

**CRASH DATA RESEARCH CENTER**

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**CALSPAN ON-SITE ADULT AIR BAG RELATED FATALITY CRASH  
INVESTIGATION**

**CASE NO: CA04-053**

**VEHICLE: 1993 CHEVROLET CORSICA**

**LOCATION: GEORGIA**

**CRASH DATE: JULY 2004**

Contract No. DTNH22-01-C-17002

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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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**CALSPAN ADULT AIR BAG RELATED FATALITY INVESTIGATION**  
**CALSPAN CASE NO: CA04-053**  
**VEHICLE: 1993 CHEVROLET CORSICA**  
**LOCATION: GEORGIA**  
**CRASH DATE: JULY 2004**

**BACKGROUND**

This on-site air bag deployment investigation focused on the injury severity and the injury sources that caused the death of an 83-year old female driver of a 1993 Chevrolet Corsica (**Figure 1**). The Corsica was equipped with a first generation driver air bag system that deployed as a result of an off-set, head-on crash with a 1986 Dodge Caravan. The driver of the Corsica initiated a wide right turn and crossed into the opposing travel lane at an offset, four-leg intersection. The Corsica was struck on the front



**Figure 1. Front right three-quarter view of the involved 1993 Chevrolet Corsica.**

right corner area by the Caravan. The crash forces were sufficient to deploy the Corsica's driver air bag system. The driver of the Corsica was restrained by the manual 3-point lap and shoulder belt system and was seated in a presumed mid track position, positioned within the deployment path of the non-tethered air bag. The deploying driver's air bag expanded against the driver's head and face which resulted in soft tissue injuries of the face, bilateral subdural hematomas, an avulsion fracture of the odontoid, a right parietal contusion and a scattered subarachnoid hemorrhage. Her loading of the shoulder belt webbing resulted in a fracture of a lower right rib. The driver was removed from the vehicle and transported by ground ambulance to a local hospital where she was admitted for treatment. A CT scan revealed a large left subdural hematoma which was surgically evacuated on the day of the crash. The driver's condition deteriorated following the surgery. She became ventilator dependent and following a family consultation, the driver was removed from the ventilator and expired seven days following the crash.

The July 2004 crash was identified by NHTSA through a search of the Fatal Analysis Reporting System (FARS) for potential air bag related fatality crashes. The Police Accident Report (PAR) was forwarded to the Calspan Special Crash Investigations (SCI) team on December 2, 2004 and assigned for on-site investigation pending the availability of the involved Chevrolet Corsica. The Corsica was sold from an insurance auction prior to case assignment and was subsequently located at a rural salvage yard in a partially dismantled state. The interior and damage profile remained intact; therefore, the vehicle was scheduled for on-site inspection. The investigation was conducted on January 13, 2005. The Dodge Caravan was considered a total loss by the insurance company and was sold at auction. The buyer's information was considered confidential; therefore, the Caravan was not inspected.

## SUMMARY

### *Crash Site*

The crash occurred at an offset, oblique four-leg intersection (**Figure 2**) of two local streets during daylight conditions. At the time of the crash, the weather was clear and the road surfaces were dry. The Corsica approached the intersection on a two lane street that was 6.2 m (20.3') in width and delineated by double yellow center lines. A regulatory stop sign controlled westbound traffic entering the intersection. The Dodge Caravan was southbound traveling on a straight and level road that was 6.9 m (22.6') in width. This north/south road was delineated by double yellow centerlines and traffic flow was not regulated through the intersection. The posted speed limit for the urban area was 48 km/h (30 mph). The Crash Schematic is attached as **Figure 10** of this report.



**Figure 2. Overall view of the crash site and trajectory of the Chevrolet Corsica.**

### *Vehicle Data*

#### *1993 Chevrolet Corsica*

The subject vehicle in this crash was a 1993 Chevrolet Corsica, four-door sedan. The vehicle was manufactured on 3/93 and was identified by Vehicle Identification Number (VIN) 1G1LT5340PY (production number deleted). Although the crash occurred in July 2004, the vehicle was located at a used auto parts facility in January 2005. At the time of the SCI inspection, the Corsica was partially disassembled with the engine, transmission, radiator, air conditioning condenser, taillight assemblies, and all four tires and wheels removed and separated from the vehicle (**Figure 3**). The exterior crush profile and the interior of the vehicle remained intact and unaltered from the crash. Non-crash related vehicle damage was noted to the right side of the Corsica. This damage is further documented in the **Vehicle Damage – Exterior** section of this report.



**Figure 3. Dismantled state of the Corsica at the time of the SCI inspection.**

The Corsica was powered by a 2.2 liter transverse mounted gasoline engine that was linked to a 3-speed automatic transmission with a console mounted shifter. The service brakes consisted of power-assisted front disc/rear drum with anti-lock (ABS). Although not available for inspection, the Corsica was equipped with OEM steel wheels and unknown type tires. The OEM plastic hubcaps were left in the vehicle and none of these hubcaps were damaged. The placarded tire data recommended P185/75R14 tires to operate at 206 kPa (30 PSI) of pressure. The Gross Vehicle Weight Rating was 1,666 kg (3,673 lb) split 884 kg (1,948 lb) front and 782 kg (1,724 lb) rear.

The interior was configured with front bucket seats and a three passenger rear bench seat with a fixed backrest. All seating surfaces were cloth covered. The reclining front seat backs were equipped with adjustable head restraints that were adjusted to the full down position at the time of the SCI inspection. In addition to fore and aft adjustments of the front seat tracks, the front seats were manually height adjustable. The steering wheel/column was fixed. This base model vehicle was equipped with manually operated windows and door locks. The vehicle's odometer reading at the time of the SCI inspection was 114,587 km (71,203 miles).

### ***Crash Sequence***

#### ***Pre-Crash***

The driver of the Chevrolet Corsica was traveling in a westerly direction on the two-lane street on approach to the offset, four-leg oblique intersection. A witness reported that the driver of the Corsica stopped for the regulatory stop sign and initiated a right turn onto the through street. As the driver of the Corsica initiated the right turn, she allowed her vehicle to drift wide left, crossing the centerline of the north/south street as if the driver was intending to initiate a left turn at the wide offset angled leg of the four-leg intersection.

A 1986 Dodge Caravan was traveling in a southerly direction on the two-lane through street as it approached the off-set intersection. The Corsica entered the southbound lane, directly into the path of the Caravan. There was no physical evidence present at the crash scene at the time of the SCI investigation due to the age of the crash. The investigating officer noted that there was no evidence documented or photographs taken during the police investigation to support pre-crash avoidance actions by either driver.

#### ***Crash***

The vehicles impacted in an off-set, head-on configuration in the southbound travel lane within the boundaries of the intersection. The front right area of the Caravan impacted the front right corner area of the Corsica. Although the Caravan was not inspected, both vehicles experienced impact forces that were within the 12 o'clock sector. The direct contact damage to the Corsica began at the front corner of the bumper fascia and extended onto the right front fender as both vehicles continued forward trajectories. The engagement continued 58 cm (23") onto the right front fender prior to separation of the vehicles. Due to the corner impact and the multiple plane engagement, the vehicles did not reach a common velocity; therefore, the impact and resultant damage was outside the scope of the WINSMASH reconstruction program. The SCI estimated velocity change for the Corsica was in the 19-24 km/h (12-15 mph) range. As a result of the crash, the driver air bag system in the Corsica deployed.

#### ***Post-Crash***

The driver of the Corsica remained in her vehicle following the crash. Although conscious, the driver was reportedly confused at the scene. Emergency personnel arrived on the scene and evaluated the driver. She was removed from the vehicle on a backboard and transported to a local hospital where she was diagnosed with a subdural hematoma. Surgical intervention was required and discussed with family members regarding the

risks and potential outcomes. Following surgery, the driver failed to regain consciousness and expired seven days following the crash.

The Corsica was towed from the crash site and transferred to a regional insurance auction facility where it was sold to a salvage yard. The Corsica was located at this yard and inspected for this investigation.

The Dodge Caravan was towed from the scene and transferred to an insurance auction facility where it was sold. The vehicle could not be tracked following its dispersal from the insurance company.

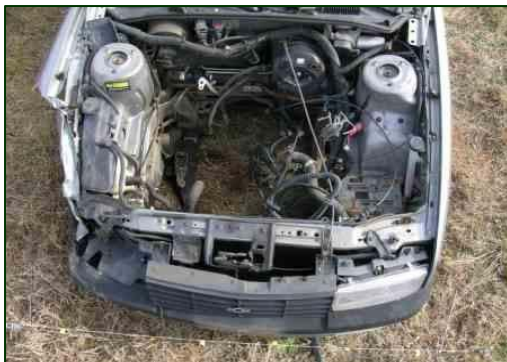
### ***Vehicle Damage***

#### ***Exterior – 1993 Chevrolet Corsica***

The exterior of the Corsica sustained moderate severity frontal and right side damage as a result of the corner engagement (**Figure 4**) with the Dodge Caravan. The maximum crush was measured at 10 cm (4”) located at the right corner of the bumper beam. The direct contact damage began 48 cm (18.75”) right of center and extended 19 cm (7.4”) to the right bumper corner. The impact deformed the full width of the bumper beam resulting in a combined direct and induced damage length of 129 cm (50.75”). A crush profile was documented at the level of the bumper beam (**Figure 5**) and the six equidistant measurements were as follows: C1 = 2 cm (0.75”), C2 = 2 cm (0.75”), C3 = 2 cm (0.75”), C4 = 3 cm (1.25”), C5 = 5 cm (1.9”), C6 = 10 cm (4”).



**Figure 4. Front right view of the corner impact damage to the Corsica.**



**Figure 5. Overhead view documenting the depth of frontal crush.**



**Figure 6. Front and right side damage to the Corsica.**

The corner impact damaged extended onto the right front fender of the Corsica, terminating 58 cm (23”) aft of the leading edge (**Figure 6**). The engagement also involved the right front tire as the lower right control arm was deformed rearward, resulting in a right wheelbase reduction of 1 cm (0.3”). Remote buckling was noted to



the roof immediately forward of the right B-pillar. All four doors remained closed and operational post-crash. The windshield was cracked adjacent to the right A-pillar due to body stress. The Collision Deformation Classification (CDC) for this impact was 12-FREE-3.

Additional body damage was located on the right side of the Corsica. This damage was highlighted by red paint transfers that did not match the police reported gray color of the involved Dodge Caravan. Red paint transfers were not present in the initial front right corner impact area. This right side direct contact damage began on the right outside rear view mirror and extended to the mid point of the right rear door, above the door rub strip. The maximum crush for this damage was measured at 5 cm (1.9”).

#### ***Interior – 1993 Chevrolet Corsica***

There was no damage or intrusion to the passenger compartment associated with this crash event. There were no driver contact points within the vehicle or loading evidence to the deployed air bag, safety belt system, or steering column compression (**Figure 7**).



**Figure 7. Steering column shear brackets; no separation**

#### ***Manual Safety Belt Systems – 1993 Chevrolet Corsica***

The 1993 Chevrolet Corsica was equipped with manual 3-point lap and shoulder belts for the four outboard seating positions and a center rear lap belt. The 3-point systems consisted of continuous loop webbings with locking latch plates and Emergency Locking Retractors (ELR). The B-pillar mounted D-rings were fixed. The center rear lap belt was equipped with a locking latch plate.

The driver’s belt system displayed historical usage indicators to suggest frequent belt usage over the life and mileage of the vehicle. The chrome-surfaced latch plate was scratched from frequent use and the edges of the belt webbing in the vicinity of the latch plate were worn. There was no damage or crash related loading evidence to the driver’s safety belt system. The front right latch plate yielded subtle wear from occasional usage. There was no wear noted to the belt webbing. All three rear belt systems were in “like-new” condition with no routine wear marks. It was suspected that the rear belts were seldom, if ever used.

#### ***Frontal Air Bag System – 1993 Chevrolet Corsica***

The Chevrolet Corsica was equipped with a first generation frontal air bag system for the driver’s position only. This air bag deployed as a result of the front right corner impact with the Dodge Caravan. The system consisted of a center front crash sensor that was mounted right of center to the upper radiator support and a safing sensor that was mounted to the center tunnel area. The Diagnostic Energy Reserve control Module

(DERM) was mounted in the right upper instrument panel. Although this unit was intact, it was not supported for download by the Vetronix Crash Data Retrieval tool.

The driver's air bag module was mounted to the two-spoke steering wheel rim. The wide spokes were positioned at the 4 and 8 o'clock positions. The driver's air bag deployed as designed from the H-configuration module cover flaps. The horizontal tear seam of the flaps measured 19 cm (7.5") in width and the vertical dimensions of the upper and lower flaps were 6 cm (2.5") and 4 cm (1.75") respectively. There was no damage or contact evidence to the cover flaps.



**Figure 8. Deployed driver air bag.**

The air bag membrane measured 67 cm (26.5") in diameter in its deflated state. The air bag was not tethered and was vented by two 1 cm (0.375") diameter ports located at the 3 and 9 o'clock positions, centered 10 cm (3.75") forward of the internally sewn peripheral seam. There was no occupant contact evidence or damage to the deployed air bag (**Figure 8**). It should be noted that although the crash occurred six months prior to this SCI inspection, the interior of the Corsica was closed to the weather and kept intact in good condition.

The maximum rearward excursion of the driver's air bag measured 55 cm (21.5"). In an attempt to replicate the crash scenario for this event, the seat track was repositioned to the mid point of the 19 cm (7.625") of total track travel and the seat back was left at the 17.5 degree recline angle. In this position, the horizontal distance between the mid point of the driver's air bag module and the seat back measured 50 cm (19.5"), at a height that was 43 cm (17.0") above the seat bight. The maximum excursion of the air bag engaged the seat back with the track adjusted to the mid position (**Figure 9**).



**Figure 9. Rearward excursion of the driver's air bag into mid track seat position.**

### ***Occupant Demographics***

#### ***Driver – 1993 Chevrolet Corsica***

Age/Sex:	83-year old female
Height:	168 cm (66.0"), estimated by hospital personnel
Weight:	50 kg (109.8 lb)
Manual Restraint Usage:	3-point lap and shoulder belt system
Usage Source:	Vehicle inspection, observations of first responders
Eyewear:	Not reported
Seat Track Position:	Presumed to be in the mid track range
Mode of Egress	

From Vehicle: Stabilized and removed by rescue personnel  
 Type of Medical Transport: Transported by ground ambulance to a local hospital  
 Type of Medical Treatment: Admitted to the local hospital where she expired seven days following the crash

***Driver Injuries***

<b>Injury</b>	<b>Injury Severity (AIS90/Update 98)</b>	<b>Injury Source</b>
Bilateral subdural hematomas (large left parietal, left occipital, small left temporal, right parietal)	Critical (140656.5,2 140652.4,1)	Expanding driver's air bag
Avulsion fracture of the odontoid along the posterior left lateral aspect	Serious (650228.3,6)	Hyperextension due to air bag expansion against head and face
1.5 cm right parietal cortical contusion	Serious (140606.3,1)	Expanding driver's air bag
Scattered foci of subarachnoid hemorrhage	Serious (140684.3,9)	Expanding driver's air bag
Lower right rib fracture	Minor (450212.1,1)	Safety belt
Right scleral and conjunctiva edema	Minor (240416.1,1)	Expanding driver's air bag
Contusion over the bridge of the nose	Minor (290402.1,4)	Expanding driver's air bag
Septal hematoma	Minor (290402.1,4)	Expanding driver's air bag
Contusion over the right face	Minor (290402.1,1)	Expanding driver's air bag
Small laceration of the inner lip	Minor (290602.1,8)	Expanding driver's air bag
Diffuse contusions of the anterior forearms	Minor (790402.1,3)	Expanding driver's air bag
Ecchymosis over the right hand	Minor (790402.1,1)	Possible fling injury from expansion of the driver's air bag into rear view mirror

*Source – Hospital medical records, radiology and discharge summary*

**Note:** The driver had a prior history of a left subdural hematoma (1990). She also had a history of osteoporosis and osteoarthritis, right mastectomy (2000), right leg fracture (2002), inguinal hernia (1992) and cataract surgery.

***Driver Kinematics***

The 83-year old female driver of the Chevrolet Corsica was seated in a presumed mid track position based on her hospital reported demographics. She was restrained by the

manual safety belt system. Although no loading evidence was noted to the belt system, historical wear to the belt system was consistent with the vehicle mileage. Additionally, the first responders to the crash scene observed the driver in the vehicle with the belt system buckled across her body.

At impact with the Dodge Caravan, the driver frontal air bag system deployed. The non-tethered air bag expanded against the arms of the driver resulting in bilateral contusions of the anterior forearms. Her right hand separated from the steering wheel rim and impacted the rear view mirror which was noted to be deflected to the right. As a result of this suspected contact, the driver sustained ecchymosis over the right hand.

The continued expansion of the air bag resulted in contact to the driver's face. She sustained soft tissue injuries of the right face, nose and inner lip. The driver also sustained a right conjunctiva edema. The air bag impacted the driver's head with sufficient force to accelerate the head rearward resulting in an avulsion fracture of the odontoid along the posterior left lateral aspect. The driver also sustained bilateral subdural hematomas, a 1.5 cm right cortical contusion and scattered subarachnoid hemorrhage. **Figure 9** represents the rearward excursion of the air bag with respect to the presumed adjusted seat track position for the driver.

She responded to the frontal crash forces by initiating a forward trajectory and loading the manual belt system. Due to the belt loading, the driver sustained an unspecified fracture of a lower right rib.

### ***Medical Treatment***

Immediately following the crash, the driver remained in her vehicle and waited for emergency personnel to arrive on scene. She communicated with the investigating officer and the first responders. The driver was removed from the Corsica on a backboard and transported to a local hospital where she was evaluated for injury.

On arrival to the hospital, the driver was conscious and communicating with the staff. A CT scan of the head was ordered which revealed a large left subdural hematoma. Surgery and risks were discussed with family members who approved the procedure. The hematoma was evacuated and the patient was placed on a ventilator. Neurologically, she failed to improve. Additional brain scans over the next several days revealed additional subdural hematomas of the right parietal, occipital and left temporal areas. These did not require surgical evacuation. The driver's condition deteriorated over the seven days of hospitalization and she was removed from ventilator support and expired. No autopsy was requested.

Figure 10 – Scene Schematic

