TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION

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CALSPAN REMOTE DRIVER AIR BAG FATALITY INVESTIGATION
CALSPAN CASE NO. CA98-32
VEHICLE: 1997 LINCOLN CONTINENTAL
LOCATION: PENNSYLVANIA
CRASH DATE: JULY, 1997

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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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BACKGROUND

This remote investigation focused on the death of an 88 year old male driver of a 1997 Lincoln Continental which was involved in an off-set, frontal crash with a 1985 Buick LeSabre. The Lincoln was equipped with frontal air bags which deployed as a result of the crash. The driver of the Lincoln sustained a fracture of the sternum, bilateral rib fractures with hemothorax, a laceration of the right heart ventricle, and multiple abrasions/contusions of the upper extremities, anterior neck, and upper chest. The driver of the Lincoln was unconscious immediately following the crash. He was subsequently administered CPR and revived. After being transported to a local hospital, the driver experienced full cardiac arrest approximately 33 minutes after the crash and was pronounced dead 58 minutes after the crash.

Calspan was initially notified of the crash during an unrelated discussion with a litigation consultant on May 10, 1998. This consultant forwarded a copy of his file to the Calspan Special Crash Investigation (SCI) team. The file was received on May 14, 1998. Following a review of the police crash report, autopsy report, and photographs of the Lincoln, the SCI COTR was contacted by telephone and briefed with respect to the contents of the case file. A remote level investigation task was assigned by the COTR on May 14th.

SUMMARY

This crash involved a 1997 Lincoln Continental and a 1985 Buick LeSabre in an off-set frontal impact at an intersection. The crash occurred as the driver of the Lincoln attempted to initiate a left turn in front of the Buick. The impact involved the left frontal area of the Lincoln **(Figure 1)** and the left frontal area of the Buick.

Figure 1. Frontal view of the 1997 Lincoln Continental.

Crash Site

The crash sequence occurred in an urban area at the intersection of two, two lane, city streets during daylight hours in July, 1997. At the time of the crash, weather conditions were clear and environmental surfaces were dry. The Lincoln approached the 90 degree intersection traveling in a southerly direction on a two lane collector roadway. The Buick approached this same intersection traveling in a northerly direction on the collector roadway. There were no traffic controls for north/southbound traffic and the speed limit on both approaches was 89 km/h (55 mph). East/westbound traffic flow on the intersecting local street was controlled by stop signs. Both edges of the intersecting roadways were bounded by curbs.

Pre-Crash

The Lincoln Continental was traversing a straight, upgrade segment as it approached the intersection traveling in a southerly direction. The Lincoln driver was decelerating in preparation for initiating a left turn onto the intersection two lane roadway. The Lincoln was traveling at an estimated speed of 16-24 km/h (10-15 mph) as it entered the intersection. Following the crash, the Lincoln driver reported to the treating EMTs that he did not see the Buick approaching from the south until after he had initiated his left turn. At that point, he continued to brake as the Lincoln proceeded to impact.

The Buick was traveling in a northerly direction, traversing a straight, downgrade segment at a driver estimated travel speed of 40 km/h (25 mph) as it approached the intersection. The Buick driver stated that she intended to proceed straight through the intersection. She further reported that the driver of the Lincoln suddenly initiated a left turn into her travel path as she entered the intersection. The left turning maneuver was initiated without activation of the Lincoln's left turn signal. The Buick driver attempted to steer to the right, but there was insufficient time to achieve crash avoidance.

Crash

The left frontal area of the Lincoln struck the left frontal area of the Buick in an oblique off-set frontal impact configuration. The resultant direction of force was within the 12 o'clock sector for both vehicles. Damage to the Lincoln consisted of abrasions to the left front bumper fascia, a fractured left headlamp and turn signal assembly, deformation of the left side of the grille, and a small dent to the hood face. There was no residual crush at the bumper level of the vehicle. Based on this minor level of damage, it was estimated that the Lincoln experienced a velocity change of approximately 11-14 km/h (7-9 mph) during the impact sequence.

Following this impact, the Lincoln deflected to its left and then rolled rearward to its final rest position within the intersection. The Buick continued past the point of impact and came to rest near the northeast corner of the intersection. The final rest of positions of the vehicles were not documented by the investigating police agency. After the vehicles came to rest, a passenger in the Buick noted that the Lincoln driver was unconscious. He subsequently removed the Lincoln driver and laid him on the pavement next to the Lincoln.

Post-Crash

Police units and an ambulance unit responded to the crash site. The first police unit arrived approximately three minutes after the crash occurred. The ambulance unit arrived several minutes later. Emergency medical technicians (EMTs) from this unit initiated CPR treatment and revived the Lincoln driver. Transport procedures were initiated relatively quickly and the Lincoln driver was transported to a local hospital, arriving approximately 33 minutes following the crash. The Lincoln driver subsequently experienced full cardiac arrest and was pronounced dead 58 minutes after the crash.

VEHICLE DATA

The subject vehicle in this crash was a 1997 Lincoln Continental, 4 door sedan. The vehicle manufacture date was 12/96 and the vehicle identification number (VIN) was 1LNLM97VOVY (production number deleted). The odometer reading at the time of the crash was 3,872.1 km (2,406.1 miles). The vehicle was equipped with power windows, power door locks, power seats, power-assisted steering, and power-assisted ABS disc brakes. The vehicle was also equipped with manual 3-point lap and torso restraints for the driver and right front seated positions and front mounted air bags for these same seated positions **(Figure 2)**. Following a post-crash vehicle inspection, the investigating officer noted that all four tires were in excellent condition and that the lighting and turn signal systems of the Lincoln were operational.

Figure 2. Overall view of the driver's compartment and the deployed air bags.

VEHICLE DAMAGE

The Lincoln was towed from the scene and stored in an outdoor facility. It was inspected two days following the crash by the investigating officer and by a litigation consultant approximately seven months after the crash (photographs in this report were provided by the litigation consultant).

Exterior

Exterior damage to the Lincoln consisted of abrasions to the left front bumper facia, a fractured left headlamp and turn signal assembly, deformation of the left side of the grille, and a small dent located on the leading edge of the hood. The direction of force associated with this damage was within the 12 o'clock sector and a CDC of 12-FLEW-1 was assigned. The width of direct and induced damage across the frontal plane was 68.6 cm (27.0") as measured from the left corner to the right **(Figure 3)**. There was no residual crush to the bumper. Based on the minor severity level of the exterior damage, it was estimated that the Lincoln experienced a velocity change during the crash which was in the range of 11 to 14 km/h (7-9 mph). In addition, the crash pulse was probably elongated resulting in air bag deployment late in the crash event.

Figure 3. Close-upview of the damage.

Interior

The integrity of the Lincoln's passenger compartment was maintained in that there was no interior intrusion or damage resulting from exterior deformation. All window glazing was also intact. The overall level of interior damage was minor and was associated with deployment of the driver and right front passenger air bag modules.

When the Lincoln was inspected by the investigating officer two days after the crash, he noted in his report that the driver's seat was found to be in the full forward position on the seat track. In this position, the

officer measured the horizontal distance between the left front seat back support and the mid point of the driver air bag module cover at 55.9 cm (22.0") **(Figure 4)**. An inspection of an exemplar vehicle by a Calspan SCI investigator determined that this seat track position was adjusted 4.4 cm (1.75") forward of the full rear position. Driver contact was noted with the module upper cover flap. This contact consisted of a vertically oriented abrasion on the lower third of the upper flap. Driver contact was also noted to the driver's air bag. A small cloth transfer was noted in the left upper quadrant of the frontal bag surface **(Figure 5)**.

Figure 4. Profile view of the horizontal distance between the seat back support and the driver air bag module as documented by the officer.

Figure 5. Close-up view of the driver air bag.

Figure 6. Rear view mirror.

The windshield of the Lincoln was fractured as a result of being struck by the right front passenger air bag module cover flap (mid-mount design). The expanding right front air bag subsequently contacted the rearview mirror, forcing the right side of the mirror upward **(Figure 6)**. No other interior damage was noted or reported as a result of the this crash sequence.

Manual Restraint System

The Lincoln was equipped with a manual 3-point lap and shoulder belt for the driver's position. This system utilized a continuous loop belt webbing. The upper anchorage (D-ring) for the system was located on the B-pillar and was adjustable. The latchplate for the left front belt displayed scratching associated with routine usage. It should be noted, however, that the Lincoln driver was removed from his vehicle by a passenger in the Buick LeSabre. The latter individual reported to the investigating officer that the Lincoln driver was not using his restraint system at the time of the crash.

Automatic Restraint System

The Lincoln involved in this crash was equipped with a Supplemental Restraint System (SRS) that consisted of frontal air bags for the driver and right front passenger seated positions. The passenger air bag was a mid-mount design with a module flap that opened upward. Both modules deployed during the crash sequence.

The driver air bag module was mounted within a 2-spoke steering wheel rim. The steering wheel spokes were located at the 4 and 8 o'clock positions. This installation utilized asymmetrical module cover flaps with the upper flap being much larger than the lower flap. A vertically oriented abrasion pattern was visible on the lower third of the upper module cover flap **(Figure 7)**. This pattern indicated that he module flap struck the driver's chest as it swung upward during the deployment sequence.

The driver air bag **(Figure 8)** deployed as designed with no tears or perforations noted to the woven nylon-type fabric. The bag was constructed of two panels that were sewn with an internal peripheral seam. This was a tethered bag design. There were four internal tether straps that were sewn to the front of the bag. The bag was vented by two 1.3 cm (0.5") diameter ports that were located on the rear surface of the bag in the 11 and 1 o'clock sectors. The serial number of the component was 269635R. The number was stamped on the front surface of the bag.

Figure 7. Vertically oriented abrasion pattern on the lower third of the upper module cover flap.

Figure 8. Driver air bag.

The driver was contacted by the expanding air bag as it deployed. A small cloth transfer was noted in the left upper quadrant of the front surface of the air bag **(Figure 5)**. The driver sustained critical severity level injuries as a result of contact with the driver air bag module upper cover flap and the expanding air bag.

Driver Demographics/Data

Age/Sex:	88 year old male
Height:	170.2 cm (67.0")
Weight:	79-82 kg (175-180 lbs), estimated by Medical Examiner
Restraint Usage:	None
Usage Source:	Passenger in Buick LeSabre
Eyeware:	Unknown
Vehicle Familiarity:	Unknown
Route Familiarity:	Travels route frequently
Medical Treatment	Transported to a local hospital for treatment

Driver Injuries

Injury	Injury Severity (AIS 90)	Injury Mechanism
Bilateral rib fractures (2-7 right and 2-6 left) with hemothorax	Critical (450242.5,3)	Air bag module cover flap
Laceration (2.5 cm) of the right ventricle	Critical (441012.5,4)	Air bag module cover flap
Contusion, posterior myocardium	Serious (441002.3,4)	Air bag module cover flap
Fracture of sternum at 4th intercostal space	Moderate (450804.2,4)	Air bag module cover flap
Laceration of pericardium	Moderate (441602.2,4)	Air bag module cover flap
Extensive abrasion, upper chest extending into left chest	Minor (490202.1,3)	Air bag module cover flap
Abrasion, chin	Minor (290202.1,8)	Expanding air bag
Abrasion, anterior neck	Minor (390202.1,5)	Expanding air bag
Contusion, upper abdomen	Minor (590402.1,7)	Expanding air bag
Abrasion, both forearms and hands	Minor (790202.1,3)	Expanding air bag
Laceration, dorsal upper left hand	Minor (790600.1,2)	Left A-pillar

Driver Kinematics

The driver of the Lincoln was the owner of a small commercial business. At the time of this crash he was en route to a job site where his company was performing work. Several of his employees reported to the investigating officer that he routinely drove his vehicle with the seat positioned very close to the steering wheel. On this basis, it was assumed that the driver was in a similar position and was located relatively close to the steering wheel immediately prior to this crash. Based on the police reported measurement of 55.9 cm (22.0") between the mid point of the module cover and the seat back, the seat would have been adjusted 4.4 cm (1.75") forward of the full rearward position. This was not consistent with statements of co-workers who noted that the driver routinely drove the Lincoln positioned close to the steering assembly. His height and weight would have prohibited him from driving with the seat adjusted to t full forward track position, therefore the seat was probably adjusted to a mid track position and moved prior to the police officer's documentation of the track position.

Following the left frontal off-set impact with the Buick LeSabre, the driver of the Lincoln began moving forward with respect to the vehicle's interior. At this point, the driver's air bag module deployed. The upper module flap struck the driver in the chest inflicting an extensive abrasion of the chest, bilateral rib fractures with a hemothorax, a fracture of the sternum, a laceration of the pericardium, a laceration of the right ventricle, and a contusion of the posterior myocardium. The driver was also contacted by the expanding air bag which inflicted an abrasion of the chin, an abrasion of the anterior neck, a contusion of the upper abdomen, abrasions of both forearms, and abrasions of both hands. Air bag contact with the driver's left arm and hand, forced his left hand to separate from the steering wheel rim and swing up and to the left. It is believed that the Lincoln driver sustained a minor laceration of the dorsal aspect of the left hand as a result of striking the left upper A-pillar with his left hand during this motion.

Subsequent to these contacts, the Lincoln driver rebounded into the left front seat and then slumped forward. He was apparently unconscious at this point. A passenger in the Buick noted that the Lincoln driver was unconscious when he checked on his condition shortly after the vehicle came to rest. He also noted that the Lincoln driver was unrestrained. The latter individual subsequently removed the Lincoln driver from his vehicle and laid him on the roadway next to the left side of the Lincoln.

Medical Treatment

An ambulance unit arrived on scene within ten minutes of crash occurrence. Emergency medical technicians from this unit provided CPR and revived the Lincoln driver. Recognizing the severity of his injuries, they provided first aid treatment and initiated transport procedures in an expeditious manner. The Lincoln driver arrived at a local hospital within 33 minutes of crash occurrence. Shortly after arriving, the driver notified hospital personnel that he was experiencing difficulty with breathing. He then experienced full cardiac arrest and was pronounced dead 58 minutes after crash occurrence.