TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION

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CALSPAN ON-SITE DRIVER AIR BAG FATALITY INVESTIGATION
CALSPAN CASE NO. CA97-23
VEHICLE: 1996 FORD EXPLORER
LOCATION: NEW JERSEY
CRASH DATE: FEBRUARY 1997

Contract No. DTNH22-94-D-07058

Prepared for:

U.S. Department of Transportation
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.

TECHNICAL REPORT STANDARD TITLE PAGE

1. *Report No.* CA97-23	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* Calspan On-Site Driver Air Bag Fatality Investigation Vehicle: 1996 Ford Explorer Location: New Jersey		5. *Report Date*: January, 1999 6. *Performing Organization Code*	
7. *Author(s)* Crash Research Section		8. *Performing Organization Report No.*	
9. *Performing Organization Name and Address* Transportation Sciences Crash Research Section Calspan Corporation P.O. Box 400 Buffalo, New York 14225		10. *Work Unit No.* 1115 (7440-7449) 11. *Contract or Grant No.* DTNH22-94-D-07058	
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		13. *Type of Report and Period Covered* Technical Report Crash Date: February, 1997 14. *Sponsoring Agency Code*	
15. *Supplementary Notes* On-site investigation of a run-off-road crash that resulted in deployment of the frontal air bag system in a 1996 Ford Explorer. The 37 year old female driver expired due to her involvement with the deploying driver air bag.			
16. *Abstract* This on-site investigation focused on a single vehicle run-off-road crash that involved a 1996 Ford Explorer, equipped with frontal air bags for the driver and front right passenger positions. The front left area of the Explorer impacted and sheared a wooden utility pole which resulted in a velocity change of 13 km/h (8 mph). This impact deployed the frontal driver and passenger air bag system. The 37 year old pregnant female driver of the vehicle was properly restrained by the manual 3-point lap and shoulder belt system. She sustained multiple soft tissue contusions and abrasions of the face and hemorrhages of the neck organs from the deploying driver side air bag. She expired immediately due to the medical examiner's diagnosis of blunt force trauma to the neck with asphyxia. Her 32 year old husband was seated in the front right position of the vehicle. He was properly belted by the manual system. This passenger sustained cervical disc herniation at C4-C5 and C6-C7. A 17 month old female was restrained in a forward facing child restraint in the left rear position of the vehicle. She was not injured as a result of the crash.			
17. *Key Words* On-site investigation Supplemental Restraint System (SRS) Air bag deployment Death due to asphyxiation		18. *Distribution Statement* General Public	
19. *Security Classif. (of this report)* Unclassified	20. *Security Classif. (of this page)* Unclassified	21. *No. of Pages* 24	22. *Price*

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BACKGROUND

This on-site investigation focused on a single vehicle run-off-road crash that involved a 1996 Ford Explorer, equipped with frontal air bags for the driver and +front right passenger positions. The front left area of the Explorer impacted and sheared a wooden utility pole which resulted in a velocity change of 13 km/h (8 mph). This impact deployed the frontal driver and passenger air bag system. The 37 year old pregnant female driver of the vehicle was properly restrained by the manual 3-point lap and shoulder belt system. She sustained multiple soft tissue contusions and abrasions of the face and hemorrhages of the neck organs from the deploying driver side air bag. She expired immediately due to the medical examiner's diagnosis of blunt force trauma to the neck with asphyxia. Her 32 year old husband was seated in the front right position of the vehicle. He was properly belted by the manual system. This passenger sustained cervical disc herniation at C4-C5 and C6-C7. A 17 month old female was restrained in a forward facing child restraint in the left rear position of the vehicle. She was not injured as a result of the crash.

NHTSA was initially notified of the February 1997 crash by an attorney who represented the husband (front right passenger) of the deceased driver. This investigation was assigned to the Calspan Special Crash Investigation Team on June 9, 1997, and the on-site inspection of the vehicle and scene was conducted on June 19. In addition to the vehicle and scene inspections, interviews were conducted with the front right passenger (husband to the driver), the medical examiner, and the investigating police officers.

SUMMARY

Crash Site

The crash occurred on the right shoulder of a two lane county road in a rural/undeveloped area during nighttime hours. The asphalt road surface was straight and level with paved shoulders bordering both travel lanes. On the evening of the crash, a heavy snowfall occurred which covered the environmental surfaces with several inches of snow. Visibility was limited due to the rate of the snowfall. The posted speed limit in the area of the crash was 80 km/h (50 mph). **Figure 1** is an overall view of the crash site.

Figure 1. Overall view of the crash site and trajectory of the Ford Explorer.

Vehicle Data/History

The involved 1996 Ford Explorer, 4-door sport utility vehicle, was leased by the driver and her husband in May 1996. It was used equally by both parties, however, the wife preferred driving the Explorer due to the height of the 4-wheel drive vehicle. The Explorer was manufactured during April 1996, and was identified by vehicle identification number 1FMDU34X3TU (production number deleted). The odometer reading at the time of our inspection was 12,938 km (8,036 miles).

In addition to the driver and passenger side air bag system, the Explorer was equipped with six-way power front bucket seats with integral head restraints, tilt steering wheel, power-assisted four-wheel disc brakes with rear anti-lock (ABS), power-assisted steering, and all-season mud and snow tires mounted on alloy wheels. It should be noted that this couple leased this vehicle for its safety features (dual air bags and 4-wheel drive) and that their other vehicle was equipped with dual front and side impact air bags.

Pre-Crash Events

On the night of the crash, the couple's 17 month old daughter was ill with a high fever. They had kept in contact with the pediatrician who advised them to transport their daughter to a local hospital. They had dressed for the cold weather and departed their residence during the early morning hours. The weather was cold with a wet snow that had accumulated on the ground and paved surfaces. The husband had initially exited the house with the child to place the child in the forward facing child restraint that was positioned in the left rear of the Explorer that was parked in the driveway. He started the vehicle and turned the defrosters on to aid in clearing the windshield of the snow. He noted that his wife then exited their residence and walked along the sidewalk to the driveway. The husband reported that his wife had slipped on the snow covered sidewalk and fell, possibly contacting her face on the ground. He noted that she may have sustained a superficial abrasion to the face. He helped her to her feet and she continued to proceed to the vehicle. Without discussion, she proceeded to the driver's side of the vehicle and entered the Explorer. The husband secured the 17 month old child into the forward facing Evenflo Champion child restraint with an integral shield that was positioned in the left rear of the vehicle. He subsequently walked to the right side of the Explorer and entered the front right position of the vehicle.

The driver backed out of the driveway and traveled approximately 0.4 km (0.3 miles) to the end of the subdivision where she turned right to proceed eastbound on the rural two-lane road. The investigating officer stated that the road surface was snow covered with ice and slush. The posted speed limit was 80 km/h (50 mph) for the straight and level roadway. As the driver traveled approximately 1.6 km (1.0 mile) in an easterly direction, she yelled to her husband that a deer was in the roadway in her lane of travel, facing in a northerly direction. As the husband looked for the deer, the driver steered to the right and probably braked in an attempt to travel around the deer on the right paved shoulder. The investigating officer noted in his report that the left side tires of the vehicle departed the travel lane and traversed the 2.2 m (7.2') south shoulder on a straight line trajectory.

Crash

A wood utility pole, that acted as a lateral support guy wire pole for a telephone pole on the north side of the roadway, was positioned approximately 1 m (3.0') outboard of the paved shoulder. The front left area of the Ford Explorer impacted and sheared the guy wire pole. The vehicle sustained 26.7 cm (10.5") of bumper crush located at the front left corner, outboard of the frame rail **(Figure 2)**. The resultant direction of force was 12 o'clock with a Collision Deformation Classification (CDC) of 12-FLEN-2. A speed change

Figure 2. Front left damage to the Ford Explorer.

of 13.0 km/h (8.1 mph) was calculated by the damage algorithm of the WinSMASH program. As a result of the frontal impact sequence with the struck pole, the driver and passenger air bags deployed. The Explorer fractured the pole and continued approximately 15 m (50.0') before coming to rest 7.0 m (23.0') south of the south edge line. At rest, the vehicle was facing in a easterly direction with the engine stalled and the lights illuminated.

Post-Crash Activities

A passing motorist noted the vehicle off-road with its lights illuminated at approximately 0150 hours. He stopped to check the conditions of the occupants. As he opened the left front door, he found the driver belted, seated behind the steering assembly in an upright attitude with her head slumped to the left. This person, who was a veterinarian, checked for a pulse on the driver and found none. He then proceeded to check the pulse of the front right passenger. He found a pulse, however, noted that the occupant was unconscious. This motorist returned to his vehicle and notified the police from his cellular telephone.

The investigating officer received notification of the crash at 0153 hours and arrived on-scene at approximately 0200 hours. The paramedics received notification at 0156 hours and arrived on-scene at 0201 hours. Paramedics reported that the driver of the Ford Explorer was found in the vehicle with the manual belt system in place with the shoulder belt riding high over her shoulder onto the neck area and the driver's air bag deployed. In addition, they noted that the driver was visibly pregnant. She was without a pulse and her eyes were closed with fixed and dilated pupils. A Lifepack EKG unit was connected to the driver and an asystole reading was obtained which indicated the driver had no vital signs. A doctor at a regional trauma center pronounced her expired via telemetry from the scene of the crash at 0221 hours. The driver's body was subsequently removed from the vehicle and held at the scene for the arrival of the medical examiner.

The paramedics found the front right passenger of the Explorer in his seat with the manual belt system properly extended across his pelvis and torso areas and the passenger side air bag deployed. He maintained a pulse, however, the passenger was initially unconscious. As paramedics attended to the front right passenger, he became conscious and began to discuss the sequence of events relating to the crash. The belt system was cut and the passenger was removed from the vehicle and transported to a local hospital by ambulance for treatment. He was subsequently transferred by ambulance to a major medical center (trauma center) where he was admitted for treatment of a cervical spine injury.

The child was found in the vehicle restrained in the child safety seat in the left rear of the vehicle. Paramedics reported that the child was conscious and alert. She was transported to a local hospital for observation and released to family members. The father noted that she did not sustain injuries from the crash and that her exposure to the cold weather decreased her temperature to within normal limits.

Automatic Restraint System

The 1996 Ford Explorer was equipped with a Supplemental Restraint System (SRS) that consisted of frontal air bags for the driver and front passenger positions. The SRS deployed as a result of the front left impact sequence with the utility pole.

The driver's air bag deployed from a symmetrical H-configuration module cover. The air bag was tethered by two internal wide band tethers (12.7 cm in width) positioned at the 12 and 6 o'clock positions. The bag was constructed of two types of fabric. The forward panel (side exposed toward driver) was lined with a neoprene liner while the back panel was not lined internally. An internal peripheral seam was used to sew the fabrics together for the 63.5 cm (25.0") diameter bag. The driver's bag was vented by two 1.3 cm (0.5") diameter ports located at the 11 and 01 o'clock positions. The ports were centered 7.6 cm (3.0") inboard of the peripheral seam.

Contact evidence on the driver's air bag consisted of black vinyl transfers from the lower module cover flap. These transfers consisted of five vertically oriented transfers that were surrounded by two semi-circular transfers covering an area of 18.4 cm (7.25") horizontally and 8.9 cm (3.5") vertically. Adjacent to these black vinyl transfers at the 5 o'clock position, was a 1.9 cm (0.75") light blue fabric transfer that probably resulted from bag contact against the driver's denim top. The transfer was located on the forward panel of the driver's bag, 6.4 cm (2.5") forward of the peripheral seam.

The passenger side air bag deployed from a mid mount module. The single top hinged module cover flap was 37.1 cm (14.6") in width and 17.1 cm (6.75") in height. The passenger bag was not tethered and was vented by two 5.2 cm (2.0") diameter ports located on the side panels at the 3 and 9 o'clock positions. The maximum rearward excursion of the passenger side air bag, in its deflated state, was 62.2 cm (24.5"). The horizontal distance between the leading edge of the passenger side air bag module cover and the front right seat back was 83.2 cm (32.75").

Driver Demographics/Data

The driver had a reported height of 163.0 cm (64.0") and weight of 55.7 kg (145.0 lbs.). Her husband noted that she was 6 months pregnant and that her weight was within normal limits for the stage of the pregnancy. The driver was dressed in a brown leather jacket over a blue denim top with black stretch pants. She was not wearing eyeglasses or contact lenses. Her husband reported that within recent weeks, the driver experienced on several occasions, mild dizziness with blackouts that was associated with the pregnancy.

The husband noted that his wife preferred to drive the Ford Explorer due to its height over automobiles. He further stated that she drove the vehicle with the six-way power seat adjusted to a forward track position with the seat adjusted vertically upward. At the time of our inspection of the vehicle, the driver's seat was adjusted to a mid track position, 11.7 cm (4.6") rearward of the full forward position, and 13.0 cm (5.1") forward of the full rearward track position. The seat back was set to the most vertical position with a seat back angle of 20 degrees rearward of vertical. With the seat adjusted to this position, a horizontal distance of 50.1 cm (19.75") was documented between the center of the driver's side air bag module cover and the seat back support. The tilt steering column was adjusted to the mid position. The driver was properly restrained by the manual 3-point lap and shoulder belt system. Belt usage was observed by the first responders to the crash scene. There was no loading evidence on the webbing, however, the latchplate did yield routine wear marks associated with frequent usage. The adjustable upper anchorage (D-ring) was positioned 3.8 cm (1.5") above the lowest adjustment point.

Driver Kinematics

The driver was seated in a normal upright attitude with the seat track adjusted to a presumed forward track position **(Figure 3)**. She was properly restrained by the manual 3-point lap and shoulder belt system with the D-ring positioned to a low adjustment point. At impact, the frontal air bag system deployed. The driver's forward position at deployment resulted in the lower segment of the air bag to expand against her protruding abdomen and chest which initially restricted the deployment path of the air bag. This resulted in the vinyl transfers on the lower quadrant of the bag. In addition, the expanding air bag contacted her denim top which produced the fabric transfer at the 5 o'clock position. The expanding air bag contacted the chest, anterior neck, and face of the driver which resulted in multiple soft tissue injuries. She sustained a doubled-bordered parallel contusion over the right scapula, a chinstrap-like contusion with abrasion to the underside of the chin, three parallel contusions with abrasion of the right face, superficial lacerations, contusions and abrasions of the lower lip, ecchymosis between the eyebrows, bilateral subjunctival hemorrhages, and a hemorrhage of the left eyelid. The bag expanded across the anterior neck which probably hyperextended her head. The neck injuries included petechial hemmorrhages in the epiglottis and laryngeal mucosa, a 1 cm hemorrhage overlying the right hyoid bone, a 1.5 cm hemorrhage over the posterior cricoid cartilage, extradural hemorrhage of the spinal cord and dura, and petechial hemorrhages on the posterior neck.

Figure 3. Profile view of the driver's seated position in relation to the deployed air bag.

The driver responded to the 12 o'clock impact force by initiating a forward trajectory. Her lower extremities contacted the knee bolster which resulted in abrasions to the knees and lower legs. There was no contact evidence to the bolster. The left side of her head probably contacted the shoulder belt webbing and/or the left B-pillar during her rebound which resulted in left earlobe ecchymosis, a scalp contusion posterior to the left ear, and stippled hemorrhages over the left temporomandibular joint. The medical examiner concluded that the cause of death resulted from blunt force trauma to the neck with asphyxia. The blunt force trauma was associated with air bag deployment.

Passenger Demographics/Data

The front right occupant was a 32 year old male with a stated height of 180.3 cm (71.0") and weight of 76.5 kg (170.0 lbs.). He was seated in an upright position with the seat track adjusted to a rearward track position, 5.1 cm (2.0") forward of the full rearward position **(Figure 4)**. He was properly restrained by the manual 3-point lap and shoulder belt system. Belt usage was supported by the first responders at the crash scene who observed the passenger unconscious in his seat with the belt system buckled across his torso and pelvic regions. Rescue personnel cut the shoulder belt webbing at a point that was 147.3 cm (58.0") above the floor anchorage. Directly above the floor anchorage was an energy management loop in the belt webbing that was designed to separate under a significant

Figure 4. Profile view of the front passenger's seated position and the deployed air bag.

occupant load. This loop remained intact on this belt system.

The front right passenger stated that as his wife alerted him of the deer standing in the roadway, he initially failed to locate the animal. He noted that he probably leaned forward as he searched for the animal, detecting it in the eastbound travel lane. The passenger stated that his wife steered to the right as if she was attempting to travel around the animal onto the shoulder. As the vehicle departed the travel lane, the passenger probably reached with his right hand to brace against the upper right instrument panel, above the passenger side air bag module assembly.

The impact with the utility pole deployed the passenger air bag. The deploying passenger air bag probably contacted the right hand and forearm of the passenger which displaced the arm in an upward and rearward direction into the padded headliner. A scuff mark on the headliner was noted 66.0-67.3 cm (26.0-26.5") rearward of the windshield header and 25.4 cm (10.0") inboard of the right roof side rail. No injury resulted from the contact sequence. The non-tethered bag continued to expand against the forward positioned passenger, probably contacting his face and anterior neck. The passenger did not sustain injury (i.e., abrasions, contusions) of the soft tissue surrounding the face and neck. This contact scenario hyperextended his head which resulted in cervical strain and a herniated disc at C4-C5 and a small right paramidline herniation of C6-C7 which indented the thecal sac with near impingement the spinal cord.

The deploying air bag accelerated the passenger in a rearward direction which probably resulted in a rebound contact with the right upper B-pillar. As a result of the rebound trajectory, the passenger sustained a concussion and loss of consciousness. The passenger remained in an unconscious state for approximately 1.5 hours. He regained consciousness as the paramedics arrived on-scene. He reported a numbness in his hands and arms and was removed from the vehicle and transported to a local hospital where he was evaluated and prepared for ambulance transfer to a regional trauma center. He was hospitalized for an overnight period and released to attend to family matters.

Child Passenger Data

The child occupant positioned in the left rear of the Ford Explorer was not injured in the crash. The female passenger was transported to a local hospital for observation and was released to family members. At the time of the crash, the child occupant was 17 months old with a height of 68.6 cm (27.0") and weight of 10.8 kg (24.0 lbs.).

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CRASH DATA

Location:	County road	
State:	New Jersey	
Area /Type:	Rural/Undeveloped	
Crash Date/Time:	February 1997, nighttime hours	
Investigating Police Agency:	Local police	
Crash Type:	Single vehicle run-off-road, front left impact with a utility pole	
Occupant Injury Severity:	Driver -	Fatal outcome (AIS-1)
	Front right Occupant -	Moderate (AIS-2)
	Left Rear Child Occupant -	Not injured

AMBIENCE

Viewing Conditions:	Dark, not lighted
Weather:	Overcast
Precipitation:	Heavy snow
Road Surface:	Snow/ice covered

HIGHWAY

Type:	Minor arterial
Number of Lanes:	2
Width:	7.3 m (24.0')
Surface:	Snow/ice covered asphalt
Median:	None
Edge:	South edge - 2.2 m (7.2') paved shoulder North edge - 2.4 m (8.0') paved shoulder
Vertical Alignment:	Level
Horizontal Alignment:	Straight
Estimated Coefficient Of Friction:	.35
Traffic Density:	No other traffic

TRAFFIC CONTROLS

Signals:	None
Signs:	No pertinent signs
Markings:	Solid white edgelines, broken yellow centerlines (all lane markings were snow covered at time of crash)
Speed Limit:	80 km/h (50 mph)

VEHICLE

Description:	1996 Ford Explorer 4x4, 4-door sport utility vehicle
V.I.N.	1FMDU34X3TU (production number deleted)
Date of Mfg.	4/96
GVWR:	2,413 kg (5,320 lb)
Odometer:	12,932 km (8,036 miles)
Color:	Gray
Engine:	V-6, 4.0 L
Transmission:	4-speed automatic overdrive, column mounted transmission selector lever
Steering:	Power-assisted rack and pinion
Brakes:	Power-assisted four-wheel disc with anti-lock (ABS)
Padding:	Upper and mid instrument panel, soft-edged steering wheel rim and air bag module covers, door panels, integral head restraints, center console, sunvisors, headliner
Automatic Restraints:	Supplemental Restraint System (SRS) that consisted of driver and passenger frontal air bags which deployed as a resulted of the crash
Manual Restraints:	3-point lap and shoulder belts in the four outboard seated positions, front belt systems had adjustable upper anchorages (D-rings), center rear lap belt
Defects:	None
Tow Status:	Towed due to vehicle damage

VEHICLE DAMAGE

Exterior:

The 1996 Ford Explorer sustained moderate frontal damage **(Figure 5)** as a result of its impact sequence with a small diameter utility pole. Maximum crush was 26.7 cm (10.5") located at the front left bumper corner. The direct contact damage began 38.7 cm (15.25") left of center and extended 17.8 cm (7.0") to the left, terminating inboard of the bumper corner. The resultant damage pattern extended across the full width of the front bumper which resulted in a combined direct and induced damage length (Field L) of 135.3 cm (53.25").

Figure 5. Frontal damage to the Ford Explorer.

VEHICLE DAMAGE (CONT'D.)

Exterior (Cont'd.):

The crush profile at bumper level **(Figure 6)** was as follows: C1= 26.7 cm (10.5"), C2= 7.6 cm (3.0"), C3= 3.8 cm (1.5"), C4= 2 cm (0.8"), C5= -1.5 cm (-0.6"), C6= -3.8 cm (-1.5").

Damaged components included the front bumper and integral rub strip, grille, left headlamp assembly, left turn signal assembly, hood and the left front fender. The left wheelbase was reduced in length by 3.2 cm (1.25") from the original specification length of 283.2 cm (111.5").

Figure 6. Overhead view of the damage profile.

The secondary impact sequence occurred as the upper segment of the fractured utility pole fell onto the roof area of the Ford Explorer as the vehicle continued in a forward direction. The direct contact damage began 36.8 cm (14.5") forward of the left B-pillar and extended 25.4 cm (10.0") forward. The lateral extent of the direct damage extended from the outboard aspect of the left front door window frame 15.2 cm (6.0") inboard onto the roof panel. The pole impact produced a maximum crush value of 2.3 cm (0.9") that was located 47.0 cm (18.5") forward of the B-pillar and approximately 5.1 cm (2.0") inboard of the left side rail. The secondary damage is depicted in **Figure 7.**

Figure 7. Secondary damage to the left roof area.

Collision Deformation Classification (CDC):

CDC:	Object Contacted	Event No.
12-FLEN-2	Utility Pole	1
00-TPLN-1	Fractured pole	2

Repair Cost:

$6500.00 (estimated)

Interior:

The interior damage to the Ford Explorer was rated as minor and was associated with occupant contact and deployment of the driver and passenger frontal air bag system. Both air bags deployed as designed from the respective module assemblies. There was no intrusion of interior components into the passenger compartment area.

The driver was properly restrained by the manual belt system which limited her movement within the vehicle, thus limiting possible contact with interior components. The soft edged steering wheel rim was abraded superficially at the 3 o'clock sector between the right side spokes. The

VEHICLE DAMAGE (CONT'D.)
Interior (Cont'd.):

abrasions possibly resulted from contact with the driver's right finger nails and/or rings during the crash and subsequent deployment of the air bag system. Scuff marks surrounded the abrasions which were 8.9 cm (3.5") apart.

Black vinyl transfers were noted to the deployed membrane of the driver's air bag at the 6 o'clock sector. The vertically oriented transfers resulted from bag expansion against the lower module cover flap due to the forward position of the driver which probably obstructed the normal deployment path of the cover flaps and air bag. The small cluster of five (5) transfers, which measured 6.1 cm (2.4") horizontally and 5.7 cm (2.25") vertically, were contained within a large bracket transfer that measured 18.4 cm (7.25") in width and was located 12.7-21.6 cm (5.0-8.5") forward of the peripheral seam. A faint light blue fabric transfer was noted to the bag at the 5 o'clock sector. The transfer, which probably resulted from contact against the driver's blue denim-type top, was approximately 1.9 cm (0.75") in diameter and located on the forward panel of the driver bag 6.4 cm (2.5") inboard if the peripheral seam.

In addition to the above transfers, several stains were noted to the driver's air bag at the 3 o'clock sector. These stains appeared to have been blood stains that were diluted by water (precipitation) after the crash. An elongated reddish transfer was noted on the outboard aspect of the front left shoulder belt webbing. This transfer also had the appearance of a diluted-type blood transfer. There was no loading transfers on the belt system.

The trailing edge of the left side trim panel over the left roof side rail disengaged from the attachment clips due to the subsequent roof impact by the fractured pole.

AUTOMATIC RESTRAINT SYSTEM

Figure 8. Overall view of the deployed frontal air bags.

The Ford Explorer was equipped with a Supplemental Restraint System (SRS) that consisted of frontal air bags **(Figure 8)** for the driver and front right passenger positions which deployed as a result of the frontal impact sequence with the utility pole. The driver's air bag deployed from a symmetrical H-configuration module cover assembly that was concealed within the four-spoke steering wheel rim. The upper flap was contoured to the top and vertical face of the module assembly. The vertical aspect of the upper flap was 7.6 cm (3.0") in height with an overall width of 22.9 cm (9.0"). The sides of the flap were contoured and tapered to a width of 17.8 cm (7.0") at the horizontal tear seam. The vehicle name FORD was embossed in the mid portion of the upper flap. Horn symbols were also embossed in the lower outboard quadrants of the upper flap for the contact points for horn activation. The lower module cover flap was 9.1 cm (3.6") in height width an overall width of 17.8 cm (7.0") at the horizontal tear seam. The side profile of the lower

flap was contoured to the lower spokes of the steering wheel rim. The identifiers SRS and AIRBAG were embossed into the mid aspect of the lower flap. The overall thickness of the cover flaps was 4.8 mm (3/16"). There was no exterior damage or occupant contact to the cover flaps.

The deployed driver's air bag was constructed of two woven nylon-type fabric panels sewn with an internal peripheral seam. The forward panel (panel exposed to the driver) was lined with a neoprene liner while the back panel was not lined internally. The bag was 63.5 cm (25.0") in diameter in its deflated state and was vented by two 1.3 cm (0.5") ports located at the 11 and 1 o'clock sectors. The vent ports were centered 7.6 cm (3.0") inboard of the peripheral seam. Internally, the driver's air bag was tethered by two wide-band tether straps that were 12.7 cm (5.0") in width attached at the 12 and 6 o'clock positions.

There was no facial contact evidence (i.e., make-up and/or tissue transfers) on the driver's air bag. Her forward position, however, restricted the normal deployment path of the air bag as evidenced by black vinyl transfers on the inside surface of the lower air bag module cover flap. These transfers consisted of five (5) vertically oriented transfers that were bordered vertically by two semi-circular striations which covered an area of 18.4 cm (7.25") horizontally and 8.9 cm (3.5") vertically. Adjacent to these black vinyl transfers at the 5 o'clock sector was a 1.9 cm (0.75") light blue fabric transfer that probably resulted from air bag expansion against the driver's denim top. This transfer was located on the forward panel of the driver bag, 6.4 cm (2.5") inboard of the peripheral seam.

The front passenger air bag was configured in a mid mount module assembly in the right upper instrument panel. The single top hinged module cover flap was 37.1 cm (14.6") in width and 17.1 cm (6.75") in height. The cover flap opened at the designated tear points and was not damaged. SRS AIRBAG was embossed in the lower right quadrant of the module cover flap. The following identification was embossed in the lower left quadrant on the internal surface of the passenger side module cover flap:

VT 438 C CAV3
P/N 2000995N
MAT SAE TEEE

The passenger air bag membrane was rectangular in shape and measured 78.7 cm (31.0") horizontally and 48.3 cm (19.0") vertically. The bag was vented with two 5.1 cm (2.0") diameter ports located on the side panels of the bag at the 3 and 9 o'clock positions. The passenger side air bag was not tethered and had a maximum rearward excursion of 62.2 cm (24.5") in its deflated state. There were no identifiers on the passenger bag or evidence of occupant contact on the bag membrane.

MANUAL RESTRAINT SYSTEMS

The Ford Explorer was equipped with manual 3-point lap and shoulder belt systems in the four outboard seated positions of the vehicle. The center rear seated position was equipped with a fixed length adjustable lap belt system.

The front belt systems consisted of a continuous loop webbings that extended from the B-pillar mounted inertia activated locking retractor. Both front belt systems were routed through an adjustable upper anchorage (D-ring) and buckled into a center mounted buckle assembly. The driver's side D-ring was found adjusted to a mid position that was 4.8 cm (1.9") below the top position and 3.8 cm (1.5") above the lowest adjustment position. The front right belt system D-ring was found adjusted 1.9 cm (0.75") above the full down position, or 7.1 cm (2.9") below the top adjustment point. The lower anchorage point for the lap belt segment of the webbing was secured to the base of the B-pillars.

The first responders to the crash scene observed the driver in the left front seat with the manual belt system properly positioned across her torso. They noted that the shoulder belt webbing rode high on her left shoulder into the neck area. Paramedics unbuckled the belt system and allowed the webbing to retract into the B-pillar prior to removal of the driver. There was no loading evidence on the left front belt system. Routine wear marks were present on the latchplate for the left front belt system which supported frequent usage. A blood-type stain was present on the shoulder belt aspect of the webbing. The stain was located 90.2-96.5 cm (35.5-38.0") above the latchplate stop button which was positioned on the webbing 57.2 cm (22.5") above the floor anchorage.

The front right occupant was restrained by the manual 3-point lap and shoulder belt system. There was no evidence of belt loading on the webbing or hardware of the system. Routine wear marks on the latchplate supported frequent use of the belt system. Belt usage was determined from observations by the first responders to the crash scene and the subsequent cutting of the belt webbing. The webbing was cut in a perpendicular direction to the webbing 147.3 cm (58.0") above the floor anchorage point. The upper aspect of the cut segment retracted into the right B-pillar. The front right belt system was equipped with an energy management loop incorporated into the lower segment of the lap belt directly above the floor anchorage. The loop did not deploy. The right side D-ring was adjusted to a point that was 1.9 cm (0.7") above the full down position and 7.4 cm (2.9") below the full up adjustment position.

VEHICLE VELOCITY ESTIMATES

Travel Speed:	32-48 km/h (25-30 mph)
Impact Speed:	32.6 km/h (20.3 mph)
Total Delta V:	13.0 km/h (8.1 mph)
Longitudinal Delta V:	-13.0 km/h (-8.1 mph)
Lateral Delta V:	0.0 km/h
Energy Dissipated:	13,297 joules

COLLISION SEQUENCE

Pre-Crash:

On the evening of the crash, the driver and her husband were attending to the needs of their 17 month old daughter who was experiencing a high fever. She had been ill for several days and was under the care of her pediatrician. Her temperature remained high (102-103 degrees F), therefore the parents made the decision to transport the child to a local hospital. The weather conditions were poor for the coastal area which was blanketed with the first snow of the winter season. The husband dressed for the winter conditions and exited the residence, carrying the child to the Ford Explorer that was parked in the driveway. He proceeded to the vehicle and placed the child in the forward facing Evenflo child safety seat that was positioned in the left rear of the Explorer. He then proceeded to start the Ford Explorer and activate the defrosters to aid in clearing the windshield of the accumulated snow. His wife subsequently exited the residence and proceeded toward the vehicle, walking on the snow and ice covered sidewalk. On her approach to the vehicle, she slipped and fell on the sidewalk, possibly contacting her face on the ground. The husband assisted his wife to her feet and she proceeded to the driver's side of the Explorer. Although the wife denied injury from the fall, she possibly sustained a superficial abrasion of the face from the ground contact.

Without discussion, the wife entered the left front door of the Ford Explorer to drive the vehicle to the hospital. Her husband noted that his wife preferred to drive the Explorer due to its height over automobiles. The husband entered the front right position with the child secured in the child safety seat in the left rear position of the vehicle. All occupants were properly restrained.

Figure 9. Pre-crash trajectory of the Ford Explorer.

The driver backed out of the driveway onto the local street and proceeded 0.4 km (0.3 miles) in a northerly direction to the stop sign at the mouth of the intersection for their subdivision. The husband stated that the driver noted the snow covered conditions of the two lane county road as she initiated a right turn to proceed in an easterly direction. As they had traveled a distance of 1.6 km (1.0 mile) on the snow covered county road **(Figure 9)**, the driver detected a deer in the eastbound travel lane. She alerted the front right occupant of its presence, however, he failed to detect the animal initially due to the snow conditions. The occupant subsequently detected the deer and noted to the investigating officer that the animal was facing in a northerly direction with its left side exposed to the travel direction of the Explorer. The vehicle's travel speed was estimated at 40-48 km/h (25-30 mph).

COLLISION SEQUENCE (CONT'D.)

Pre-Crash (Cont'd.)

In an attempt to avoid the deer, the driver initiated a clockwise steering input which redirected the vehicle toward the south (right) shoulder. In addition, she probably applied a braking force to the Explorer on the straight and level road surface. As a result of the steering maneuver, the Explorer departed the eastbound travel lane at a departure angle of approximately 8-10 degrees and traveled a police documented distance of 18.4 m (60.3') while traversing the snow covered paved shoulder **(Figure 10)**.

Figure 10. Departure of the right front tire from the paved shoulder.

Crash:

The front left headlight area of the Ford Explorer impacted a utility pole that was located at the outboard edge of the south shoulder. The pole was approximately 22.9 cm (9.0") in diameter and supported a guy wire system for a utility pole located on the opposite side of the roadway. The vehicle's impact speed was computed at 32.6 km/h (20.3 mph) by the damage and trajectory algorithm of the WinSMASH program. Initial contact involved the front left bumper fascia and left headlight area of the Explorer, 38.7-56.5 cm (15.25-22.25") left of the vehicle's centerline. The crash resulted in an impact force of 12 o'clock and produced a maximum residual bumper crush value of 26.7 cm (10.5"). The impact fractured the wooden pole at its base as the vehicle continued on its pre-crash trajectory in a southeasterly direction. A barrier equivalent speed change of 13.0 km/h (8.1 mph) was computed by the damage algorithm of the WinSMASH program.

As the Explorer continued on its post-crash trajectory, the upper aspect of the fractured pole impacted the left roof side rail area of the vehicle. The non-horizontal (00) impact force produced 2.3 cm (0.9") of residual crush to the left roof/side rail area. The subsequent impact did not influence the post-crash trajectory of the vehicle.

The initial frontal impact with the Ford Explorer probably tripped the fuel cutoff switch which stalled the V-6 engine as the vehicle continued in a tracking mode, decelerated by the engine and drivetrain, on a diagonal trajectory off the south shoulder. The vehicle's center of gravity traveled approximately 15.2 m (50.0') southeast of its at impact position prior to coming to rest approximately 7.0 m (23.0') outboard of the south edgeline.

Post-Crash:

Occupant Activities - The driver was probably rendered unconscious immediately as a result of her involvement with the deploying frontal air bag. She subsequently expired with no apparent attempt to exit the vehicle. The driver came to rest in an upright attitude in the left front seat with the manual belt system in position around her body. Her head was slumped onto her left shoulder. The front right passenger was rendered unconscious by his involvement with the

deploying front right air bag and probable rebound contact with the right B-pillar. At rest, the passenger was upright in the front right seated position with the manual belt system in place across his body. The child occupant was found in a conscious and alert secured in the child restraint in the left rear position of the vehicle.

First Responder On-Scene - A passing motorist was traveling in a westerly direction on the county road and noted the Ford Explorer positioned off-road at rest with its headlights and taillights illuminated. He stopped to check the condition of the occupants and failed to detect a pulse for the driver. He subsequently checked for a pulse of the front right passenger and noted an active pulse for the apparent unconscious passenger. The motorist returned to his vehicle and used his cellular telephone to notify the local police department of the crash.

Rescue/Emergency Response - Paramedics receive the call and arrived on-scene within five minutes of the call, or approximately 1.5 hours following the crash. The paramedics were the first emergency responders to the scene having arrived prior to the arrival of the local police. On scene, they noted the doors to the vehicle were closed. Initially, the paramedics opened the left front door and observed the driver in the left front seat with the shoulder belt in position , riding high on her neck area. They noted that she was visibly pregnant and pulseless. In addition, the paramedics observed the deployed air bag system. Paramedics administered a portable monitoring system and determined the driver had expired. Results were forwarded via telemetry to a hospital where a physician pronounced the driver deceased 20 minutes following the paramedics arrival on-scene.

The passenger was initially observed by the paramedics as unconscious within the vehicle. The driver noted that as the paramedics approached the vehicle and began to administer aid the occupants, he began to regain consciousness as he detected light from flashlights. The driver's body was removed from the vehicle to provide access to the front right passenger of the Explorer. He was subsequently removed from the vehicle on a backboard and transported by ambulance to a local hospital for initial evaluation.

The child occupant was observed in an alert state and was removed from the vehicle and transported to a local hospital for examination of possible injuries.

Police Activities - The investigating police officer arrived on-scene immediately following the arrival of the paramedics. The officer requested the assistance of additional personnel from the department. The police noted in their report that as they arrived on-scene, the vehicle was positioned off-road with the lights and windshield wipers in the on-position. The police initiated their on-site investigation and documentation of the crash scene.

Scene Clearance - Following the on-site investigation, the Ford Explorer was towed from the scene and impounded by the local police.

HUMAN DEMOGRAPHICS/DRIVER DATA

Driver:	37 year old female, 6 months pregnant
Height:	163.0 cm (64.0")
Weight:	55.7 kg (145.0 lb)
Manual Restraint	
Usage:	3- point lap and shoulder belt system
Usage Source:	Vehicle inspection, PAR, statements from first responders at crash scene
Eyeware:	None
Vehicle Familiarity:	8 months
Route Familiarity:	Daily
Medical Treatment:	N/A, expired at scene

DRIVER INJURIES

Injury	Severity (AIS-90 Code)	Injury Mechanism
Subjunctival hemorrhages and a few scattered petecial hemorrhages in the palpebral and bulbar conjunctivia bilaterally	Not codeable under AIS-90	Deploying driver's side air bag
Small petechiae hemorrhage of the left eyelid	Not codeable under AIS-90	Deploying driver's side air bag
Purplish ecchymotic area over the glabella, left of midline between the eyebrows, 0.25" transverse by 0.1" vertically	Minor (290402.17)	Deploying driver's side air bag
Left earlobe ecchymosis	Minor (290402.12)	Probable rebound contact against the shoulder belt webbing and/or the left B-pillar
Scalp contusion posterior to the left ear	Minor (190402.12)	Probable rebound contact against the shoulder belt webbing and/or the left B-pillar

Purple-like (up to 1 cm) stippled hemorrhages over the left temporomandibular joint, 1.5" x 1.25" area	Not codeable under AIS-90	Probable rebound contact against the shoulder belt webbing and/or the left B-pillar
Left lower lip contusion with abraded surface	Minor (290402.18) Minor (290202.18)	Deploying driver's side air bag
Labial mucosa of lower lip with multiple superficial lacerations	Minor (243204.18)	Deploying driver's side air bag
Three parallel contusions of the right face that extend from below the level of the lip to the underside of the chin with abrasion	Minor (290402.11) Minor (290202.11)	Deploying driver's side air bag
Chinstrap-like contusion with abrasion to the underside of the chin	Minor (390402.15) Minor (390202.15)	Deploying driver's side air bag
0.25" abrasion below the right patella and over lateral aspect of right leg, 0.5" abrasion of the mid leg 1.0" below the patella	Minor (890202.11) Minor (890202.11)	Knee bolster
0.5" x 0.75" abrasion above left knee	Minor (890202.12)	Knee Bolster
0.75" x 0.25" abrasion on mid left lower leg	Minor (890202.12)	Knee Bolster
Double-bordered parallel contusion over the upper right scapula	Minor (690402.11)	Deploying driver's side air bag
Petechial hemorrhages (almost tardieu hemorrhage) on the posterior neck	Not codeable under AIS-90	Hyperextension of the head from the deploying driver's side air bag
Scattered petechial hemorrhages on the pleural surfaces	Not codeable under AIS-90	Deploying driver's side air bag

Sparse petechial hemorrhages in the epiglottis and laryngeal mucosa	Not codeable under AIS-90	Deploying driver's side air bag
1 cm focal area of hemorrhage overlying the right hyoid bone	Not codeable under AIS-90	Deploying driver's side air bag
1.5 cm hemorrhage over the posterior cricoid cartilage on the right side	Not codeable under AIS-90	Deploying driver's side air bag
Extradural hemorrhage of the cervical spinal cord and dura	Not codeable under AIS-90	Hyperextension of the head from the deploying driver's side air bag
Cause of Death - Blunt force trauma with asphyxia	Not codeable under AIS-90	Deploying driver's side air bag against her anterior neck

* All injuries were documented in the Medical Examiner's autopsy report.

DRIVER KINEMATICS

The 37 year old female driver of the Ford Explorer was 6 months pregnant at the time of the crash. Her husband noted that within recent weeks of the crash, she experienced dizziness and blackouts on several occasions that he attributed to the pregnancy. The dizziness usually occurred from a sudden change of position, such as standing from a sitting position. The husband further noted that she never experienced the dizziness while driving.

On the evening of the crash, the driver and her husband were attending to the needs of their 17 month old daughter who was experiencing a high fever. Following a telephone consultation with the pediatrician, the driver and her husband dressed for the winter conditions and prepared to transported the child to a local hospital. The driver was dressed in a brown leather jacket over a blue denim top and black stretch (maternity) pants. She was not wearing eyeglasses or contact lenses. As she exited the house and walked to the Ford Explorer that was parked in the driveway, the driver slipped on the snow and ice covered sidewalk and fell to the ground. She did not complain of injury from the fall and proceeded to the driver's side of the Explorer.

The driver entered the vehicle and properly buckled the manual 3-point lap and shoulder belt system across her hips and torso. The husband noted that due to the pregnancy, the driver wore the lap belt properly across her hips and below her protruding abdomen. Belt usage was supported by statements from the first responders at the crash scene who observed the belt in position across the driver and from evidence on the belt system. The latchplate yielded routine usage wear marks and an apparent diluted blood stain was noted on the shoulder belt webbing.

DRIVER KINEMATICS (CONT'D.)

There was no loading evidence on the belt system. The adjustable D-ring was positioned 3.8 cm (1.5") above the lowest adjustment point.

Figure 11. Right profile view of the driver's seat position and the deployed air bag.

The driver was presumed to have been seated in a forward position with respect to the steering wheel assembly with her seat adjusted to a forward track position **(Figure 11)**. Her husband noted that she preferred to driver the Explorer due to its height over automobiles and that she drove with the seat track and back rest adjusted to forward positions. At the time of our inspection of the vehicle, which occurred over four months after the crash, the driver's seat track was adjusted to a mid track position, 11.7 cm (4.6") rearward of the full forward position and 13.0 cm (5.1") forward of the full rearward position. The seat back was adjusted to the most vertical position with a measured angle of 20 degrees at the lumbar support area. With the seat assembly adjusted to this position, the horizontal distance between the mid point of the air bag module cover assembly and the seat back support was 50.1 cm (19.75"). The tilt steering wheel was adjusted to a mid position.

On the approach to the crash scene, the driver was seated in an upright attitude. She probably had both hands positioned on the steering wheel rim as she was driving in poor conditions due to the heavy wet snow. The driver detected a deer in the roadway directly ahead of her path of travel. She called out to her husband to alert him of the animal as she initiated avoidance action by steering to the right and braking the ABS equipped vehicle. The avoidance action redirected the vehicle toward the right shoulder of the roadway. As a result of her detection of the deer and the subsequent avoidance action, the driver probably moved slightly forward in her seat which would have positioned her closer to the driver's side air bag module assembly.

At impact with the wooden utility pole, the vehicle experienced a 12 o'clock impact force and a longitudinal deceleration that was sufficient to deploy the frontal driver and passenger air bag system. As the air bag system deployed, the driver's forward position impeded the deployment path of the driver's side air bag. This was evidenced by black vinyl transfers on the air bag membrane at the 6 o'clock sector from bag expansion against the inner surface of the lower module cover flap. The air bag subsequently expanded against her thoracic and/or protruding abdominal area as she initiated a forward trajectory in response to the frontal impact force. Her forward trajectory and subsequent loading of the shoulder belt webbing probably resulted in her head jackknifing forward of her body into the path of the expanding bag membrane.

The deploying air bag against her torso/abdominal area resulted in a faint blue fabric transfer on the forward panel of the air bag at the 5 o'clock sector. Although no abdominal or fetal injuries

DRIVER KINEMATICS (CONT'D.)

were noted by the medical examiner, the continued expansion of the air bag produced multiple soft tissue injuries (AIS-1) to the driver's upper torso, neck and face.

The driver's involvement with the expanding air bag resulted in a chinstrap-like contusion with abrasion to the underside of her chin, sparse petechial hemorrhages in the epiglottis and laryngeal muscosa, a 1 cm focal area of hemorrhage overlying the right hyoid bone, a 1.5 cm hemorrhage over the posterior cricoid cartilage on the right side, three parallel contusions of the right face that extended from below the level of the lip to the underside of the chin with abrasion, labial muscosa of the lower lip with multiple superficial lacerations, a lower lip contusion with abrasion, a purplish ecchymotic area over the glabella area, a small petechiae hemorrhage of the left eyelid, and subjunctivial hemorrhages with a few scattered petecial hemorrhages in the palpebral and bulbar conjunctivia bilaterally.

The bag expansion to the underside of the driver's chin and facial regions resulted in a hyperextension of the head and extradural hemorrhage of the cervical spinal cord and dura and petechial hemorrhages on the posterior neck.

Air bag expansion against the chest of the driver resulted in a double-bordered parallel contusion over the upper right scapula and scattered petechial hemorrhages on the pleural surfaces. These thoracic injuries probably occurred as the body was responding in a forward direction which allowed her lower extremities to engage against the knee bolster. As a result of bolster contact, the driver sustained multiple abrasions over the knees and legs below the level of the patella. There was no contact evidence to the knee bolster.

The expansion of the air bag against the driver probably displaced her in an upward and rearward direction which resulted in probable head contact to the shoulder belt webbing and the left B-pillar and/or adjustable D-ring. There was no contact evidence to support this trajectory, however, the driver sustained a scalp contusion posterior to the left ear, ecchymosis of the left earlobe, and purple-like stippled hemorrhages over the left temporomandibular joint area. No underlying injuries were discovered during the autopsy.

The driver subsequently rebounded and came to rest in an upright seated position in the left front seat with her head slumped onto her left shoulder. There was no evidence of an apparent struggle by the driver within the vehicle as she came to rest. The left front door remained closed and the manual belt system remained buckled across her body, therefore she was probably rendered unconscious immediately following her involvement with the deploying air bag. The medical examiner identified the cause of death as blunt force trauma to the anterior neck area with resulting asphyxiation.

FRONT RIGHT PASSENGER DEMOGRAPHICS/DATA

Age/Sex:	32 year old male
Height:	180.3 cm (71.0")
Weight:	76.5 kg (170.0 lb)
Manual Restraint Usage:	3-point lap and shoulder belt system
Usage Source:	Vehicle inspection, passenger statements
Eyeware:	Prescription eyeglasses, displaced from face
Mode of Transport From Scene:	Ambulance to a local hospital and transferred to a regional trauma center where he was admitted (one day) for treatment of his injuries

FRONT RIGHT PASSENGER INJURIES

Injury	Injury Severity (AIS-90)	Injury Mechanism
Small right paramidline disc herniation at C6-C7, indents the thecal sac and almost impinges the spinal cord	Moderate (650202.2,6)	Deploying passenger side air bag
Small central disc herniation at C4-C5 which apparently represents a small bulge	Moderate (650202.2,6)	Deploying passenger side air bag
Cervical strain with weakness of the upper extremities	Minor (640278.1,6)	Deploying passenger side air bag
Concussion (not further specified)	Minor (160499.1,0)	Deploying passenger side air bag/possible rebound contact into right B-pillar/D-ring
Pain over the right posterior scalp	Not codeable under AIS 90	Rebound contact into the right B-pillar/D-ring
*Pain over right occipital area of scalp	Not codeable under AIS-90	Rebound contact into the right B-pillar/D-ring

All driver related injuries were documented in the hospital medical records except the posterior scalp pain which was provided through interview data.

FRONT RIGHT PASSENGER KINEMATICS

The 32 year old male front right passenger of the Ford Explorer was seated in an upright attitude on the vehicle's approach to the crash scene. His seat track was adjusted to a rearward position, 5.1 cm (2.0") forward of the full rearward position with the seat back support set to a slightly reclined position. He was properly restrained by the manual 3-point lap and shoulder belt system, however, there was no loading evidence on the belt system. Belt usage was determined from observations made by the first medical responders to the crash scene who observed the occupant positioned in the vehicle in an unconscious state with the belt system buckled across his torso and pelvic regions. In addition, a scissor-like cut of the belt webbing was made by rescue personnel during the in-vehicle treatment of the occupant.

Prior to the utility pole impact, the driver of the Ford Explorer noted the deer in the roadway and alerted the front right passenger. He initially failed to detect the animal, however, the passenger probably leaned in a forward direction in search of the deer, placing himself within the deployment path of the passenger side air bag. Although unconfirmed by injury, the passenger possibly extended his arms in a forward direction while searching for the animal, or in an attempt to brace against the instrument panel prior to impact with the pole.

The passenger air bag deployed from its mid mount configuration within the right instrument panel. The passenger air bag was a non-tethered design with a maximum rearward excursion of 62.2 cm (24.5") in its deflated state **(Figure 12)**. The horizontal distance between the adjusted front right seat position and the leading edge of the mid mount passenge air bag module cover was 83.2 cm (32.75").

Figure 12. Front right passenger seated position and the deployed air bag.

The initial expansion of the passenger air bag probably resulted in contact with the anterior aspects of the front right occupant's forearms. Although no injury occurred, the occupants left wrist and/or forearm was probably displaced laterally to the left into the right side of the interior rear view mirror. The mirror glass was fractured right of center and the mirror assembly was displaced in a downward direction. Three fabric fibers were embedded into the mirror at the day/night adjustment lever. The occupants right arm was probably displaced in an upward direction in an arcing motion and contacted the padded headliner directly above his seated position. A longitudinally oriented scuff marked was present on the headliner 66.0-67.3 cm (26.0-26.5") rearward of the windshield header. Again, no injury resulted. The occupants heavy weight jacket probably protected the forearms from superficial soft tissue injury commonly associated with air bag/forearm contact.

The passenger side air bag continued to expand against the anterior aspect of the occupant's chin and anterior neck, extending the head in a rearward direction. As a result of the extension, the

FRONT RIGHT PASSENGER KINEMATICS (CONT'D.)

occupant sustained a small central disc herniation at C4-C5 and a small right paramidline disc herniation at C6-C7 which indented the thecal sac and nearly impinged the spinal cord (AIS-2).

In addition to the disc herniation, the passenger sustained cervical strain with weakness of the upper extremities. He did not sustain soft tissue injury of the neck, chin, and/or face. The continued expansion of the passenger air bag displaced the occupant in a rearward direction. The right occipital region of his scalp probably impacted the right B-pillar and/or D-ring which resulted in pain to the contacted region. The occupant also sustained a concussion with an unspecified loss of consciousness from his involvement of the expanding air bag and/or subsequent contact with the rigid pillar area. There was no contact evidence on the deployed passenger air bag to support the passenger's involvement with the expanding membrane.

As a result of the extension of the cervical spine and the closed head injury, the occupant was rendered unconscious for an occupant estimated time frame of approximately 1 hour and 30 minutes. This length of conscious was not medically confirmed, however, as rescue personnel arrived at the scene of the crash, the front right occupant was found to be in an unconscious state positioned in an upright attitude in the front right seat with the belt system in place across his torso and pelvic regions. He subsequently regained consciousness as rescue personnel initiated emergency procedures at the crash scene. The emergency personnel cut the shoulder belt webbing prior to removing the occupant from the vehicle. The webbing was cut at a point that was 147.3 cm (58.0") above the floor anchorage.

MEDICAL TREATMENT

The front right passenger was removed from the vehicle and transported by ambulance to a local hospital where he was evaluated and treated for his injuries. He was prepared and transferred to a major trauma center and was admitted during the early morning hours. An MRI was performed on his cervical spine which identified the nature and extent of his injuries. He was discharged from the trauma center on the day following admission to attend to the needs of his family.

CENTER REAR PASSENGER DEMOGRAPHICS

Age/Sex:	17 month old female
Height:	68.6 cm (27.0")
Weight:	10.9 kg (24.0 lb)
Restraint Usage:	Restrained in a forward facing Evenflo Champion child safety seat. The restraint was secured in the vehicle by the manual lap belt system.
Mode of Transport From Scene:	Ambulance to a local hospital where she was examined for possible injury and released.

CENTER REAR PASSENGER INJURIES

Injury	Injury Severity (AIS-90	Injury Mechanism
Not injured	N/A	N/A

CENTER REAR PASSENGER KINEMATICS

The child passenger was positioned and secured in the vehicle by her father prior to the departure from their residence. She had developed a high temperature and was recommended to the local emergency room by her pediatrician. During the crash sequence, the child remained secured in the child safety seat and was not injured by the crash forces.

Following the crash, she remained in the restraint for the estimated time frame of 1 hour and 30 minutes. During this time, the driver had expired and the front right occupant was rendered unconscious as a result of his head and cervical injuries. The vehicle's engine apparently stalled during the crash which allowed the vehicle's interior to cool to the ambient temperature. As a result of the child's exposure to the cold, her fever had dropped to within normal limits. She was subsequently removed from the vehicle by emergency personnel and transported to a local hospital where she was examined for possible injury and released to family members.