

Child Safety Seat Fatality Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS05013
2002 Ford Expedition
1993 Dodge Caravan
Nevada
August 2005

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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 be 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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16. Abstract This on-site investigation focused on the performance of forward facing child safety seats that were installed in the rear of a 2002 Ford Expedition and in the rear of a 1993 Dodge Caravan. The Dodge Caravan was occupied by a 43-year-old male driver, a 3-year-11-month old female, a 10-year-old female, and 3-year-old male. The second vehicle in the case (Ford Expedition) was occupied by two 21-month-old children who were seated in child seats, who were not seriously injured. The Ford Expedition was occupied by a 37-year-old male driver, a 36-year-old female front right occupant, and the two children in the second row seats. The Ford Expedition was struck in the left side by the front of a 1993 Dodge Caravan in an intersection crash. There was a second, side-slap type impact between the two vehicles. The driver of the Ford Expedition sustained lung and chest injuries. The front right occupant sustained a contusion to the right upper arm, an abrasion to the left triceps, a cervical strain and a fracture to the front right incisor tooth. The second row left 21-month-old male child sustained several small abrasions. The second row right 21-month-old female did not sustain any injuries. The driver of the Dodge Caravan was transported to a local trauma center for treatment. The 3-year-11-month old female in the third row left seat position was fatally injured. The 10-year-old female and 3-year-old male were seriously injured.			
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Dynamic Science, Inc.
Crash Investigation
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BACKGROUND

This on-site investigation focused on the performance of forward facing child safety seats that were installed in the rear of a 2002 Ford Expedition and in the rear of a 1993 Dodge Caravan. This child safety seat fatality case was identified by NHTSA from an on-line news article. DSI was notified on August 22, 2005. Initially, the focus of the investigation was on the child fatally injured in a Dodge Caravan who was thought to have been in a child safety seat. During the early parts of the investigation this changed as the police indicated that there had been a mistake and the child was not in a child seat. This changed again as it was later determined that there were actually two child seats in use in the Caravan, not one, and the fatally injured child was in one of the child seats.

The Dodge Caravan was occupied by a 43-year-old male driver, a 3-year-11-month old female third row left occupant seated in a child safety seat, a 10-year-old female third row middle occupant using a lap belt, and 3-year-old male third row right occupant seated in a child safety seat. The second vehicle in the case (Ford Expedition) was occupied by two 21-month-old children who were seated in child seats and who were not seriously injured. The Ford Expedition was occupied by a 37-year-old male driver, a 36-year-old female front right occupant, and the two children in the second row seats. The Ford Expedition was struck in the left side by the front of a 1993 Dodge Caravan in an intersection crash. There was a second, side-slap type impact between the two vehicles.

The driver of the Ford Expedition sustained lung and chest injuries. He was transported by ambulance to a local trauma center where he was hospitalized for nine days. The front right occupant sustained a contusion to the right upper arm, an abrasion to the left triceps, a cervical strain and a fracture to the front right incisor tooth. She also complained of head and chest pain. She was transported by ground ambulance to a local trauma center. The second seat right 21-month-old male child sustained several small abrasions to his right arm due to glass fragments. He was transported by ground ambulance to a local trauma center where he was treated and released. The 21-month-old female seated in the second row right seat did not sustain any injuries. The child's mother wanted to have the child checked. She was transported by ground



Figure 1. Left side, 2002 Ford Expedition



Figure 2. Front, 1993 Dodge Caravan

ambulance to a local trauma center. She was examined and observed for one hour before being released.

The driver of the Dodge Caravan was transported to a local trauma center for treatment.

The 3-year-11-month old female in the third row left seat position was fatally injured. Paramedics responded to the scene and found her beyond resuscitation still buckled in the car seat. An external examination revealed petechial hemorrhages within the lower palpebral conjunctiva, over the right upper eyelid, the upper bridge of the nose, and the right cheek. There was a dark track-like impression over the lower aspect of the abdomen that was situated approximately 6.3 cm (2.5 in) below the level of the umbilicus and extended into the flank. Associated with the impression were abrasions on the left aspect of the lower abdomen and flank. There was also an abrasion on the right leg just above the ankle. X-rays were negative for any skull fractures, maxillary fractures, cervical spine fractures, or clavicle fractures. The cause of death was given as “due to deceleration injury due to motor vehicle collision.”

The 10-year-old female in the third row middle seat position was transported to a local trauma center for treatment. She arrived with a spinal cord injury with paraplegia. An MRI of the lumbosacral spine revealed an injury of the conus medullaris with epidural hematoma at the L4-L5 level. On examination she was able to move her upper extremities but did not have any movement of her lower extremities.

The 3-year-old male in the third row right seat of the Dodge Caravan was seriously injured. He was transported from the scene by ground ambulance. He was transported in the child seat and arrived at the hospital with a GCS of 15. EMS personnel indicated that he did lose consciousness and had vomited 2-3 times. The doctor indicated that this child had sustained a concussion and an intra-abdominal injury. This occupant was admitted and hospitalized for an unknown number of days.

DSI located the Ford Expedition and the child seats on August 24, 2005, and obtained permission to inspect the vehicle and seats from the local district attorney on August 30, 2005. DSI was assigned the case on August 31, 2005. The vehicle and seat inspections took place on September 2, 2005. The investigating officer was present during the vehicle inspections.

SUMMARY

Crash Site

This two vehicle crash occurred in August 2005 at approximately 2000 hours. The crash occurred within the confines of a four-leg intersection formed by an interstate off-ramp and a city street. It was dark at the time of the crash and there were no streetlights available. The roadways were dry. The northbound leg of the intersection is comprised of two travel lanes and is undivided.



Figure 3. Approach for Ford Expedition (north)

There is an uphill grade and the road surface is asphalt. The speed limit for this leg of the intersection is 56 km/h (35 mph). The northbound approach is controlled by a stop sign. There is also a “Traffic from Left Does Not Stop” warning sign. The westbound leg of the intersection is comprised of a left turn lane, two eastbound travel lanes, and a right hand turn lane. The roadway is curved to the left. There is an uphill grade and the road surface is asphalt. The speed limit for the interstate off-ramp was 89 km/h (55 mph).

Pre-Crash

The case vehicle is a 2002 Ford Expedition sport utility vehicle that was being driven by a restrained 37-year-old male. The front right seat was occupied by a restrained 36-year-old female. The second row was occupied by 21-month-old twins. Both were seated in Evenflo Triumph 5 convertible child safety seats. Both seats were anchored to the Expedition using the manual 3-point lap and shoulder belts. The male twin was seated in the second row left position. The female twin was seated in the second row right position. The Ford was initially traveling northbound and had come to a stop at the intersection.

The other vehicle was a Dodge Caravan driven by a 43-year-old male. This vehicle was traveling on the interstate off-ramp at a police estimated speed of between 80-97 km/h (50-60 mph). There was speedometer slap evidence indicating an impact speed of approximately 100 km/h (62 mph). The third row left seat was occupied by a 3-year-11-month old female in a Cosco Alpha Omega convertible child safety seat. The third row middle seat was occupied by a 10-year-old female using the lap belt. The third row right seat was occupied by a 3-year-old male who was seated in an unknown make/model child safety seat.

The Ford Expedition apparently pulled out from the stop and into the travel path of the Dodge Caravan. This vehicle was traveling at a DSI estimated speed of 16.0 km/h (10 mph)

Crash

The front of the Caravan (12FDEW2) struck the left side of the Expedition (09LYAW3). The WinSmash program computed a total delta V of 28.8 km/h (17.9 mph) for the Expedition. The longitudinal and lateral components were -5.0 km/h (-3.1 mph) and 28.4 km/h (17.6 mph), respectively.

The Expedition was redirected in a clockwise direction and the Caravan rotated counterclockwise. There was a secondary impact between the left

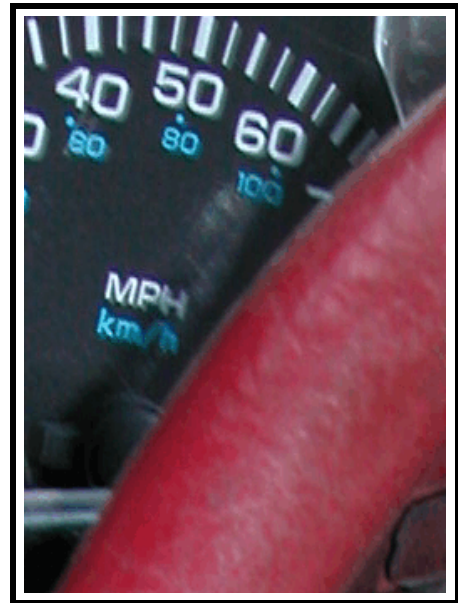


Figure 4. Speedometer needle “slap” marking



Figure 5. Front, Dodge Caravan

corner of the Expedition (09LBEE1) and the right side of the Caravan (03RPEW1). Both vehicles slid in a northeast direction down a dirt embankment north of the interstate roadway.

Post-Crash

The 37-year-old driver of the Ford Expedition sustained a left-sided diaphragm rupture, a left lung laceration, splenic and pancreatic contusions, and multiple left side rib fractures with left-sided pneumothorax. He was transported to a local hospital and arrived with a Glasgow Coma Scale (GCS) score of 15. He was admitted to the intensive care unit postoperatively for further observation. The following day he developed ventricular tachycardia¹. He remained in the hospital for a total of nine days.



Figure 6. Left side, Ford Expedition

The 36-year-old female front right occupant sustained a contusion to the right upper arm, an abrasion to the left triceps, a cervical strain and a fracture to the front right incisor tooth. She also complained of pain to her head and chest. She was able to exit the vehicle on her own and did not report any loss of consciousness. She was transported by ground ambulance to a local trauma center. A CT scan later ruled out any mediastinal injury or pneumothorax with the complaint of chest pain. She was released later in the evening.

The 21-month-old male second row left occupant sustained several small abrasions to his right arm due to glass fragments. He was transported by ground ambulance to a local trauma center. He was examined and observed for one hour before being released.

The 21-month-old female second row right occupant did not complain of any injuries. The child's mother wanted to have the child checked. She was transported by ground ambulance to a local trauma center. She was examined and observed for one hour before being released.

The driver of the Dodge Caravan was transported to a local trauma center for treatment.

The 3-year-11-month old female in the Caravan's third row left seat was fatally injured. Paramedics responded to the scene and found her beyond resuscitation still buckled in the car seat. An external examination revealed petechial hemorrhages within the lower palpebral conjunctiva, over the right upper eyelid, the upper bridge of the nose, and the right cheek. There was a dark track-like impression over the lower aspect of the abdomen that was situated

¹Ventricular tachycardia is a rapid heart beat initiated within the ventricles, characterized by 3 or more consecutive premature ventricular beats. Ventricular tachycardia is a potentially lethal disruption of normal heartbeat (arrhythmia) that may cause the heart to become unable to pump adequate blood through the body. The heart rate may be 160 to 240 (normal is 60 to 100 beats per minute).

approximately 6.3 cm (2.5 in) below the level of the umbilicus and extended into the flank. Associated with the impression were abrasions on the left aspect of the lower abdomen and flank. There was also an abrasion on the right leg just above the ankle. X-rays were negative for any skull fractures, maxillary fractures, cervical spine fractures, and clavicle fractures. The cause of death was given as “due to deceleration injury due to motor vehicle collision.”

The 10-year-old female in the third row middle seat was transported to a local trauma center for treatment. She arrived with a spinal cord injury with paraplegia. An MRI of the lumbosacral spine revealed an injury of the conus medullaris with epidural hematoma at the L4-L5 level. On examination she was able to move her upper extremities but did not have any movement of her lower extremities.

The 3-year-old male in the third row right seat of the Dodge Caravan was seriously injured. He was transported from the scene by ground ambulance. He was transported in the child seat and arrived at the hospital with a GCS of 15. EMS personnel indicated that he did lose consciousness and had vomited 2-3 times. The doctor indicated that this child had sustained a concussion and an intra-abdominal injury. A laparotomy was undertaken which revealed small tears in the jejunum and serosa with a complete transection of the small bowel and an ischemic area in the transverse colon. He also sustained abrasions to the chest, above the right eyebrow, and to the right nostril. The linear abdominal abrasion measured 5.0 x 3.0 cm (1.9 x 1.2 in). It began in the right lower quadrant and extended diagonally towards the left upper quadrant. This occupant was admitted and hospitalized for an unknown number of days.

Both vehicles were towed from the scene due to damage. Both vehicles were placed on an indefinite police hold.

VEHICLE DATA - 2002 Ford Expedition

The 2002 Ford Expedition XLT 4x2 sport utility vehicle was identified by the Vehicle Identification Number (VIN): 1FMRU15W42Lxxxxxx. The vehicle was equipped with a 4.6 liter V-8 engine, a 4 speed automatic transmission, power steering, rear wheel drive and disc brakes.

The vehicle was equipped with Continental Contitrac P275/60R17 tires. The recommended cold tire pressure was 179 kPa (26 psi) for the front and 228 kPa (33 psi) for the rear. The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Flat	7 mm (9/32 in)	No	None
LR	221 kPa (32 psi)	8 mm (10/32 in)	No	None
RR	200 kPa (29 psi)	7 mm (9/32 in)	No	None
RF	207 kPa (30 psi)	7 mm (9/32 in)	No	None

The seating in the 2002 Ford Expedition was configured with front leather covered bucket seats, a second row split bench with a folding back, and a third row split bench with a folding back. The third row seat was in the down position.

VEHICLE DAMAGE

Exterior Damage - 2002 Ford Expedition

The 2002 Ford Expedition sustained major left side damage as a result of the first impact with the Dodge Caravan. The direct damage began at the left front tire and extended 222.0 cm (87.4 in) rearward along the left side plane. The combined direct and induced damage began 50.0 cm (19.7 in) forward of the front axle and extended 280.0 cm (110.2 in) rearward along the left side plane. The maximum lateral crush was located at C3 and measured 60.0 cm (23.6 in) at the sill level. Both left side doors were deformed and initially jammed shut. The driver's door was pried open by emergency personnel. The wheelbase on the left side was shortened by 26.0 cm (10.2 in). Six crush measurements were documented at the sill level as follows: C1= 0.0 cm (0.0 in), C2= 28.0 cm (11.0 in), C3= 60.0 cm (23.6 in), C4= 55.0 cm (21.6 in), C5= 20.0 cm (7.9 in), C6= 3.0 cm (1.2 in). There was a second, side-slap type impact between the left corner of the Expedition and the right rear door area of the Caravan. The direct damage began at the left rear bumper corner and extended 18.0 cm (7.0 in) forward along the left side.

CDC:	Impact 1: 09LPAW3	
	Impact 2: 09LBEE1	
Delta V (Impact 1):	Total	28.8 km/h (17.9 mph)
	Longitudinal	-5.0 km/h (-3.1 mph)
	Latitudinal	28.4 km/h (17.6 mph)
	Energy	98,358 joules (72,677 ft lbs)

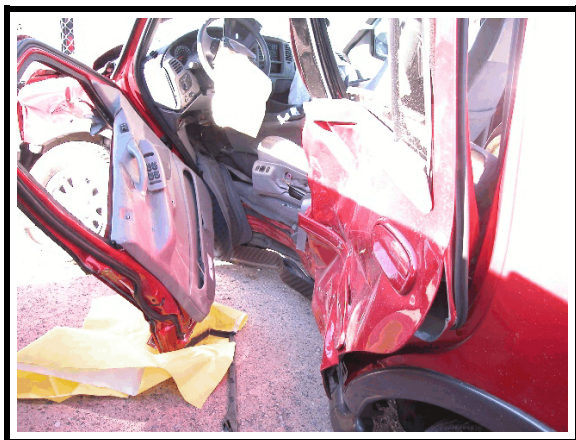


Figure 7. Ford Expedition, left side impact



Figure 8. Ford Expedition, second impact

Interior Damage - 2002 Ford Expedition

The 2002 Ford Expedition sustained major interior damage as a result of passenger compartment intrusion. The left side doors and A-pillar sustained lateral intrusion. There was also vertical intrusion to the floor.

The specific passenger compartment intrusions were documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
LF	Sill	50.0 cm (19.7 in)	Lateral
LF	Door	40.0 cm (15.7 in)	Lateral
LF	Lower A pillar	35.0 cm (13.8 in)	Lateral
LF	B pillar	36.0 cm (14.2 in)	Lateral
LR	Door	30.0 cm (11.8 in)	Lateral
LF	Floor	13.0 cm (5.1 in)	Vertical

MANUAL RESTRAINT SYSTEMS - 2002 Ford Expedition

The 2002 Ford Expedition was configured with manual 3-point lap and shoulder belts for each outboard seating position. The second row middle seat was equipped with a manual lap belt. Both front seat safety belts were equipped with retractor pretensioners that actuated during the crash and adjustable D rings that were in the full down position. The second row outboard seats were equipped with adjustable D rings; the right adjuster was in the full up position, right left in the full down position. The driver's safety belt was configured with a sliding latch plate and an Emergency Locking Retractor (ELR). The driver's belt had been cut by EMS personnel during the extrication of the driver.

The remaining outboard safety seats were configured with sliding latch plates and switchable ELR/Automatic Locking Retractors (ALR). The front right safety belt was locked in the spooled out position at the time of the vehicle inspection.

The second row left and second row right safety belts were used to anchor the forward facing child safety seats.

Supplemental Restraint System - 2002 Ford Expedition

The 2002 Ford Expedition was equipped with dual-stage frontal air bags and safety belt retractor pretensioners for the driver and front right positions. The frontal air bags deployed as a result of the impact with the Dodge Caravan.

The driver's air bag deployed from the center of the steering wheel hub through H-configuration module cover flaps. The top flap measured 13.0 cm (5.1 in) in height and 18.0 cm (7.0 in) in width. The bottom flap measured 4.0 cm (1.6 in) in height and 18.0 cm (7.0 in) in width. The deployed driver's air bag measured 59.0 cm (23.2 in) in diameter in its deflated state. The air bag was tethered by a single internal strap. Two circular vent ports were located at the 11 and 1 o'clock aspects on the rear of the air bag. There were no contacts or damage to the air bag or module cover.



Figure 9. Deployed driver's air bag

The front right passenger's air bag deployed from a mid-mount module with a rectangular cover flap that was hinged at the forward aspect. The module cover flap measured 35.0 cm (13.8 in) along the top, 16.0 cm (6.3 in) in width, and 38.0 cm (15.0 in) along the bottom. The deployed front right passenger's air bag measured 52.0 cm (20.5 in) laterally from seam to seam. There were no vent ports or tethers. There were no contacts or damage to the air bag or module cover.



Figure 10. Deployed front right passenger's air bag

Child safety seats - 2002 Ford Expedition

The 21-month-old male/female twins were seated in identical Evenflo Triumph 5 convertible child safety seats. The seats were configured with a 5-point harness, a two piece locking harness retainer clip and an adjustable reclining base. At the time of the child safety seat inspection, the harness straps were routed through the top set of harness slots. The seat in the second row left position had a model number of 3591328 P1 and was manufactured on May 7, 2004. The seat in the second row right position had a model number of 3591453 P1 and was manufactured on May 24, 2004. The manufacturer recommends that the seats be used in the forward facing position for children weighing between 9-18 kg (20-40 lbs), and in the rear facing position for children weighing between 2.3-13.6 kg (5-30 lbs). Both children met the weight recommendations. The second row left occupant weighed 12.95 kg (28.5 lbs). The second row right occupant weighed 9.09 kg (20.0 lbs).

Both child safety seats had been installed in a forward facing fashion. Both seats were anchored to the vehicle using the manual 3-point lap and shoulder belts in their respective seating positions. The seat belts at these locations were configured with sliding latch plates and switchable ELR/Automatic Locking Retractors (ALR). It is not known if the belts had been switched at the time of the crash.

There were no indications of damage or loading to either child safety seat.

Both seats were equipped with top tether and lower LATCH attachments but were not used at the time of the crash.



Figure 11. Evenflo Triumph 5 CSS (second row, left)



Figure 12. Evenflo Triumph 5 CSS (second row, right)

VEHICLE DATA - 1993 Dodge Caravan

The 1993 Dodge Caravan minivan was identified by the VIN: 2B4GH2530PRxxxxxx. The vehicle was equipped with a 3.0 liter 6 cylinder engine, an automatic transmission, and power steering. The vehicle was equipped with BF Goodrich P195/75R14 tires. The recommended cold tire pressure was 241 kPa (35 psi). The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	152 kPa (22 psi)	5 mm (6/32 in)	Yes	None
LR	Flat	4 mm (5/32 in)	No	Rim ground down
RR	207 kPa (30 psi)	6 mm (7/32 in)	No	None
RF	186 kPa (27 psi)	5 mm (6/32 in)	Yes	None

The seating in the 1993 Dodge Caravan was configured with front cloth covered box mounted seats, and a third row bench seat with a folding back. The second row seat unit had been removed prior the crash.

VEHICLE DAMAGE

Exterior Damage - 1993 Dodge Caravan

The 1993 Dodge Caravan sustained major front end damage as a result of the first impact with the Ford Expedition. The direct damage began at the front right bumper corner and extended across the entire front end. Six crush measurements were documented at the bumper level as follows: C1 = 35.0 cm (13.8 in), C2 = 26.0 cm (10.2 in), C3 = 28.0 cm (11.0 in), C4 = 29.0 cm (11.4 in), C5 = 28.0 cm (11.0 in), C6 = 36.0 cm (14.2 in). The right side wheelbase was shortened by 8.0 cm (3.1 in). The left side wheelbase was shortened by 12.0 cm (4.7 in). There was a second, side-slap type impact between the right rear door of the Caravan and the left bumper corner of the Expedition. The direct damage began 87.0 cm (34.3 in) forward of the rear axle and extended 33.0 cm (13.0 in) forward along the right side.

CDC:

Impact 1: 12FDEW2

Impact 2: 03RPEN2

Delta V (Impact 1):

Total 46.5 km/h (28.9 mph)

Longitudinal -45.8 km/h (-28.5 mph)

Latitudinal -8.1 km/h (-5.0 mph)

Energy 95,737 joules
(70,611 ft lbs)



Figure 13. 1993 Dodge Caravan, front impact



Figure 14. Dodge Caravan, secondary impact

Interior Damage - 1993 Dodge Caravan

The 1993 Dodge Caravan sustained minor interior damage as a result of passenger compartment intrusion and occupant contacts. The specific passenger compartment intrusions were documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
LF	Toe pan	16.0 cm (6.3 in)	Longitudinal
LF	Seat back	17.0 cm (6.7 in)	Longitudinal
RF	Seat back	8.0 cm (3.1 in)	Longitudinal

Child safety seat - 1993 Dodge Caravan

The 3-year-11-month old female third row left occupant was seated in a Cosco Alpha Omega convertible child safety seat. The child seat model number was 02-332. The seat was configured with a tray shield. The manufacturer recommends that the child safety seat only be used for children weighing between 2.3-18.1 kg (5.0-40.0 lbs) and whose height is between 7.5-15.7 cm (19.0-40.0 in). The seat is intended to be used in the rear facing mode for children weighing less than 10.0 kg (22.0 lbs). The seat was installed in the forward facing mode. The internal harness was routed through the single set of harness slots. The 3-year-old child using this seat met the recommendations for weight but exceeded the maximum height by 5.0 cm (2.0 in).

According to several reports, the child safety seat that was being used in the third row right position was removed from the vehicle with the male child in the seat. Both the seat and the child were transported to the hospital. The location of this seat is not known. There is no additional information about the make/model/style of seat. It was being used in a forward facing fashion and was anchored to the case vehicle with the manual 3-point lap and shoulder belt.



Figure 15. Cosco Alpha Omega convertible child safety seat (used by 3-year-11-month old child in third row left seat)

OCCUPANT DEMOGRAPHICS - 2002 Ford Expedition

	Driver	Occupant 2
Age/Sex:	37/Male	36/Female
Seated Position:	Front left	Front right
Seat Type:	Leather covered bucket seat, adjusted to rear most track position	Leather covered bucket seat, adjusted to rear most track position
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	N/A
Driving Experience:	Unknown	N/A
Body Posture:	Normal, upright	Normal, upright
Hand Position:	Unknown	Unknown
Foot Position:	Right foot presumed to be on accelerator, left on floor	Unknown
Restraint Usage:	3-point lap and shoulder belt available, used	3-point lap and shoulder belt available, used
Air bag:	Steering wheel mounted frontal air bag available, deployed	Mid instrument panel mounted frontal air bag available, deployed

OCCUPANT DEMOGRAPHICS - 2002 Ford Expedition

	Occupant 3	Occupant 4
Age/Sex:	21 month/Male	21 month/Female
Seated Position:	Second row left	Second row right
Seat Type:	Leather covered split bench with folding back	Leather covered split bench with folding back
Height:	Unknown	Unknown
Weight:	12.95 kg (29 lbs)	9 kg (20 lbs)
Occupation:	N/A	N/A
Pre-existing Medical Condition:	None	None
Alcohol/Drug Involvement:	N/A	N/A
Driving Experience:	N/A	N/A
Body Posture:	Upright, CSS	Upright, CSS
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt used to anchor child safety seat	Lap and shoulder belt used to anchor child safety seat

OCCUPANT DEMOGRAPHICS - 1993 Dodge Caravan

	Driver	Occupant 2
Age/Sex:	43/Male	3year-11-month/Female
Seated Position:	Front left	Third row left
Seat Type:	Box mounted seat, fabric covered	Fabric covered bench with a folding back
Height:	Unknown	107 cm (42 in)
Weight:	Unknown	17 kg (37 lbs)
Occupation:	Unknown	N/A
Pre-existing Medical Condition:	None noted	None
Alcohol/Drug Involvement:	Unknown	N/A
Driving Experience:	Unknown	N/A
Body Posture:	Upright	Seated in CSS
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap and shoulder belt used with CSS. Shield in down position.

OCCUPANT DEMOGRAPHICS - 1993 Dodge Caravan

	Occupant 3	Occupant 4
Age/Sex:	10/Female	3/Male
Seated Position:	Third row middle	Third row right
Seat Type:	Fabric covered bench with a folding back	Fabric covered bench with a folding back
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	N/A	N/A
Pre-existing Medical Condition:	Pneumonia when admitted	None noted
Alcohol/Drug Involvement:	N/A	N/A
Driving Experience:	N/A	N/A
Body Posture:	Likely upright, between the two child seats	Seated in CSS
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap belt available, used	Lap and shoulder belt used with child safety seat

OCCUPANT INJURIES -2002 Ford Expedition

Driver: Injuries obtained from radiology report and discharge summary.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Rib fractures, left side, multiple	450220.2,2	Door/arm rest	Certain
Left diaphragm rupture	440606.4,8	Door/arm rest	Certain
Left lung laceration	441414.3,2	Door/arm rest	Certain
Hematoma at hilum of spleen	544210.2,2	Door/arm rest	Certain
Pancreatic contusion	542810.1,7	Door/arm rest	Certain
Left lower lobe atelectasis ²	Not codeable		

Front right occupant: Injuries obtained from emergency department records and radiology reports.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Contusion, right upper arm	790402.1,1	Door	Possible
Abrasion, left triceps	790202.1,2	Center console	Probable
Cervical strain	640278.1,6	Impact forces	Probable
Fracture, right incisor	251404.1,8	Impact forces	Probable

Second row left occupant: Injuries obtained from emergency room records

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Abrasions, both arms	790202.1,3	Flying glass	Certain

²Collapse of part or all of a lung by blockage of the air passages.

Second row right occupant: No injuries, per emergency room records.

OCCUPANT INJURIES - 1993 Dodge Caravan

Driver: Injuries are not known. Driver was transported but no records were found.

Third row left occupant: Injuries obtained from Coroner's Report of Investigation. X-rays were negative for any skull fractures, maxillary fractures, cervical spine fractures, and clavicle fractures. The cause of death was given as "due to deceleration injury due to motor vehicle collision." Petechial hemorrhages are generally a sign of terminal asphyxia and are related to increased intravascular pressure.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Petechial hemorrhages within the lower palpebral conjunctiva, over the right upper eyelid, the upper bridge of the nose, and the right cheek. All were very subtle and faint.	Not codeable	Child seat shield	Probable
Contusion, lower aspect of the abdomen that was situated approximately 6.3 cm (2.5 in) below the level of the umbilicus	590402.1,0	Child seat shield	Certain
Abrasion, lower left abdomen and flank	590202.1,2	Child seat shield	Certain
Abrasion, right leg just above ankle	890202.1,1	Unknown	Unknown

Third row middle occupant: Injuries obtained from radiology reports, emergency room records, and discharge summary. She arrived with a spinal cord injury with paraplegia. An MRI of the lumbosacral spine revealed an injury of the conus medullaris with epidural hematoma at the L4-L5 level. On examination she was able to move her upper extremities but did not have any movement of her lower extremities.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Fracture/dislocation L4-L5, partial transection of cauda equina with mechanical and neurological instability	640616.4,8 630628.3,8 ³	Lap belt	Certain
Injury of the conus medullaris (terminal end of spinal cord) with epidural hematoma at the L4-L5 level	617099.7,8	Lap belt	Certain
Sigmoid colon injury	540899.2,8	Lap belt	Certain
Rupture, ligamentum flavum	650684.1,8	Lap belt	Certain
Small bowel mesenteric hematoma	542010.2,8	Lap belt	Certain

Third row right occupant: Injuries obtained from emergency department and operative records.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Concussion, loss of consciousness, vomiting	160406.2,0	Impact forces	Probable
Complete transection, small bowel. Small tears in the jejunum and serosa. Ischemic area in the transverse colon.	541426.4,8	CSS harness	Certain
Abrasion, chest	490202.1,9	CSS harness	Certain
Abrasion, right eyebrow	290202.1,7	Unknown	Unknown
Abrasion, right nostril	290202.1,4	Unknown	Unknown
Linear abdominal abrasion measuring 5.0 x 3.0 cm (1.9 x 1.2 in). Begins in the right lower quadrant and extends diagonally towards the left upper quadrant	590202.1,0	CSS harness	Certain
Abdominal contusion	590402.1,4	CSS harness	Certain

³Coded as incomplete cauda equina syndrome with fracture and dislocation

OCCUPANT KINEMATICS - 2002 Ford Expedition

Driver Kinematics

The 37-year-old male driver was seated in an upright posture and restrained by the 3-point manual lap and shoulder belt. The seat track was in the middle position. At the time of the vehicle inspection, the seat back was found at a 63 degree angle and the seat bottom at a 6 degree angle. At impact, the frontal air bags deployed and the safety belt pretensioners actuated. The male driver initiated a lateral and slightly forward trajectory. The left door intruded into the passenger compartment. The driver contacted the door with his left side. He sustained a left-sided diaphragm rupture, a left lung laceration, as well as left-sided pneumothorax. He required extrication from the vehicle. He was then transported to a local hospital and arrived with a Glasgow Coma Scale (GCS) score of 15. He was admitted to the ICU postoperatively for further observation. The following day he developed ventricular tachycardia. He remained in the hospital for a total of nine days.



Figure 16. Contact/puncture to driver's door panel

Front Right Occupant Kinematics

The 36-year-old female front right seat occupant was seated in an upright posture and restrained by the 3-point lap and shoulder belt. At the time of the vehicle inspection, the seat back was found at a 68 degree angle and the seat bottom at a 16 degree angle. At impact, the frontal air bags deployed and the safety belt pretensioners actuated. This occupant initiated a lateral and slightly forward trajectory. Her left side heavily engaged the center console—shifting it to the left. This contact caused an abrasion to the left triceps and the movement likely caused a cervical strain and a fracture to the front right incisor tooth. This occupant also complained of pain to her head and chest. She was able to exit the vehicle on her own and did not report any loss of consciousness. She was transported by ground ambulance to a local trauma center. A CT scan later ruled out any mediastinal injury or pneumothorax with the complaint of chest pain. She was released later in the evening.

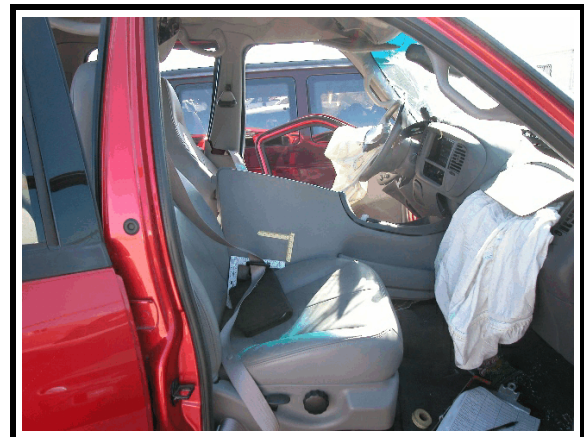


Figure 17. Contact to center console

Second Row Left Occupant Kinematics

The 21-month-old male child was restrained in a forward facing convertible child safety seat by the 5-point harness. The child seat was anchored in the second row left seat position with the 3-point manual lap and shoulder belt. The leather covered split bench seat with a folding back had a seat back angle of 63 degrees and a seat bottom angle of 11 degrees. At impact, the child and child seat initiated a lateral and slightly forward trajectories to the left. The child seat engaged and cracked the door side panel. The child likely engaged the left interior of the child seat shell, but there were no resultant injuries. He sustained several small abrasions to his right arm due to glass fragments. He was transported by ground ambulance to a local trauma center. He was examined and observed for one hour before being released.



Figure 18. Second row, left seating area

Second Row Right Occupant Kinematics

The 21-month-old female child was restrained in a forward facing convertible child safety seat by the 5-point harness. The child seat was anchored in the second row right seat position with the 3-point manual lap and shoulder belt. The leather covered split bench seat with a folding back had a seat back angle of 71 degrees and a seat bottom angle of 11 degrees. At impact, the child and child seat initiated a lateral and slightly forward trajectories to the left. The webbing on the lap portion of the lap and shoulder belt exhibited signs of loading. The child likely contacted the left interior shell of the child seat, but there were no resultant injuries. There were no indications of any injuries. The child's mother wanted to have the child checked. The child was transported by ground ambulance to a local trauma center. She was examined and observed for one hour before being released.



Figure 19. Loading to second row right seat belt webbing

OCCUPANT KINEMATICS - 1993 Dodge Caravan

Driver Kinematics

The 43-year-old male driver of the Dodge Caravan was seated in a forward facing fashion. He was wearing the manual 3-point lap and shoulder belt. At impact, the frontal air bag deployed. The male driver initiated a forward trajectory. He loaded the safety belt and both knees engaged the lower instrument panel/knee bolster. The seat back was deformed forward by impact forces and possibly some unknown object. During the second impact there would have been some small amount of lateral motion to the right. The driver sustained “moderate” injuries according to the police report. He was transported to a local trauma center for treatment. The extent of his injuries are not known. The medical facility could not locate any records for this person.



Figure 20. Driver's seated position

Third Row Left Occupant Kinematics

The 3-year-11-month-old female child was restrained in a forward facing child safety seat by the tray shield. According to the coroner investigations, the child seat was anchored to the vehicle using the manual lap and shoulder belt. At the time of the vehicle inspection, the bench seat back was found at a 68 degree angle and the seat bottom at a 9 degree angle. At impact, this occupant initiated a forward trajectory and engaged the child seat shield. There was a dark track-like impression over the lower aspect of the child's abdomen that was situated approximately 6.3 cm (2.5 in) below the level of the umbilicus and extended into the flank. Associated with the impression were abrasions on the left aspect of the lower abdomen and flank. X-rays were negative for any skull fractures, maxillary fractures, cervical spine fractures, and clavicle fractures. The cause of death was given as “due to deceleration injury due to motor vehicle collision.”



Figure 21. Cosco Alpha Omega child safety seat

Based on the injury pattern it would appear that the full impact was loaded through the shield.

Third Row Middle Occupant Kinematics

The 10-year-old female third row middle occupant was likely seated in an upright posture between the two child seats. She was wearing the manual lap belt. It is not known if the lap belt was being used correctly, but it appears that it was more likely than not being worn above the iliac crests at the abdomen level. At the time of the vehicle inspection, the seat back was found at a 68 degree angle and the seat bottom at a 9 degree angle. At impact, this occupant initiated a forward trajectory. She loaded and then jackknifed over the lap belt. The loading motion caused a fracture/dislocation of the L4-L5 spine, a partial transection of cauda equina, a sigmoid colon injury, and a rupture the ligamentum flavum. On examination she was able to move her upper extremities but did not have any movement of her lower extremities.

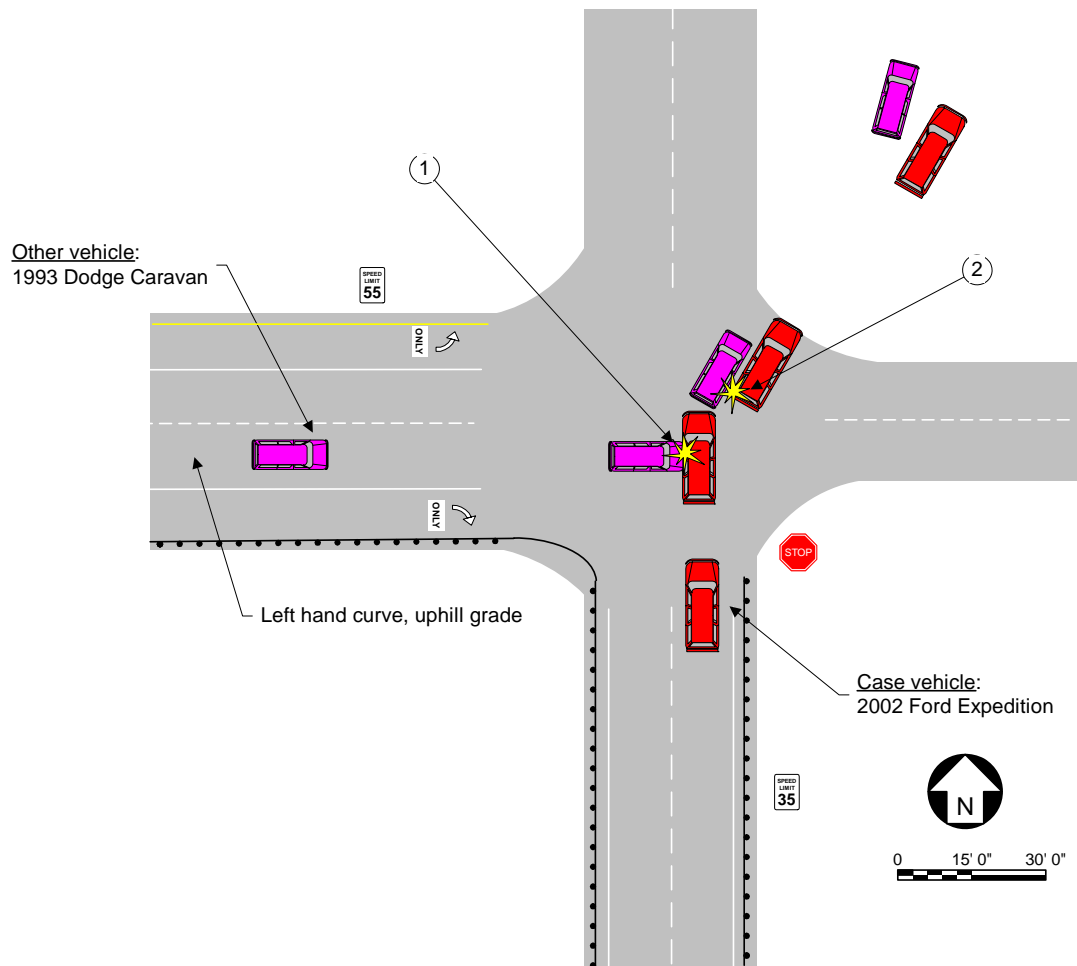
Third Row Right Occupant Kinematics

The 3-year-old male child was restrained in a forward facing child safety seat. The child seat was anchored to the vehicle using the 3-point manual lap and shoulder belt. Based on the child's injury pattern it is believed that the child was wearing the internal child seat harness. At the time of the vehicle inspection, the vehicle seat back was found at a 68 degree angle and the seat bottom at a 9 degree angle. At impact, this occupant initiated a forward trajectory and loaded the internal child seat harness, causing the internal abdominal injuries and the external abdominal abrasion/contusion. He was transported from the scene by ground ambulance. He was transported in the child seat and arrived at the hospital with a GCS of 15. EMS personnel indicated that he did lose consciousness and had vomited 2-3 times. This occupant was admitted and hospitalized for an unknown number of days.



Figure 22. Seat area for third row, right occupant

Attachment 1. Scene Diagram



Attachment 2. Speed Calculations

CASE NUMBER: DS05013

* * END VEL W/ A RATE, I VEL, DISTANCE * *

$Ve = \sqrt{Vi^2 + 2 \times a \times D}$

$Ve = \sqrt{0.00^2 + 2 \times 4.80 \times 24.00}$

$Ve = \sqrt{0.00 + 230.40}$

$Ve = \sqrt{230.40}$

Ve = 15.17

Ve = Ending Velocity in FPS.
 Vi = Initial Velocity in FPS.
 a = Acceleration in FPS².
 D = The Distance in Feet.
 2 = A Constant.

INPUTS:		RESULTS:	
The Initial Vel in FPS is:	0.00	The Ending Vel in FPS is:	15.17
The Acceleration Rate is:	4.80		
The Distance in Feet is:	24.00		

7.50.13