TRANSPORTATION SCIENCES CENTER
ACCIDENT RESEARCH GROUP

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Buffalo, New York 14225

CALSPAN REMOTE DRIVER AIR BAG/FATALITY

DEPLOYMENT CRASH INVESTIGATION

CALSPAN CASE NO. CA 97-021

SUBJECT VEHICLE - 1994 OLDSMOBILE CUTLASS CIERA S
VEHICLE #2-1997 FORD TAURUS
VEHICLE #3-1994 DODGE RAM 4X2 PICK-UP TRUCK

LOCATION - STATE OF FLORIDA

CRASH DATE - NOVEMBER, 1996

Contract No. DTNH22-94-D-07058

Prepared for:

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National Highway Traffic Safety Administration
Washington, D.C. 20590

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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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15. *Supplementary Notes* Remote investigation of a front-to-rear crash between a 1994 Oldsmobile Cutlass Ciera 5, a 1997 Ford Taurus, and a 1994 Dodge Ram 4x2 pickup truck for which the driver of the air bag equipped 1994 Oldsmobile Cutlass Ciera S sustained an intimal tear of the ascending aorta which was subsequently fatal.			

16. *Abstract*

A remote investigation was conducted into a three vehicle front-to-rear crash which occurred in the month of November, 1996. The crash occurred on an urban five-lane, undivided straight and level roadway in the early afternoon hours.

All vehicles were traveling in a westerly direction on the urban five lane roadway on the second travel lane from the curb. Vehicle #2 was stopped behind vehicle #3 in a line of standing traffic waiting for a red traffic signal controlling an intersection. The Oldsmobile was traveling in the same lane at a police estimated speed of 48 km/h (30 mph). The driver of the Oldsmobile apparently failed to detect the stopped vehicles and impacted its frontal plane with the rear of the vehicle #2 subsequently initiating a chain-reaction impact. The initial impact prompted the deployment of the subject vehicle*s driver side air bag. Vehicle #2 was subsequently displaced forward and impacted it*s frontal plane with the rear of vehicle #3. This impact initiated the deployment of vehicle #2*s driver and passenger side air bag system. The missing vehicle algorithm of the SMASH program computed the delta V for the subject vehicle as 24.3 km/h (15.0 mph) and 21.2 km/h (13.0 mph) for the rear impact to vehicle #2.

The driver of the Oldsmobile was a 78 year old female who was 157 cm (62 in) tall and weighed 64 kg (142 lb.). She sustained a large purple contusion over the large area of the chest (AIS-1), a mid-chest abrasion (AIS-1), fractures of the anterior segments of the right 1st through 7th ribs (AIS-3), an intimal tear of the ascending aorta (AIS-4), a laceration of the tricuspid valve leaflet (AIS-5), and a laceration on the intra-ventricular septum (AIS-5) from contacted the driver side air bag module cover flap. The driver also sustained abrasions to the right side of the chin (AIS-1) and over the anterior and interior aspects of the chin (AIS-1) as well as a right breast contusion (AIS-1) and a contusion over the right arm proximal to the right axilla (AIS-1). These injuries were attributed to contact with the expanding driver side air bag. A purple contusion (AIS-1) of the dorsal right hand was also sustained by the driver and was attributed to contact with the right A-pillar. She refused medical treatment at the scene of the crash. Once the driver was home she began to experience chest pain and was transported to a near-by hospital by a relative in a private vehicle. The treating physician prescribed pain medication and sent her home. Several hours later, the driver returned to the hospital where the severity of her injuries were diagnosed. She was immediately prepared for surgery, however, she expired before the surgery.

The 30 year old pregnant female passenger of vehicle #2 sustained abdominal wall trauma (medical information was not specific enough to assign AIS-90 severity) which was attributed to the manual lap belt, and left dorsal wrist and left hand contusions (AIS-1) attributed to contact with the rearview mirror. The passenger was transported from the scene to a hospital for approximately five hours following the crash for fetal monitoring. The passenger experienced occasional sharp pains to her left abdomen for two to three weeks following the crash. She continued regular visits to her mid wife until her child was delivered two weeks prematurely. The infant was born healthy.

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CALSPAN CASE NO. CA 97-021
VEHICLE: 1994 OLDSMOBILE CUTLASS CIERA S
LOCATION: STATE OF FLORIDA
CRASH DATE: NOVEMBER, 1996

SUMMARY

This remote investigation focused on a three vehicle front-to-rear crash that resulted in the fatality of a 78 year old female driver from the deployment of the driver*s side air bag of a 1994 Oldsmobile Cutlass Ciera S. The front of the Oldsmobile impacted the rear of a 1997 Ford Taurus causing moderate damage to the frontal plane of the Oldsmobile. The Taurus was subsequently displaced forward and engaged in its second crash event by impacting its front with the rear of a 1994 Dodge Ram 4x2 pickup truck. The Oldsmobile*s driver sustained injuries which included anterior right rib (1-7) fractures (AIS-3), and lacerations of the tricuspid valve leaflet (AIS-5) and intra-ventricular septum (AIS-5). The fatality of this driver was attributed to the intimal tear of the ascending aorta (AIS-4) due to blunt impact to the chest caused by contact with the deploying driver side air bag module cover flap. The driver refused medical treatment at the scene of the crash. The intimal tear resulted from the fractured ribs puncturing the aorta. The subsequent crash between the front of the 1997 Ford Taurus and the rear of the Dodge pick-up truck involved the driver and passenger side air bag deployment of the Taurus. A pregnant female (7 months) was seated in the right front passenger position of the Taurus. This 30 year old passenger was transported to a medical facility where fetal monitoring was conducted. She sustained dorsal left wrist and left hand abrasions (AIS-1) and abdominal wall trauma. The infant was born healthy.

This crash occurred during the month of November, 1996, and was identified by NHTSA through a search of the Fatal Analysis Reporting System (FARS). The case was subsequently assigned to Calspan*s Special Crash Investigation Team on May 28, 1997, and a remote investigation was initiated the same day.

This crash occurred on an urban five-lane undivided straight and level roadway during daylight hours. The roadway was a dry bituminous state route with a speed limit of 72 km/h (45 mph). The weather was clear at the time of the crash.

The subject vehicle was a 1994 Oldsmobile Cutlass Ciera 5, 4-door sedan (3.1 liter, V-6), that was equipped with power windows and door locks, tilt steering wheel, automatic 3-point lap and shoulder belts in the front outboard seated positions, and a Supplemental Inflatable Restraint (SIR) system that consisted of a driver side air bag. The vehicle was identified by vehicle identification number 1 G3AG55M9R6 (production numbers deleted) and the odometer read 42,444 km (26,374 miles).

The second vehicle in this crash was a 1997 Ford Taurus, 4-door sedan (3.0 liter, V-6), that was equipped with a Supplemental Restraint System (SRS) that consisted of driver and passenger side air bags. The Ford was also equipped with manual lap and shoulder restraint systems with height adjusters

in the front outboard seated positions. The vehicle was identified by vehicle identification number 1FALP52U1VA (production numbers deleted).

The third vehicle in this crash was a 1994 Dodge Ram 4x2 pickup truck (5.2 liter, V-8) 1500 job rated series. It was identified by vehicle identification number 1B7HC16Y1RS (production numbers deleted).

All vehicles were traveling in a westerly direction on the urban five lane roadway on the second travel lane from the curb. The Ford Taurus was stopped behind the Dodge Ram in a line of standing traffic waiting for a red traffic signal controlling an intersection. The Oldsmobile Cutlass Ciera S was traveling in the same lane at a police estimated speed of 48 km/h (30 mph). The driver of the Oldsmobile apparently failed to detect the stopped vehicles and impacted its frontal plane with the rear of the Ford Taurus subsequently initiating a chain-reaction impact. The initial impact prompted the deployment of the Oldsmobile*s driver side air bag. The Ford was subsequently displaced forward and impacted it*s frontal plane with the rear of the Dodge. This impact initiated the deployment of the Ford*s driver and passenger side air bag system. Avoidance maneuvers were not evidenced and/or recorded by the investigating officer at the scene of the crash, or were they reported by the occupants of the Ford Taurus. All of the involved vehicles came to final rest in their respective travel lanes. The Oldsmobile and the Taurus were towed from the scene of the crash.

The Oldsmobile sustained moderate frontal damage which resulted in a Collision Deformation Classification (CDC) of 12-FYEW- 1. Maximum crush was estimated at 25 cm (10 in) at the left front bumper corner from police and insurance photographs (refer to Figures 1 and 2). The SMASH missing vehicle algorithm calculated a total Delta V of 24.3 km/h (15.0 mph) and a longitudinal change in velocity of -24.3 km/h (15.0 mph) for the Oldsmobile. This impact initiated the deployment of the driver*s side air bag.

Figure 1. Left front three-quarter view

Figure 2. Right front three-quarter view

The driver side air bag module cover opened in the typical H-configuration. There were symmetrical vertical abrasions and cloth transfers on the lower segment of the upper module cover flap. The face of the air bag had several drops of blood on its fabric that may have been a result of a nosebleed possibly sustained by the driver. Injury information did not reveal external lacerations that may have resulted in the discharge of blood.

Figure 3. Perpendicular view of the deployed air bag and the steering wheel rim

Figure 4. Upper module cover flap and the deployed air bag

The Oldsmobile was occupied by the 78 year old female driver with a reported height of 157 cm (62 in) and weight of 64 kg (142 lbs). The supplement to the Police Accident Report (PAR) reported the driver as unrestrained. Lack of evidence within the vehicle confirmed this. There were no apparent transfers on the belt webbing from clothing, contact from the air bag module cover flap, and/or the air bag. In addition there was no loading evidence on the belt webbing. She was presumably seated with the seat track adjusted to a forward position. The forward positioned, unrestrained driver was at, or within a close proximity to the air bag module cover flap when it opened to deploy the air bag. She sustained vertical abrasions on the medial aspect of her chest (refer to Image No. 19) that were consistent with the vertical abrasions on the cover flap (refer to Image No. 6). The flap opened against the female driver*s chest and caused the following injuries:

- Large purple contusion over the large area of the chest (AIS-1)
- Central chest abrasion (AIS-1)
- Fractures of the anterior segments of the right 1st through 7th ribs (AIS-3)
- Intimal tear of the ascending aorta (AIS-4)
- Laceration of the tricuspid valve leaflet (AIS-5)
- Laceration on the intra-ventricular septum (AIS-5)

The driver, who was presumably positioned forward due to pre-impact braking, responded to the 12 o*clock impact force as the air bag deployed against her chest. The combination of the driver*s forward momentum and subsequent restricted path of the deploying air bag caused the upper sector of the steering wheel rim to be displaced forward. The upper sector of the rim sustained approximately 2.5 cm (1 in) of deformation. The air bag caused a purple contusion on the right breast (AIS-1) and a purple contusion over right arm proximal to the right axilla (AIS-1). Abrasions from the expanding air bag were also evident to the right side of the chin (AIS-1) and over the anterior and inferior chin (AIS-1). A purple contusion of the dorsal right hand (AIS-1) was probably sustained as the air bag expanded against the anterior forearm and displaced the hand from the steering wheel into the left A-pillar.

Following the crash, it was reported by both the investigating officer and the occupants of the Ford that the driver of the Oldsmobile was walking around for approximately one hour at the crash scene

waiting for private transfer from the scene to her residence. She refused medical treatment at the scene. The police detective assigned to this case stated that once the driver was home, she began to experience chest pain and was transported to a nearby hospital by a relative in a private vehicle. The treating physician prescribed pain medication and sent her home. Several hours later, this driver returned to the hospital where it was discovered that she had sustained an aortic dissection. She was immediately prepared for surgery, however, she expired prior to surgery.

The Ford Taurus sustained moderate rear damage from contact with the Oldsmobile as well as minor damage to its frontal plane from striking the rear of the Dodge. The rear damage had an estimated CDC of 06-BDEW-1 (from insurance company photographs). The missing vehicle algorithm of the SMASH program calculated the total Delta V at 21.2 km/h (13.0 mph).The frontal damage was located primarily to the grill and hood and had an estimated CDC of 12-FDMW-1 (from insurance photographs). This impact caused the driver and passenger side air bag systems to deploy. Windshield cracking on the passenger side resulted from passenger side air bag flap contact.

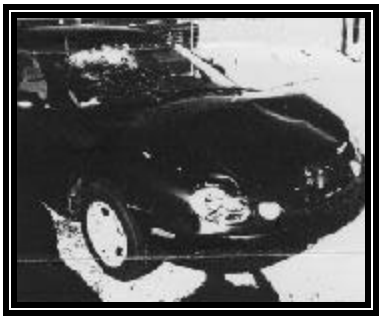

Figure 5. Ford Taurus right front three-quarter view

Figure 6. Ford Taurus right rear three-quarter view

This vehicle was occupied by a 30 year old male driver and a 30 year old pregnant (7 months) female passenger seated in the right front position. The right front passenger had a stated height of 157 cm (62 in) and weight of 68 kg (152 lbs) at the time of the crash. The female passenger was properly restrained by the manual lap and shoulder belt system (police report and interview) with the lap belt positioned under her protruding abdomen. This passenger did not recall the position of the height adjuster for this belt system. She stated that the seat track was adjusted to the rear most position as her abdomen was “at least two feet from the instrument panel”. Presumably, the minor initial impact to this vehicle*s rear plane did not significantly displace the pregnant female. The second impact to the frontal plane of her vehicle displaced her towards the 12 o*clock impact force as the air bag deployed. The pregnant female sustained abdominal wall trauma (medical information was not specific enough to assign AIS-90 severity) which was attributed to the manual lap belt, and left dorsal wrist and left hand contusions (both AIS-1). The left hand and wrist contusions were attributed to contact with the rearview mirror as the hand, which was probably bracing on the upper instrument panel, was displaced as the air bag expanded against her arm. The passenger was transported from the scene to a hospital for approximately five hours following the crash for fetal monitoring.

The passenger stated that she experienced occasional sharp pains to her left abdomen for two to three weeks following the crash. She continued regular visits to her mid-wife until her child was delivered two weeks prematurely. The infant was born healthy.

The driver of the Dodge was a 54 year old male. The police report indicated that this driver was restrained by a lap and shoulder belt system. The police report indicated that he sustained a “C” (possible) injury as a result of the crash.

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LOCATION: STATE OF FLORIDA
CRASH DATE: NOVEMBER, 1996

CRASH DATA

Location:	State Route
State:	Florida
Crash Date/Time:	November, 1996/ Daylight hours
Investigating Police Agency:	City Police Department
Crash Type:	Car/Car/Pick-up truck, front-to-rear, chain reaction impact configuration
Air Bag Driver Injury Severity:	Critical (AIS-5) with fatal outcome
Other Vehicle Pregnant Passenger Air Bag Injury Severity:	Minor (AIS-1)

AMBIENCE

Viewing Conditions:	Daylight
Weather:	Clear
Precipitation:	None
Road Surface:	Dry

HIGHWAY

Type:	State Route
Number of Lanes:	Five, not physically divided

HIGHWAY (CONT*D)

Surface:	Asphalt
Speed Limit:	72 km/h (45 mph)

VEHICLES

Subject Vehicle

Description:	1994 Oldsmobile Cutlass Ciera 5,4-door sedan
V.I.N.:	1G3AG55M9R6 (production number deleted)
Color:	White
Odometer:	42,444 km (26,374 miles)
Engine:	3.1 liter, V-6
Transmission:	4-speed automatic overdrive transmission, column mounted transmission lever.
Brakes:	Front disc, rear drum, four wheel anti-lock (ABS)
Manual Restraints:	Center front- Lap belt Left rear- Lap and shoulder belt Center rear- Lap belt Right rear- Lap and shoulder belt
Automatic Restraints:	3-point door mounted lap and shoulder belt system in the front outboard seated positions. Supplemental Inflatable Restraint (SIR) system which consisted of a driver side air bag which deployed as a result of the vehicle*s impact with the rear of vehicle # 2.
Tow Status:	Towed due to damage

Vehicle 2

Description:	1997 Ford Taurus, 4-door sedan

VEHICLES (CONT*D)

Vehicle 2 (cont*d)

V.I.N.:	1FALP52U1VA (production number deleted)
Engine:	3.0 liter, V-6
Manual Restraints:	3-point lap and shoulder belts in the front outboard seated positions.
Automatic Restraints:	Supplemental Restraint System (SRS) which consisted of a driver*s and passenger*s side air bag system which deployed as a result of the vehicle*s subsequent impact with vehicle #3.
Tow Status:	Towed due to damage

Vehicle 3

Description:	1994 Dodge Ram 4x2 pickup truck, 1500 job rated series
V.I.N.:	1B7HC16Y1RS (production number deleted)
Engine:	5.2 liter, V-8
Tow Status:	Not towed

HUMAN DEMOGRAPHICS/OCCUPANT DATA

Subject Vehicle

Driver:	78 year old female
Height:	157cm (62 in)
Weight:	64 kg (142 lbs)
Seat Belt Usage:	None
Seat Belt Usage Source:	Injuries, injury sources, PAR, lack of belt evidence

HUMAN DEMOGRAPHICS/OCCUPANT DATA (CONT*D)

Subject Vehicle (cont*d)

Medical Treatment: Refused treatment at the scene of the crash. The driver was transported to a hospital several hours following the crash and was discharged by a physician. The driver*s pain persisted and she was taken back to the hospital where the severity of her injury was discovered. She was prepared for surgery but expired while waiting for surgical intervention.

Driver Injuries

Injury	Injury Severity (AIS)	Injury Mechanism
Laceration of the tricuspid valve leaflet	Critical (441200.54)	Driver side air bag module cover flap
Laceration of the intra ventricular septum	Critical (441300.54)	Driver side air bag module cover flap
Intimal tear of ascending aorta	Severe (420202.44)	Driver side air bag module cover flap
Anterior segments of right 1-7 rib fractured, bilaterally	Serious (450230.31)	Driver side air bag module cover flap
Right breast contusion	Minor (490402.11)	Driver side air bag
Contusion over the dorsal left hand	Minor (790402.12)	Left A-pillar
Mid-chest abrasion	Minor (490202.14)	Driver side air bag module cover flap
Right arm contusion above right axilla	Minor (790402.11)	Driver side air bag
Contusion over anterior chest	Minor (490402.10)	Driver side air bag module cover flap
Abrasion over interior and anterior chin	Minor (290202.18)	Deploying driver side air bag
Abrasion over the right side of the chin	Minor (290202.11)	Deploying driver side air bag

HUMAN DEMOGRAPHICS/OCCUPANT DATA (CONT*D)

Vehicle 2

Right Front Occupant:	30 year old pregnant (7 months) female
Height:	157cm (62 in)
Weight:	68 kg (152 lbs)
Manual Restraint Usage:	3-point manual lap and shoulder belt
Usage Source:	Interview, injuries, and PAR
Medical Treatment:	Transported via ambulance to a medical facility. Fetal monitoring was conducted for approximately *5* hours after the crash.

Passenger Injuries

Injury	Injury Severity (AIS-90)	Injury Mechanism
Dorsal left wrist and left hand abrasions	Minor (790202.12)	Rear view mirror
Abdominal wall trauma not further specified	Unknown severity (515099.70)	Lap belt