

Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (1998-073-106A)

1998 Lincoln Continental

Indiana

August/1998

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16. Abstract <p>This remote investigation focused on the redesigned air bag system deployment of a 1998 Lincoln Continental 4-door sedan. This fatal injury crash occurred in August, 1998 in the evening. The weather was clear and the bituminous roadway was dry. The crash occurred on a two lane, undivided roadway. The road is straight and level and there are no traffic controls at the area of impacts. The speed limit for this road is 89 kmph (55 mph). Vehicle 1, a 1998 Lincoln Continental 4-door sedan (case vehicle) driven by an 80 year old male, was in the process of pulling out of a private parking lot, preparing to make a left turn onto the westbound lane of the roadway at a passenger estimated speed of 8-16 kmph (5-10 mph). The driver was unrestrained. The front right seat was occupied by a 70 year old female, who was restrained by the available manual lap/shoulder restraint. The back right seat was occupied by an 8 year old female (unknown ht/wt), who was restrained by the available manual lap/shoulder restraint. Vehicle 2, a 1997 Ford F-series pickup truck driven by a 30 year old male (193 cm/76 in, 109 kg/240 lb), was traveling eastbound in the eastbound travel lane at a driver estimated speed of 72 kmph (45 mph). There were no other occupants in Vehicle 2. Vehicle 1 pulled out into the path of Vehicle 2 and was struck. The front plane of Vehicle 2 (12FDEW3) struck the front plane of Vehicle 1 (70FYEW99) in the eastbound lane. The two vehicles then sideslapped with the right plane of Vehicle 2 (03R99999) striking the left plane of Vehicle 1 (09LBEW2) in the westbound lane. Vehicle 1 then departed the north road edge and came to rest in the grass roadside facing northeast. Vehicle 2 rotated 180 degrees clockwise and was pushed eastward from the force of the impact and came to rest in the eastbound lane facing south. A Delta V was calculated for event 1 for Vehicle 1, using the Missing Vehicle Algorithm of WinSMASH, as 40 kmph (25 mph). A Delta V was also calculated for event 2 for Vehicle 1, using the Missing Vehicle Algorithm of WinSMASH, as 7 kmph (4.3 mph). As a result of the first impact, the supplemental restraint system (driver and passenger side redesigned air bags) of the case vehicle deployed. The driver of Vehicle 1 was fully ejected through the left front door which came open during the crash due to latch/striker failure. All three occupants of the case vehicle sustained serious injuries and were transported to a trauma center where the driver died the following day. The front right passenger of Vehicle 1 was hospitalized, while the back right passenger was treated and released. The driver of Vehicle 2 sustained minor injuries in the crash and was transported to a trauma center where he was treated and released. Both vehicles became disabled from damage sustained in the crash and were towed from the scene.</p>			
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***Summary***

This remote investigation focused on the redesigned air bag system deployment of a 1998 Lincoln Continental 4-door sedan. This fatal injury crash occurred in August, 1998 in the evening. The weather was clear and the bituminous roadway was dry. The crash occurred on a two lane, undivided roadway. The road is straight and level and there are no traffic controls at the area of impacts. The speed limit for this road is 89 kmph (55 mph).

Vehicle 1, a 1998 Lincoln Continental 4-door sedan (case vehicle) driven by an 80 year old male (173 cm/68 in, 136 kg/298 lb), was in the process of pulling out of a private parking lot, preparing to make a left turn onto the westbound lane of the roadway at a passenger estimated speed of 8-16 kmph (5-10 mph). The driver was unrestrained. The front right seat was occupied by a 70 year old female (155 cm/61in, 54 kg/120 lb), who was restrained by the available manual lap/shoulder restraint. The back right seat was occupied by an 8 year old female (unknown ht/wt), who was restrained by the available manual lap/shoulder restraint.

Vehicle 2, a 1997 Ford F-series pickup truck driven by a 30 year old male (193 cm/76 in, 109 kg/240 lb), was traveling eastbound in the eastbound travel lane at a driver estimated speed of 72 kmph (45 mph). There were no other occupants in Vehicle 2.

***Crash Events***

Vehicle 1 pulled out into the path of Vehicle 2 and was struck. The front plane of Vehicle 2 (12FDEW3) struck the front plane of Vehicle 1 (70FYEW99) in the eastbound lane. The two vehicles then sideslapped with the right plane of Vehicle 2 (03R99999) striking the left plane of Vehicle 1 (09LBEW2) in the westbound lane.



**Figure 1.** Exterior, Vehicle 1 (Lincoln Continental)



**Figure 2.** Exterior, Vehicle 2 (Ford F-series)

Vehicle 1 then departed the north road edge and came to rest in the grass roadside facing northeast. Vehicle 2 rotated 180 degrees clockwise and was pushed eastward from the force of the impact and came to rest in the eastbound lane facing south.

A Delta V was calculated for event 1 for Vehicle 1, using the Missing Vehicle Algorithm of WinSMASH, as 40 kmph (25 mph). A Delta V was also calculated for event 2 for Vehicle 1, using the Missing Vehicle Algorithm of WinSMASH, as 7 kmph (4.3 mph).

As a result of the first impact, the supplemental restraint system (driver and passenger side redesigned air bags) of the case vehicle deployed.



Figure 3. Crash scene, Vehicle 2 approach path.

The driver of Vehicle 1 was fully ejected through the left front door which came open during the crash due to latch/striker failure. All three occupants of the case vehicle sustained serious injuries and were transported to a trauma center where the driver died the following day. The front right passenger of Vehicle 1 was hospitalized, while the back right passenger was treated and released. The driver of Vehicle 2 sustained minor injuries in the crash and was transported to a trauma center where he was treated and released.

Both vehicles became disabled from damage sustained in the crash and were towed from the scene.

Table 1. Delta V

	Case Vehicle		Other Vehicle	
	km/h	mph	km/h	mph
Total	40	24.9	20	12.4
Longitudinal	-14	-8.7	-20	-12.4
Lateral	37	23	0	0
Barrier speed	34	21.1	34	21.1

**Exterior of Case Vehicle**

**Table 2. Vehicle Information**

Model year, make and model	1998 Lincoln Continental
VIN	1LNFM97VXWY
CDC	70FYEW99
PDOF	290 degrees



**Figure 4.** Exterior, Vehicle 1 (1998 Lincoln Continental)



**Figure 5.** Exterior, Vehicle 2 (1997 Ford F series)

**Table 3. Crush Measurements**

Plane of Impact	Field L cm/in.	C1 cm/in.	C2 cm/in.	C3 cm/in.	C4 cm/in.	C5 cm/in.	C6 cm/in.
No crush profile	Unk	Unk	Unk	Unk	Unk	Unk	Unk

**Interior of Case Vehicle**

The interior of the Lincoln Continental sustained minor damage from occupant contact. There were no areas of intrusion into the passenger compartment. There was occupant contact evidence to the left instrument panel, windshield, and glove compartment door.

The case vehicle was equipped with bucket seats in the front left and front right seating positions. The front left seat was adjusted to the middle track position. The front right seat was adjusted between the middle and rear most track positions. Both front seats were equipped with adjustable head restraints which were not damaged. The rear of the vehicle was equipped with bench seats in all three seating positions which were not adjustable. The outboard seats were equipped with integral head restraints which were not damaged, while the center seating position was not equipped with a head restraint system.

### *Case Vehicle Occupant Protection Systems*

The Lincoln Continental 4-door sedan was equipped with a redesigned air bag system which consisted of front left and front right air bag modules which housed air bags and depowered inflator units.

The front left air bag was housed in the steering wheel hub and was concealed by a single D-shaped cover flap which was not damaged. The circular air bag was equipped with 2 tethers and no vent ports. The bag showed scuffing from contact with the cover flap, but no evidence of occupant contact. The bag was not damaged in the crash.

The front right air bag was housed in the top-instrument panel position. The single air bag module cover flap was in the shape of an inverted “D” and was not damaged. The rectangular air bag was equipped with 1 tether and 2 vent ports. The bag showed several areas of burns which fused the bag together at the top and created several holes. The bag showed no evidence of occupant contact.



**Figure 6.** Interior, case vehicle. Driver's side air bag.



**Figure 7.** Interior, case vehicle. Passenger's side air bag.



**Figure 8.** Interior, case vehicle. Passenger's side air bag (burn hole).

***Case Vehicle Occupant Demographics***

**Table 4. Case Vehicle Occupant(s) Demographics**

	Occupant 1	Occupant 2	Occupant 3
Age/Sex:	80/Male	72/Female	8/Female
Seated Position:	Front left	Front right	Back right
Seat Type:	Bucket - leather covered	Bucket - leather covered	Bench - leather covered
Height (cm/in.):	173 68	155 61	Unknown
Weight (kg/lbs):	136 298	54 120	Unknown
Pre-existing Medical Condition:	None noted	None noted	None noted
Body Posture:	Normal - upright in seat facing forward	Normal - upright in seat facing forward	Normal - upright in seat facing forward
Hand Position:	Both on steering wheel	Both on lap	Unknown
Foot Position:	On floor or foot controls	On floor	Unknown
Restraint Usage:	None used	Manual lap & shoulder restraint	Manual lap & shoulder restraint
Air bag:	Deployed redesigned air bag system	Deployed redesigned air bag system	None available

## Occupant Injuries

**Table 5. Injuries**

Occupant #	Injury	Injury Severity (AIS)	Injury Mechanism
1	Unconscious on admission	5	Left A-pillar
1	Vault fracture comminuted	3	Left A-pillar
1	Base (basilar) fracture complex	4	Roof
1	Extensive cerebrum contusion	5	Left A-pillar
1	Large subdural hemorrhage	5	Left A-pillar
1	Large subdural hemorrhage	5	Left A-pillar
1	Cerebrum subarachnoid hemorrhage	3	Left A-pillar
1	Cerebrum subarachnoid hemorrhage	3	Left A-pillar
1	Cerebrum intraventricular hemorrhage	4	Left A-pillar
1	Cerebrum intraventricular hemorrhage	4	Left A-pillar
1	Bilateral lung contusion	4	Left side interior surface
1	Rib cage fracture >3 ribs	4	Left side interior surface
1	Moderate liver laceration	3	Left side hardware or armrest
1	Minor scalp laceration	1	Left A-pillar
1	Scalp contusion	1	Left A-pillar
1	Forehead skin abrasion	1	Windshield
1	Eyelid contusion	1	Roof
1	Eyelid contusion	1	Roof
1	Right arm skin contusion	1	Driver's side air bag
1	Chest skin contusion	1	Driver's side air bag
1	Left arm skin abrasion	1	Flying glass
1	Right knee skin abrasion	1	Knee bolster
2	Rib cage fracture >3 ribs	3	Passenger's side air bag
2	Chest skin contusion	1	Passenger's side air bag
2	Left hip skin contusion	1	Lap belt
2	Left knee skin contusion	1	Glove compartment door
2	Left chest skin abrasion	1	Passenger's side air bag
2	Abdominal skin contusion	1	Lap belt
3	Right shoulder skin abrasion	1	Shoulder belt
3	Right shoulder skin contusion	1	Shoulder belt
3	Abdominal skin abrasion	1	Lap belt

3	Abdominal skin contusion	1	Lap belt
3	Chest 2 <sup>nd</sup> degree burn <10% TBS	1	Shoulder belt
3	Right chest skin contusion	1	Shoulder belt

### *Occupant Kinematics*

The driver (case occupant 01) of the Lincoln Continental was seated in a normal upright posture in the front left position of the vehicle. He was unrestrained. The front right passenger (case occupant 02) was seated in a normal upright posture and was wearing the manual lap/shoulder restraint. The back right passenger (case occupant 03) was also seated in a normal upright posture and was wearing the manual lap/shoulder restraint. Seat belt usage was determined through visual inspection by the researcher, observations by the investigating police officer at the scene of the crash, as well as examination of the injury patterns of the occupants. Reportedly there were no pre-impact avoidance maneuvers performed so the occupants should not have moved significantly prior to impact.

At impact, the occupants reacted to the 290 degree principle direction of force by moving forward and to the left. The unrestrained case occupant 01 struck the roof and left A-pillar with his head-causing the multiple internal and external brain/head injuries. He also struck the left interior door panel-causing the rib, lung, and liver injuries. The occupant also struck the windshield and roof-causing the facial abrasions and contusions. Although the driver's side air bag showed no physical evidence of occupant contact, it is believed that contact with the deploying air bag caused the right arm and chest contusions. When the left front door was struck, the latch/striker was damaged allowing the door to come open. The unrestrained driver was then fully ejected through the open door. Case occupant 01 died at the hospital on the second day of admission from injuries sustained in the crash.

Case occupant 02 loaded the lap/shoulder restraint upon impact preventing further movement of her torso. Contact with the lap belt caused the hip and abdominal contusions. Contact with the deploying passenger's side air bag caused the chest contusions and abrasions, and also the rib fractures, although the bag showed no physical evidence of occupant contact. It also appears that the occupant's left knee struck the glove compartment door-causing the knee contusion. Case occupant 02 was hospitalized for an unknown number of days for injuries sustained in the crash.

Case occupant 03 loaded the lap/shoulder restraint upon impact preventing further movement of her torso. Contact with the lap belt caused the abdominal abrasion and contusion. Impact with the shoulder belt caused the right



**Figure 9.** Latch/striker failure, left front door.



**Figure 10.** Interior, case vehicle. Area of ejection.

shoulder abrasion and contusion, the chest contusion, and the 2<sup>nd</sup> degree chest burn. Case occupant 03 was treated and released for injuries sustained in the crash.

Scene Diagram

