

The crash occurred in the daylight hours of March 1998 on a straight and level segment of a two lane north/south roadway. The asphalt road surface was dry at the time of the crash. The weather was not a factor. At the crash scene, there was a residence with a U-shaped private driveway on the west side of the road. The speed limit in the area of the crash scene was 64 km/h (40 mph). Figure 1 is a southbound view of the scene.

Figure 1: Southbound approach view of the crash scene.

The subject vehicle was a 1998 Lincoln Navigator, 4-door full size sport utility vehicle operated by a 35 year old male with a height of 178 cm (70") and weight of 90 kg (200 lb). He was southbound en route to his residence following the completion of his nighttime hour work shift as a communications dispatcher for the Sheriff's Department. The driver began to fall asleep as he approached a stopped southbound Mazda MPV. The driver of the Mazda stopped for a southbound school bus, that had stopped to pickup students at a local residence. The bus reportedly stopped at the southernmost entrance of the U-shaped driveway (referenced above). The overhead flashing red stop lights on the bus were activated as the driver of the Lincoln approached the Mazda.

The front of the Lincoln impacted the rear of the Mazda in a 12/06 o'clock impact configuration. The Lincoln sustained 79.0 cm (31.0 in) of direct contact damage to the left and center portions of the front bumper (Figures 2 and 3). The direct damage began 3.8 cm (1.5 in) left of center and continued left to

the left front bumper corner. The measured crush profile of the bumper reinforcement bar was as follows: C1=21.8 cm (8.6 in), C2=19.0 cm (7.5 in), C3=15.2 cm (6.0 in), C4=8.9 cm (3.5 in), C5=0, C6=0. Maximum crush occurred at C1. There was no measurable reduction in the left side wheelbase measurement. The left front fender deformed slightly rearward binding the front door at the hinge pillar. The Collision Deformation Classification (CDC) of the Lincoln was 12-FYEW-1. Speed reconstruction indicated the Lincoln was traveling approximately 30 mph at the time of the crash. The delta V of the Lincoln was calculated to be approximately 13 km/h (8 mph) by the damage only routine of the SMASH program. The delta V determined by SMASH appears be underestimated based on SCI experience and forensic analysis of the damage pattern. A momentum calculation determined the delta V of the Lincoln was approximately 19 km/h (12 mph). The 19 km/h (12 mph) delta V is more consistent with the vehicular damage. As a result of the crash, the Navigator's depowered frontal air bag system deployed. Repair estimates for the Lincoln exceeded $8,000.

Figure 2: Close-up view of the Lincoln's damage frontal plane.

Figure 3: Left lateral view across the Lincoln's front plane.

Inspection of the 1991 Mazda MPV revealed the vehicle had sustained 92.0 cm (36.3 in) of direct contact damage to the rear bumper (Figure 4). The damage began 12.7 cm (5.0 in) left of center and continued rightward to the right rear bumper corner. The measured crush profile of the bumper reinforcement bar was as follows: C1=0, C2=0, C3=10.8 cm (4.3 in), C4=16.5 cm (6.5 in), C5=16.5 cm (6.5 in), C6=16.5 cm (6.5 in). There was no measurable change in the right side wheelbase measurement. The right rear unitized structure deformed forward and was in contact with the right rear tire (Figure 5). The backlight disintegrated from the impact force. The CDC of the Mazda was 06-BZAW-2

Figure 4: Rear view of the Mazda MPV

Figure 5: Right rear view of the Mazda.

The driver of the Lincoln was seated in an upright driving posture with the 6-way power seat. He indicated his seat was adjusted to a mid-track position. He was not wearing the manual 3-point lap and shoulder belt system. At impact, the frontal air bag system deployed. The expanding air bag probably contacted the anterior aspect of his left wrist and produced a superficial abrasion to the anterior wrist. He initiated a forward trajectory and loaded the deployed depowered front left air bag with his thoracic and facial areas. His loading force against the fully deployed air bag did not result in injury. There was no compression of the energy absorbing steering column or deformation of the two-spoke steering wheel rim. The anterior aspect of his lower extremities contacted the knee bolster which scuffed the bolster on both sides of the steering column. The driver did not sustain injury from the bolster contact. He probably rebounded into the left front seat back where he came to rest in an upright attitude.

The driver of the Lincoln declined medical treatment. There were no injuries reported to the 72 year old male driver of the struck Mazda. Both vehicles sustained disabling damage and were towed from the scene.

AIR BAG VEHICLE

The 1998 Lincoln Navigator was identified by the vehicle identification number (VIN) of: 5LMFU28L6WL (production sequence deleted). The Lincoln was a 4-wheel drive, 4-door multi-purpose vehicle. The vehicle was manufactured in June, 1997. The odometer read 18,243 km (11,336 miles). The vehicle's power train consisted of a 5.4 liter V-8 engine linked to a 4-speed automatic transmission. Additional safety equipment included a 4-wheel anti-lock braking system.

The vehicle's interior was tan in color and was a high grade vinyl/leather. The front seats were 6-way power adjustable. The left front seat was located in mid to rear track, positioned 3.2 cm (1.25 in) forward of the full rear position. It was possible the seat was moved from its at-crash position. The anti-submarine angle of the seat cushion was measured as 13 degrees. The seat back was reclined 25 degrees. The head restraint was adjusted in the full down position. There were no seat performance failures.

INTERIOR DAMAGE

Two specific areas of contact were identified on the left front interior as a result of the driver contact. The knee bolster exhibited two minor scuffs from knee contact. These scuffs measured approximately 2 cm x 2 cm (1 in x 1 in) and were located 43 cm (17 in) below the top of the instrument panel. The center of the left and right scuffs were located 61 cm (24 in) left of centerline and 25 cm (10 in) left of centerline respectively.

The lower right corner of the windshield exhibited two small vinyl transfers as a result of contact from the lower right corner of the passenger air bag module cover flap. The contact occurred as the cover flap rotated open during the deployment sequence. The transfers were located 63.5 cm (25.0 in) right of the vehicle's centerline and 12.2 cm (4.8 in) and 22.9 cm (9.0 in) above the instrument panel respectively.

MANUAL RESTRAINT SYSTEM

The Lincoln was equipped with 3-point lap and shoulder belt systems in the 6 outboard seated positions. The front seat belt systems consisted of a continuous loop lap and shoulder belt webbing with a sliding latch plate. An inertia activated locking retractor was located in the base of each B-pillar. The restraint's upper anchorages (D-rings) were adjustable. The left front D-ring was adjusted 2.5 cm (1.0 in) above the full down position. In his interview, the driver indicated he was not restrained. Examination of the restraint did not reveal any marks associated with restraint usage in this crash.

SUPPLEMENTAL RESTRAINT SYSTEM

The Lincoln was equipped with a Supplemental Restraint System (SRS) that consisted of "Second Generation" depowered air bags for the driver and right front passenger (Figure 6). The driver air bag module was located in the typical manner in the center hub of the tilt steering wheel (Figure 7). The steering wheel was positioned in the center of its adjustment range. There was no steering wheel rim deformation or movement of the steering column's shear capsules. The H-configuration air bag module opened as designed at the designated tear points during the deployment sequence. The width of the horizontal seam measured 19.3 cm (7.6 in). The height of the upper and lower flaps measured 19.8 cm (7.8 in) and 8.9 cm (3.5 in) respectively. A 5 cm x 5 cm (2 in x 2 in) scuff mark was located on the lower left corner of the upper cover flap. This scuff was attributed to contact with the steering wheel rim.

Figure 6: Second Generation Air bag sticker on the left window glazing.

The driver air bag was tethered by two 13 cm (5 in) wide straps. In its deflated state, the air bag measured 62.2 cm (24.5 in) in diameter. The face was the bag was stamped with the following identification number: 113712R. There was a light tan transfer mark 3.8 cm (1.5 in) in length located in the 6 o'clock sector , 11.4 cm (4.5 in) below the center of the bag. This contact was a possible fabric transfer from the driver's clothing. The air bag was vented by two 3.3 cm (1.3 in) diameter ports on the back side of the bag. The ports were located in the 11 and 1 o'clock sectors. The back side of the bag exhibited black scuff marks in the 10, 2 and 6 o'clock sectors attributed to interaction with the interior surfaces of the module cover flaps in the deployment sequence.

Figure 7: Front interior view.

Figure 8: Driver air bag.

SUPPLEMENTAL RESTRAINT SYSTEM (CONT'D)

The passenger air bag was configured as a mid-mount design located in the right instrument panel. The width and height of the rectangular cover flap measured 38.9 cm (15.3 in) and 16.5 cm (6.5 in) respectively. A small vinyl abrasion was noted on the lower right corner of the flap that related to the right side windshield contact noted earlier in this report. The passenger air bag was untethered. The fabric was porous and the bag vented through the fabric. The air bag extended approximately 24 in from the instrument panel in its deflated state. The face of the deflated bag measured 61.7 cm (24.3 in) by 66.0 (26.0 in) width by height. There was no contact evidence on the air bag.

DRIVER INJURY

Injury	Injury Severity (AIS 90)	Injury Mechanism
Superficial abrasion left anterior wrist	Minor (790202.1,2)	Deploying depowered driver air bag

DRIVER KINEMATICS

Immediately prior to impact, the driver was seated unrestrained in an upright position with his seat adjusted in a mid-track position. He indicated his hands were in the 10/2 o'clock positions on the steering wheel. He had begun to fall asleep just prior to the crash and was unaware of the stopped vehicles ahead. There were no pre-impact avoidance maneuvers. At impact, the depowered SRS of the Lincoln deployed and the driver initiated a forward trajectory. The deploying air bag expanded against the anterior aspect of his anterior wrists and displaced the driver's hands from the steering wheel. This contact produced a superficial abrasion to the anterior aspect of his left wrist. The driver's thoracic and facial areas contacted the deployed air bag. The anterior aspect of his lower extremities contact and the scuffed the knee bolster on both sides of the steering column. His loading force against the deployed airt bag and knee bolster did not result in any injury. The driver then rebounded back into the seat. The driver declined medical attention at the scene and did not require any follow-up consultation.