

**CRASH DATA RESEARCH CENTER**

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**CALSPAN ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION  
INVESTIGATION**

**CASE NO: CA04-005**

**VEHICLE: 2002 FORD EXPLORER**

**LOCATION: MARYLAND**

**CRASH DATE: FEBRUARY 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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<i>16. Abstract</i> This on-site investigative effort focused on the performance of the side impact Inflatable Curtain (IC) and the fatal injury sources for a 60-year-old female driver of a 2002 Ford Explorer. The Explorer was equipped with frontal air bags and inflatable curtain (IC) side air bags. A 35-year-old female front right passenger also occupied the Explorer. Both occupants were restrained by the manual 3-point lap and shoulder belts. The driver of the Explorer entered a four-leg intersection that was controlled by three-phase traffic signals. A 24-year-old male driver of a Chevrolet Astro minivan was operating the vehicle on the northbound travel lanes at a high rate of speed on approach to the intersection. He was attempting to elude police, who had previously abandoned the pursuit due to safety concerns. As the Explorer entered the intersection, the driver of the Explorer did not detect the approaching Astro minivan. The driver of the minivan disregarded a red traffic signal and proceeded into the intersection at a police-estimated speed of 113 km/h (70 mph). The front of the Astro minivan struck the left side of the Explorer. The impact resulted in severe damage to both vehicles and was sufficient to deploy the left side IC in the Explorer. The impact deflected the Explorer rapidly to the right across the northwest quadrant of the intersection. The Explorer turned onto its right side and slid longitudinally along the curbed median. The curb contact to the right front side step bar caused the Explorer to right itself and travel across the median in a tracking mode to final rest in the southbound travel lanes. The driver of the Explorer sustained police-reported fatal head injuries as a result of passenger compartment intrusion. She was removed from the vehicle upon arrival of rescue personnel and transported by ambulance to a local hospital located near the crash site. The driver expired approximately 20 minutes after the crash due to head, cervical, and thoracic injuries. The 35-year-old female front right passenger sustained a police-reported spleen injury and other trauma. She was transported by ambulance to a local hospital and admitted for treatment.			
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**CALSPAN ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION  
INVESTIGATION  
CASE NO.: CA04-005  
LOCATION: MARYLAND  
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CRASH DATE: FEBRUARY 2004**

***BACKGROUND***

This on-site investigative effort focused on the performance of the side impact Inflatable Curtain (IC) and the fatal injury sources for a 60-year-old female driver of a 2002 Ford Explorer (**Figure 1**). The Explorer was equipped with frontal air bags and inflatable curtain (IC) side air bags. A 35-year-old female front right passenger also occupied the Explorer. Both occupants were restrained by the manual 3-point lap and shoulder belts. The driver of the Explorer entered a four-leg intersection that was controlled by three-phase traffic signals. A 24-year-old male driver of a Chevrolet Astro minivan was operating the vehicle on the northbound travel lanes at a high rate of speed on



**Figure 1. On-scene view of damaged Ford Explorer**

approach to the intersection. He was attempting to elude police, who had previously abandoned the pursuit due to safety concerns. As the Explorer entered the intersection, the driver of the Explorer did not detect the approaching Astro minivan. The driver of the minivan disregarded a red traffic signal and proceeded into the intersection at a police-estimated speed of 113 km/h (70 mph). The front of the Astro minivan struck the left side of the Explorer. The impact resulted in severe damage to both vehicles and was sufficient to deploy the left side IC in the Explorer. The impact deflected the Explorer rapidly to the right across the northwest quadrant of the intersection. The Explorer turned onto its right side and slid longitudinally along the curbed median. The curb contact to the right front side step bar caused the Explorer to upright itself and travel across the median in a tracking mode to final rest in the southbound travel lanes. The driver of the Explorer sustained police-reported fatal head injuries as a result of passenger compartment intrusion. She was removed from the vehicle upon arrival of rescue personnel and transported by ambulance to a local hospital located near the crash site. The driver expired approximately 20 minutes after the crash due to head, cervical, and thoracic injuries. The 35-year-old female front right passenger sustained a police-reported spleen injury and other trauma. She was transported by ambulance to a local hospital and admitted for treatment.

This crash was reported to the Crash Investigation Division of the National Highway Traffic Safety Administration by the investigating police agency due to the deployment of the 2002 Ford Explorer's left side IC and the fatal injuries sustained by the driver. An on-site investigation was assigned to the Calspan Special Crash Investigations team on February 18, 2004. Cooperation was established with the investigating police agency and a copy of the Police Accident Report (PAR) and on-scene photographs were obtained. The on-site investigation was conducted on February 25, 2004.

**SUMMARY**

**Vehicle Data – 2002 Ford Explorer**

The 2002 Ford Explorer was identified by the Vehicle Identification Number (VIN): 1FMDU73E92Z (production sequence omitted). The Explorer was a four-door, 4 x 4, sport utility vehicle that was configured with a 4.0 liter, V-6 engine, a five-speed automatic transmission, four-wheel disc brakes with anti-lock, power steering, a tilt steering wheel, and a sunroof. The Explorer’s odometer could not be read due to the lack of electrical power to the vehicle. The Explorer was configured with Michelin Cross Terrain P235/70R16 tires. The manufacturer’s recommended tire pressure was unknown as the manufacturer’s label was inaccessible due to a jammed door. The specific tire data at the time of the SCI vehicle inspection was as follows:

<b>Position</b>	<b>Measured Pressure</b>	<b>Measured Tread</b>	<b>Restricted</b>	<b>Damage</b>
LF	207 kPa (30 PSI)	7 mm (9/32”)	No	None
LR	193 kPa (28 PSI)	6 mm (8/32”)	No	None
RF	0.0 kPa	6 mm (8/32”)	No	Tear in tread
RR	186 kPa (27 PSI)	6 mm (8/32”)	No	None

The seating positions in the Explorer were configured with front bucket seats with integral head restraints, and a rear split bench seat with folding backs with adjustable head restraints for the outboard positions. Both front seats were slightly reclined at the time of the vehicle inspection.

**Vehicle Data – 1989 Chevrolet Astro**

The 1989 Chevrolet Astro minivan was identified by the VIN: 1GBDM15Z6KB (production sequence omitted). The vehicle was a three-door, conversion minivan that was equipped with a 4.6 liter, V-6 engine, anti-lock brakes, and power steering. The entire interior was carpeted and the front and second seating areas were configured with after-market captain’s chair seats. The third row consisted of a single bench seat. The Astro minivan was configured with Mastercraft P225/70R15 tires. The manufacturer’s recommended tire pressure was unknown as the manufacturer’s label was inaccessible due to a jammed door. The specific tire data at the time of the SCI vehicle inspection was as follows:

<b>Position</b>	<b>Measured Pressure</b>	<b>Measured Tread</b>	<b>Restricted</b>	<b>Damage</b>
LF	0.0 kPa	2 mm (3/32”)	Yes	Tear in sidewall
LR	172 kPa (25.0 PSI)	4 mm (5/32”)	No	None
RF	0.0 kPa	7 mm (9/32”)	Yes	Tear in sidewall
RR	128 kPa (18.5 PSI)	2 mm (3/32”)	No	None

## Crash Site

This two-vehicle crash occurred during the nighttime hours of February 2004 in the state of Maryland. At the time of the crash it was dark, and the roadway was illuminated by overhead luminaires. The weather was clear and the asphalt roadway surfaces were dry. The crash occurred on a four-leg intersection consisting of an eight-lane divided roadway, which crossed a three-lane divided roadway and a three-lane commercial driveway. Traffic flow through the intersection was controlled by overhead three-phase traffic signals. The north/south roadway was straight and level and consisted of two southbound travel lanes and three northbound travel lanes that were separated by a curbed median barrier and bordered by concrete curbs. The southbound lanes widened at the intersection to accommodate an outboard right turn lane, and the curbed median width was reduced at the intersection to accommodate center left turn lanes. The three-lane commercial driveway on the west leg was configured with one right turn lane and one through/left turn lane for outbound traffic and single inbound lane. The driveway surface was asphalt and bordered by concrete curbs. The east leg was configured with two travel lanes in each direction separated by a curbed median barrier and bordered by concrete curbs. The posted speed limit was 64 km/h (40 mph). The scene schematic is included as **Figure 11** of this report.

## Crash Sequence

### Pre-Crash

The 60-year-old female driver of the Ford Explorer was eastbound and brought the vehicle to a controlled stop at the mouth of the west leg of the intersection (**Figure 2**). The traffic signal was in the red phase for eastbound traffic. The 24-year-old male driver of the Chevrolet Astro minivan was operating the vehicle on the outboard southbound lane and was attempting to elude police pursuit. The pursuing police vehicle abandoned the pursuit due to safety concerns and continued to follow the Astro minivan in a non-emergency mode. The minivan continued to accelerate and was traveling at a police-estimated speed of 113 km/h (70 mph) as it approached the four-leg intersection (**Figure 3**). The driver of the minivan steered into the right turn lane. As the Astro minivan approached the intersection, the traffic signals cycled to green for eastbound traffic and red for north/south traffic. The driver of the Explorer did not detect the approaching minivan and proceeded into the intersection across its path upon the green traffic signal. The driver of the Astro minivan disregarded the red traffic signal and entered the intersection while moving from the right turn lane to the outboard travel lane. Neither driver attempted any



**Figure 2. Eastbound path of travel for the Ford Explorer**



**Figure 3. Southbound approach for the Chevrolet Astro minivan**

avoidance maneuvers prior to the collision. The pre-impact distance traveled by the Explorer was approximately 8 m (26') from its stationary position.

### Crash

The full frontal area of the Astro minivan impacted the left passenger compartment area of the Ford Explorer (**Figure 4**). The directions of force for the Explorer and the Astro minivan were in the 9 and 12 o'clock sectors, respectively. The impact resulted in severe damage to both vehicles and was sufficient to deploy the left side inflatable curtain in the Explorer. The damage algorithm of the WinSMASH program computed a total delta-V of 45 km/h (28 mph) for the Explorer and a total delta-V of 65 km/h (40.4 mph) for the Astro minivan based on the respective crush profiles. The WinSMASH-computed delta-V appeared low for the Explorer.



**Figure 4. Police reconstruction showing impact positions of the vehicles**

Based on a visual evaluation of the Explorer and SCI experience, the delta-V of the Explorer appeared to be in the range of 48 – 56 km/h (30 – 35 mph). The impact deflected the Explorer forward of the Astro minivan's post-impact travel. Since the impact was forward of the Explorer's center of gravity, the impact induced a clockwise rotation. The lateral resistance of the Explorer's right side tires and CW rotation resulted in a trip-over onto the vehicle's right side. The Explorer slid on its right side in a southerly direction across the inboard travel lane and contacted the concrete curb of the center median at an angle with the right front wheel and the forward aspect of the right side step bar. Gouges were present along the roadway surface and plastic transfers from the plastic side step bar were present along the curb face of the center median. There were no gouges on the curb. Due to the forward momentum of the Explorer, the curb contact caused the vehicle to upright itself onto the curbed median approximately 27 m (89') from the point of impact. The Explorer traveled across the median in a tracking mode and came to rest facing east across the northbound travel lanes. The Astro minivan initiated a counterclockwise (CCW) post-impact rotation, evidenced by yaw marks from the minivan's rear tires. The minivan traveled approximately 19 m (62') in a CCW yaw to final rest across the southbound travel lanes, facing east.

### Post-Crash

Rescue personnel arrived on the scene and removed the occupants of the Ford Explorer from the vehicle. The driver of the Explorer sustained maximum AIS-6 level injuries and was immediately transported by ambulance to a local hospital that was in close proximity to the crash scene. She expired 20 minutes following the crash. The front right passenger of the Explorer sustained multiple police-reported incapacitating injuries and was transported by ambulance to a regional trauma center and admitted for treatment. The driver of the Astro minivan was removed from the vehicle through the left front door window opening. He sustained police-reported incapacitating injuries and was transported by ambulance to a regional trauma center and admitted for treatment.

## Vehicle Damage

### Exterior Damage – 2002 Ford Explorer

The 2002 Ford Explorer sustained severe left side damage (**Figure 5**) as a result of the impact with the Chevrolet Astro minivan. The direct contact damage began 13 cm (5.0”) aft of the left front axle and extended rearward 206 cm (81.0”). White paint transfers were present along the direct damage width from contact with the Astro minivan. The left side trim and left side step bar were separated and the left sill was crushed. Direct contact abrasions extended 13 cm (5.0”) above the beltline on the rear aspect of the left front door. The severe crush resulted in the bowing of the Explorer. The maximum crush was located 23 cm (9.0”) aft of the left B-pillar and measured 67 cm (26.5”). The frontal end shift measured 28 cm (11.0”) to the left. The combined direct and induced damage measured 440 cm (173.0”), beginning at the front bumper corner and terminating at the rear bumper corner. The left front fender was deformed and crushed laterally at the rear aspect. The plastic fender trim was fractured. The roof and roof side rail were deflected laterally. Vertical separation between the left roof side rail began at the windshield header and extended rearward 83 cm (32.5”). The maximum vertical separation measured 6 cm (2.5”) and was located 18 cm (7.0”) forward of the left B-pillar. The Collision Deformation Classification (CDC) for the impact with the Astro minivan was 89-LPAW-4, which was incremented by 80 to reflect the bowing. Six crush measurements were documented at the mid-door and were as follows: C1 = 15 cm (5.7”), C2 = 11 cm (4.2”), C3 = 61 cm (24.0”), C4 = 44 cm (17.5”), C5 = 18 cm (20.7”), C6 = 0.0 cm.



**Figure 5. View of the damaged left side of the Ford Explorer**

The Explorer sustained moderate right side damage as a result of the trip-over (**Figure 6**). The direct contact began 13 cm (5.0”) aft of the right front bumper corner and extended rearward 305 cm (120.0”) along the right side plane. The right mirror was separated. Heavy abrasions were present on the right front fender, the leading edge of the right front door, the leading edge of the right rear door, and on both door handles. Yellow paint transfers were present on the front door handle and the leading edge of the right front door from contact with the yellow inboard delineation line adjacent to the median. Heavy abrasions were also present on the right front roof side rail. The CDC for the turn-over was 00-RDAO-2.



**Figure 6. View of the right side trip-over damage to the Ford Explorer**

The Explorer sustained damage to its right front wheel and step-bar as a result impact the center median curb separating north/south traffic. The right front alloy wheel was abraded, gouged, and

partially debanded. The right front tire sustained a tear to the tread. The step bar was deflected upward and the forward aspect of the right side step bar was scuffed and gouged from contact with the concrete curb. The CDC for the curb impact was 00-RYLW-2.

**Interior Damage – 2002 Ford Explorer**

The 2002 Ford Explorer sustained severe interior damage as a result of lateral passenger compartment intrusion (**Figure 7**). The left front and left rear doors were jammed shut. The tilt-steering wheel was jammed in the mid-position. Lateral intrusions into the driver’s seating position included the left front door, left A- and B-pillars, left sill, and the left roof side rail. The driver’s seat was compressed laterally, which reduced its overall width by 15 cm (6.0”). The instrument panel was compressed laterally and deflected upward at the center aspect, which resulted in the partial separation and deformation of the knee bolster, instrument panel trim, and the displacement of the non-deployed front right passenger’s air bag module. The lateral deflection of the driver’s seat caused compression and fractures of the center console between the driver’s and front right seats. The rear inboard aspect of the driver’s seat was disengaged from the inboard track and was displaced laterally 13 cm (5.0”) inboard of the track. The rear view mirror and roof-mounted console were separated. Intrusions into the rear left seating position included the left B- and C-pillars, left door, left sill, and the left roof side rail. The rear left seat and mounting hardware were deflected laterally and compressed due to intrusion.



**Figure 7. View of interior from the rear showing intrusions**

The intrusions identified during the SCI inspection are listed by their magnitude in the following table:

<b>Position</b>	<b>Component</b>	<b>Magnitude</b>	<b>Direction</b>
Second row left	Sill	56 cm (22.0”)	Lateral
Second row left	Door panel	55 cm (21.7”)	Lateral
Front left	Door panel	30 cm (11.8”)	Lateral
Front left	B-pillar	29 cm (11.4”)	Lateral
Second row left	B-pillar	29 cm (11.4”)	Lateral
Front left	Sill	26 cm (10.2”)	Lateral
Front left	Kick panel	26 cm (10.2”)	Lateral
Front left	Roof side rail	23 cm (9.1”)	Lateral
Second row left	Roof side rail	23 cm (9.1”)	Lateral
Second row left	Floor pan	20 cm (7.9”)	Vertical
Front left	Floor pan	16 cm (6.3”)	Vertical
Front left	Window frame	15 – 30 cm (5.9 – 11.8”)	Lateral
Front left	A-pillar	6 cm (2.4”)	Lateral
Front center	Seat back	3 cm (1.2”)	Lateral
Front right	Center console	3 cm (1.2”)	Lateral

### Exterior Damage – 1989 Chevrolet Astro Minivan

The 1989 Chevrolet minivan sustained severe frontal damage (Figure 8) as a result of the impact with the 2002 Ford Explorer. The direct damage involved the entire frontal width of the minivan and measured 160 cm (63.0"). The entire frontal structure was crushed rearward. The front bumper was partially separated at the front left corner. The combined direct and induced damage also involved the entire frontal width of the vehicle. The hood was buckled upward and rearward. Both front fenders were crushed rearward and buckled outward. The maximum crush was located at the front right bumper corner and measured 59 cm (23.3"). The frontal crush displaced the front axle rearward, which reduced the left wheelbase by 18 cm (7.1") and the right wheelbase by 5 cm (2.0"). The left and right side doors were jammed shut. The impact deflected the right A-pillar rearward which resulted in the vertical deflection of the right roof side rail. The CDC for the frontal impact with the Ford Explorer was 12-FDEW-4. Six crush measurements were documented along the front bumper and were as follows: C1 = 50 cm (19.5"), C2 = 34 cm (13.5"), C3 = 48 cm (19.0"), C4 = 52 cm (20.4"), C5 = 49 cm (19.3"), C6 = 58 cm (23.3").



Figure 8. Damaged Chevrolet Astro minivan

### Manual Restraints – 2002 Ford Explorer

The 2002 Ford Explorer was equipped with continuous loop, manual 3-point lap and shoulder belts with adjustable D-rings for each outboard seating position. The rear center position was configured with a lap belt. The driver's safety belt was configured with a belt-sensitive, Emergency Locking Retractor (ELR) and the remaining outboard safety belts were configured with belt-sensitive, switchable ELR/Automatic Locking Retractors (ALR). The driver's D-ring was found in the mid-position at the time of the vehicle inspection; however, due to the B-pillar intrusion and deformation, the D-ring would not lock in position. Rescue personnel cut the driver's safety belt. The driver's safety belt webbing (Figure 9) measured 130 cm (51.0") in length from the plastic stop button, and the webbing below the stop button was restricted between the outboard seat cushion and the intruded left front door. The entire length of the webbing was corrugated and red/pink fabric transfers were present on the inboard aspect of the webbing near the edges (against the occupant), and were located 38 cm (15.0") from the stop button and extended 13 cm (5.0") up the webbing. The driver's plastic-covered latch plate exhibited heavy abrasions as a result of occupant loading against the webbing.



Figure 9. View of the cut driver's safety belt

The front right passenger's adjustable D-ring was located 3 cm (1.2") below the full-up position and the switchable ELR/ALR retractor was operational. The plastic housing around the D-ring

sustained a 5 mm (1/8") notch on the forward aspect from occupant engagement, which was located 15 cm (6.0") above the bottom of the adjustment slide. Corrugation was present on the safety belt webbing, which began 29 cm (11.5") above the stop button and continued 43 cm (17.0") up the webbing. The plastic-covered latch plate exhibited moderate frictional abrasions as a result of occupant loading.

### **Frontal Air Bag System – 2002 Ford Explorer**

The 2002 Ford Explorer was equipped with redesigned frontal air bags for the driver and front right passenger positions. The driver's air bag was housed in the center of the steering wheel hub and the front right passenger's air bag was housed in a mid-mount module located on the right instrument panel. The frontal air bags did not deploy in this crash.

### **Side Impact Inflatable Curtain – 2002 Ford Explorer**

The 2002 Ford Explorer was equipped with side impact Inflatable Curtains (IC). The left side IC deployed as a result of the left side impact with the Chevrolet Astro minivan. The IC (**Figure 10**) deployed downward from the left roof side rail through a separation of the roof headliner from the side-rail that measured 152 cm (60.0") between the left A- and C-pillars. The left IC was rectangular in shape and measured 152 cm (60.0") in length and 43 cm (16.8") in height. The IC was tethered on the forward aspect by a 1 cm (1/4") diameter rope-type tether, which measured 36 cm (14.0") in length. The tether was located 20 cm (8.0") above the base of the left A-pillar and had been cut by rescue personnel. The bottom of the IC was located 9 cm (3.5") above the belt line. The bottom of the IC measured 75 cm (29.5") above the driver's seat cushion and 61 cm (24.0") above the rear left seat cushion. A light scuff mark was present on the inboard aspect of the IC from contact with the top outboard aspect of the driver's seat back. The intrusion of the passenger compartment deflected the IC laterally into the seat back. The scuffmark, which measured 9 cm (3.5") in height and 12 cm (4.8") in width, was located 52 cm (20.5") aft of the leading edge of the IC and 10 cm (4.0") above the bottom edge. A faint diagonal scuffmark from probable contact with the driver's head was located 32 cm (12.8") aft of the leading edge of the IC and 4 cm (1.5") below the top aspect. The scuffmark measured 9 cm (3.5") in height and 12 cm (4.8") in width.



**Figure 10. Inboard view of the deployed left IC**

## Occupant Demographics – 2002 Ford Explorer

### Driver

Age/Sex: 60-year-old/Female  
 Height: 168 cm (66")  
 Weight: 72 kg (159 lbs)  
 Seat Track Position: Mid-track  
 Manual Restraint Use: Manual 3-point lap and shoulder belt  
 Usage Source: Vehicle inspection  
 Eyewear: Not reported  
 Type of Medical Treatment: Transported by ambulance to a local hospital and expired

### Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Cervical spine (C1 and C2) fracture with epidural hemorrhage	Maximum (640232.6,6)	Left B-pillar
Transected aorta with perioesophageal and mediastinal hemorrhages (1200 ml of blood in left chest cavity and 120 ml in right cavity)	Maximum (420218.6,4)	Left door panel
*Fractured ribs (2-8) on anterolateral left side and (rib #9) on posterior left side	Critical (450242.5,2)	Left door panel
*Fractured ribs (5-8) on right posterior side	Critical (450242.5,1)	Center console
Cerebrum subarachnoid hemorrhage on dorsal left frontal lobe	Serious (140684.3,2)	Left B-pillar
Cerebrum subarachnoid hemorrhage on dorsal right frontal lobe	Serious (140684.3,1)	Left B-pillar
Liver laceration 5 cm (2") OIS grade III	Serious (541824.3,1)	Shoulder belt restraint webbing
Forehead abrasion	Minor (290202.1,7)	Inflatable curtain air bag
Right ear abrasion	Minor (290202.1,9)	Unknown
Left facial skin abrasion	Minor (290202.1,2)	Inflatable curtain air bag
Left arm abrasion (NFS)	Minor (790202.1,2)	Inflatable curtain air bag
Left facial skin laceration	Minor (290602.1,2)	Left B-pillar
Left lower lip laceration	Minor (243099.1,8)	Left B-pillar

Left upper incisor fracture	Minor (251404.1,8)	Left B-pillar
Occipital scalp contusion	Minor (190402.1,6)	Left B-pillar
Multiple lacerations on dorsal surface of right hand	Minor (790602.1,1)	Center console
Contusion on right index finger	Minor (790402.1,1)	Center console
Upper back skin abrasion	Minor (690202.1,7)	Front left seat back
Contusion on anterior upper left leg	Minor (890402.1,2)	Left door panel
Abrasion to medial right knee	Minor (890202.1,1)	Left instrument panel
Contusion to medial right lower leg	Minor (890402.1,1)	Left instrument panel
Contusion to anterior of right foot	Minor (890402.1,1)	Brake pedal

*Source: Autopsy Report*

*\*The rib fractures have been separated into two lines of code for this summary report due to the fact that two separate sources contributed to the injuries. They are combined in the EDS program.*

### **Driver Kinematics**

The 60-year-old driver of the Explorer was seated in an upright attitude with the seat back slightly reclined. She was restrained by the manual 3-point lap and shoulder belt. At impact, the left side IC deployed and she responded to the direction of force with a lateral trajectory to the left. She loaded the safety belt and contacted the deployed IC with her head and face resulting in abrasions to her forehead, right ear, left temple, and upper left arm. Due to the severe intrusion of the B-pillar, her head and neck loaded the intruded B-pillar through the deployed IC resulting in a fracture of C1/C2 with an epidural hemorrhage, cerebrum subarachnoid hemorrhages to the left and right frontal lobes, a fractured upper left incisor, and soft tissue injuries to the face, lip and scalp. The driver also loaded the intruded left door panel and sustained a transected aorta, with resultant perioesophageal and mediastinal hemorrhages, along with fractures to six ribs (2-8) on her left anterior rib cage and one (9th rib) to her left posterior rib cage.

The driver rebounded laterally to the right and against the center console when the Explorer rotated onto its right side. As she rebounded to the right, she struck the center console and sustained fractures to three posterior ribs (5-8) on her right side along with soft tissue injuries to her right hand. The driver's lower extremities contacted the underside of the left instrument panel during the overturn causing soft tissue injuries to her right leg; her right foot sustained a soft tissue injury through contact with the brake pedal, which was bent. The manual restraint prevented additional movement in the vehicle; however, due to the subsequent compression of the seat by the intruded door panel and B-pillar, she sustained a 5 cm (2") liver laceration from the shoulder belt. She was redirected to the left as the Explorer uprighted itself and may have contacted the intruded B-pillar and door panel a second time. Her specific posture as the vehicle came to rest is unclear. She was removed from the vehicle by rescue personnel and immediately

transported to a local hospital a short distance from the crash site. She expired 20 minutes following the crash.

**Front Right Passenger**

Age/Sex: 35-year-old female  
 Height: Not reported  
 Weight: Not reported  
 Seat Track Position: Mid-track  
 Manual Restraint Use: Manual 3-point lap and shoulder belt  
 Usage Source: Vehicle inspection  
 Eyewear: Not reported  
 Type of Medical Treatment: Transported by ambulance to a regional trauma center and admitted for treatment

**Front Right Passenger Injuries**

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Ruptured spleen	Serious (544240.3,2)	Loading against the front right passenger’s shoulder belt webbing

*Injury source: Police Report*

**Front Right Passenger Kinematics**

The 35-year-old female front right passenger was presumed to have been seated in an upright attitude with the seat back slightly reclined. She was restrained by the manual 3-point lap and shoulder belt. At impact with the Chevrolet Astro minivan, she initiated a lateral trajectory to the left. She loaded the safety belt and the center console, which intruded slightly to the right. The loading against the shoulder belt resulted in a police-reported ruptured spleen. She rebounded to the right and was redirected against the right front door as the Explorer turned onto its right side. Safety belt use prevented additional movement and ejection from the vehicle. She was redirected laterally to the left as the Explorer uprighted itself and rebounded to the right before coming to rest. Her specific posture after the vehicle came to rest was not known. Rescue personnel removed the front right passenger from the vehicle. She was transported to a regional trauma center and admitted for treatment.

**Figure 11. Scene Schematic**

