

**TRANSPORTATION SCIENCES
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**VERIDIAN REMOTE AIR BAG RELATED
DRIVER FATALITY INVESTIGATION
VERIDIAN CASE NO. CA98-051
VEHICLE: 1992 LINCOLN CONTINENTAL
LOCATION: VIRGINIA
CRASH DATE: FEBRUARY 1996**

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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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<p>16. <i>Abstract</i> This remote investigation focused on the death of a 86 year old male driver of a 1992 Lincoln Continental that was involved in an off-road, center frontal impact with a utility pole. The Lincoln was equipped with frontal air bags for the driver and right passenger positions that deployed as a result of the crash. The driver of the Lincoln sustained a laceration of the upper lip, a contusion of the right upper chest, an abrasion of the left lateral neck, bilateral rib fractures 3-6 with a bilateral hemothorax, a rupture of the superior vena cava, and lacerations of the liver. The first EMT responding to this call arrived on-scene within minutes of the time of the crash. He noted that the Lincoln driver was discolored and appeared to be dead at the time of his arrival. The driver was transported to a local hospital where he was pronounced dead approximately 50 minutes after the crash.</p>			
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BACKGROUND

This remote investigation focused on the death of a 86 year old male driver of a 1992 Lincoln Continental that was involved in an off-road, center frontal impact with a utility pole (**Figure 1**). The Lincoln was equipped with frontal air bags for the driver and right passenger positions that deployed as a result of the crash. The driver of the Lincoln sustained a laceration of the upper lip, a contusion of the right upper chest, an abrasion of the left lateral neck, bilateral rib fractures 3-6 with a bilateral hemothorax, a rupture of the superior vena cava, and lacerations of the liver. The first EMT responding to this call arrived on-scene within minutes of the time of the crash. He noted that the Lincoln driver was discolored and appeared to be dead at the time of his arrival. The driver was transported to a local hospital where he was pronounced dead approximately 50 minutes after the crash.



Figure 1. Final rest position of Lincoln Continental.

Veridian was initially notified of this February 1996 crash during an unrelated on-site investigation of another case (CA98-049). The NHTSA's Field Operation's Branch was subsequently contacted and this crash was assigned as a remote level investigation on September 22,1998.

SUMMARY

Crash Site

The crash occurred in an urban area near the intersection of a four-lane minor arterial roadway and a collector roadway. At the time of the crash, weather conditions were clear, however, portions of the arterial roadway were snow covered from a previous snow fall. In the immediate vicinity of the crash site, the arterial roadway consisted of five lanes. There were two northbound and two southbound travel lanes separated by a two way channelization lane. The north and southbound travel lanes were delineated by broken white lane lines and both edges of the roadway were bounded by snow covered shoulders. The arterial roadway was straight and level. The inboard southbound lane was generally wet and the outer portion of the outboard southbound lane was snow covered.

Crash Sequence

Pre-Crash

The Lincoln approached the crash site traveling on the inboard southbound lane at a police estimated travel speed of 56 km/h (35 mph). As the Lincoln driver approached the intersection of the arterial roadway with a collector roadway, he initiated a lateral lane change maneuver from the inboard lane to

the outboard travel lane. After entering the outboard lane, the driver did not initiate corrective steering input to remain in the outboard travel lane. The Lincoln continued in a south southwesterly direction and exited the right (west) edge of the roadway. Free rolling tire prints (**Figure 2**) in the snow on the west shoulder of the roadway indicated that the Lincoln driver did not initiate steering or braking inputs between the point of roadway departure and the point of impact. (NOTE: The autopsy report indicated that the driver had coronary arteriosclerosis and arterial nephrosclerosis. After completing the autopsy, the Medical Examiner informed the investigating officer that the driver could have experienced a pre-crash heart related episode which caused him to relinquish steering control.)

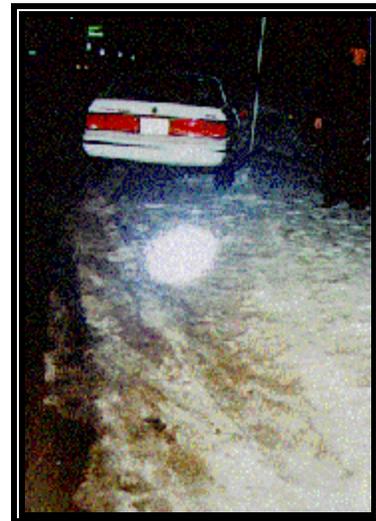


Figure 2. Off-road trajectory of Lincoln.

Crash

After departing the roadway, the Lincoln traveled approximately 18.6 m (61') to impact. The right side of the Lincoln initially struck a bus stop sign. This impact bent the sign post in a southwesterly direction (**Figure 3**). The center frontal area of the Lincoln then struck a wooden utility pole that was located a short distance outboard of the west shoulder (**Figure 4**). The resultant direction of force for this impact was 12 o'clock and the velocity change experienced by the Lincoln was visually estimated to be in the 22-29 km/h (14-18 mph) range. As a result of the center frontal impact sequence, the frontal air bag system deployed. The Lincoln came to rest engaged against the utility pole facing in a south southwesterly direction.



Figure 3. Sign post struck by Lincoln.



Figure 4. Frontal damage sustained by Lincoln.

Post-Crash

A police unit and a rescue unit responded to the scene. The police unit arrived approximately 10 minutes after the crash. At that point, the Lincoln driver had been removed from his vehicle by an EMT responding directly to the scene. The EMT relayed to the investigating officer that the Lincoln driver was not using the available restraint system prior to the crash, that the driver's flesh tone appeared to be discolored, and that the driver appeared to be dead upon the EMT's arrival at the scene. The driver was subsequently transported by ambulance to a local hospital where he was pronounced dead on-arrival

approximately 50 minutes after the crash. The Lincoln was towed from the scene as a result of crash related damage.

Vehicle Data

The subject vehicle in this crash was a 1992 Lincoln Continental, 4-door sedan. The vehicle was equipped with power windows, power door locks, power seats, power-assisted steering, and a power-assisted four wheel disc ABS braking system. The vehicle was also equipped with 3-point lap and shoulder restraints for the driver and front right seated positions. Both frontal air bags deployed during the crash sequence. The investigating officer observed and noted that the driver's seat track was adjusted to a forward position. This was supported by on-scene police photographs. The vehicle identification number and odometer reading were not reported by the police.

Vehicle Damage

Exterior

Exterior damage to the Lincoln was moderate in severity and was associated primarily with the center frontal impact with the utility pole (**Figure 5**). Damaged components included the front bumper, grille, both headlight assemblies, the radiator and radiator support panel, the hood, and the forward portion of both front fenders. The direction of force for this impact was 12 o'clock with a Collision Deformation Classification (CDC) of 12-FCEN-2. A maximum frontal crush value was estimated to be 30-36 cm (12-14") in the vicinity of the vehicle's centerline. The change in velocity resulting from this damage was estimated to be in the 23-29 km/h (14-18 mph) range. Green paint transfers were noted to the right side of the front bumper and the right front fender. These paint transfers were associated with the initial impact with the bus stop sign post. The estimated CDC for this initial impact event was 12-RYES-1.



Figure 5. Frontal damage sustained by Lincoln.

Interior

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

When the Lincoln was inspected by the investigating officer after the crash, the driver's seat was found to be in a forward seat track position. In this position, the Lincoln driver would have been located in a close proximity to the steering wheel and driver air bag module. On-scene photographs (**Figure 6**), verified that the driver was contacted by the upper flap of the driver's air module, as that module deployed. The contact produced a vertically oriented abrasion of the lower right portion of the flap. (NOTE: The full width of the flap was



Figure 6. Deployed driver's air bag module.

not visible in available photographs. It is possible that the noted contact could have extended further to the left across the flap.) In addition, damage was noted to the lower peripheral seam of the driver's bag (seam appeared to be torn), indicating that the bag was heavily loaded as it expanded. Again, available photographs were not sufficiently clear to determine if the steering wheel rim was back-loaded and deformed, as a result of the air bag attempting to inflate against a closely positioned driver.

The windshield of the Lincoln was stress cracked as a result of being struck by the front right passenger module cover flap (mid-mount design) during the deployment sequence. No other interior damage was noted or reported as a result of this crash sequence.

Manual Restraint Systems

The Lincoln was equipped with a manual 3-point lap and shoulder belts for the four outboard seated positions. At the driver's position, this belt system utilized a continuous loop belt webbing with the upper anchorage (D-ring) located on the left B-pillar. The first EMT to arrive on scene noted smoke coming from beneath the hood of the Lincoln as he checked on the condition of the driver. As a precaution, he removed the driver from the vehicle prior to initiating first aid treatment. The EMT reported to the investigating officer that the driver was not using the available restraint system prior to the crash.

Frontal Air Bag 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 front right passenger positions. Both modules deployed during the crash sequence.

The driver air bag module was mounted in a 2-spoke steering wheel rim. 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 right portion of the upper flap. This pattern indicated that the module flap struck the driver's chest as it swung upward during the deployment sequence.

The driver was also contacted by the expanding air bag. Damage was noted to the lower peripheral seam of the air bag. Specifically, the seam appeared to have torn and partially separated. It is believed that this damage is an indicator that the close proximity of the driver to the steering wheel interfered with normal bag inflation. The quality and range of on-scene photographs was insufficient to determine if back-loading of the steering wheel rim during the inflation sequence resulted in deformation of the rim. Virtually all of the driver's reported injuries were associated with being contacted by either the air bag module flap or the expanding air bag.

The passenger air bag was a mid-mount design with a module flap that opened upward. Due to the limited on-scene police photographs, the particular data points pertaining to the front right passenger air bag could not be identified.

Driver Demographics/Data

Age/Sex: 86 year old male
Height: 165.1 cm (65.0")
Weight: 64.4 kg (142.0 lbs)
Restraint Usage: None
Usage Source: EMT who provided on-scene first aid treatment
Seat Track
Position: Forward
Eyeware: Unknown
Vehicle Familiarity: Unknown
Route Familiarity: Unknown
Medical Treatment: Transported to a local hospital where he was pronounced dead on arrival

Driver Injuries

Injury	Injury Severity (AIS 90)	Injury Mechanism
Laceration, upper lip	Minor (290602.1,8)	Expanding driver air bag
Contusion, right upper chest	Minor (490402.1,1)	Driver air bag module cover flap and/or expanding driver air bag
Abrasion, left lateral neck	Minor (390202.1,2)	Expanding driver air bag
Bilateral rib fractures 3-6 with bilateral hemothorax	Critical (450242.5,3)	Driver air bag module cover flap and/or expanding driver air bag
Rupture of superior vena cava	Serious (421802.3,1)	Driver air bag module cover flap and/or expanding driver air bag
Lacerations of liver	Moderate (541820.2,1)	Expanding driver air bag

** Source of Injuries - Autopsy Report*

Driver Kinematics

The exact pre-crash seated posture and position of the Lincoln driver could not be established with the available data. As a minimum, he was seated in a forward position and was in-close proximity to the steering wheel. The lack of pre-crash steering/braking inputs by the driver, however, tended to indicate that the driver may have been incapacitated and slumped in a forward position. This hypothesis was supported by the Medical Examiner who indicated that the driver may have experienced a heart related episode during the pre-crash phase. There were no witnesses to the crash event.

As the front of the Lincoln impacted the utility pole, the frontal air bag system deployed. The forward positioned driver was struck in the chest by the deploying driver air bag module cover flap and bag membrane. This contact sequence resulted a contusion of the right upper chest, bilateral rib fractures 3-6 with bilateral hemothorax, a rupture of the superior vena cava, and laceration of the liver. As the air bag continued to expand, the driver sustained abrasions of the left lateral neck and a laceration of the upper lip.

It appeared that the air bag's inflation pattern may have been impeded due to the driver's relatively close proximity to the steering wheel. Specifically, the bottom portion of the peripheral seam was partially ruptured during the inflation sequence. Available photographs were insufficient to determine if the steering wheel rim was deformed by back-loading from the air bag during the deployment.

Following the deployment sequence, the Lincoln driver rebounded into the front seat back support and then slumped forward. He was found in this position by the first EMT who responded to the scene. The EMT also indicated that the driver's flesh tone was discolored upon his arrival and that the driver appeared to be dead at this time.

Medical Treatment

The first arriving EMT provided first aid treatment for the Lincoln driver. Subsequent resuscitation attempts initiated by rescue unit personnel were unsuccessful. The driver remained in a non-responsive state. He was subsequently transported by ambulance to a local hospital where he was pronounced dead on arrival approximately 50 minutes after the crash.