

Rollover and Child Safety Seat Investigation / Rollover
Dynamic Science, Inc. / Case Number: DS06021
2006 Ford Freestar
Arizona
May 2006

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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.

1. Report No. DS06021		2. Government Accession No.		3. Recipient Catalog No.	
4. Title and Subtitle Rollover and Child Safety Seat Investigation				5. Report Date April 13, 2007	
				6. Performing Organization Report No.	
7. Author(s) Dynamic Science, Inc.				8. Performing Organization Report No.	
9. Performing Organization name and Address Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401				10. Work Unit No. (TRAVIS)	
				11. Contract or Grant no. DTNH22-01-C-27002	
12. Sponsoring Agency Name and Address U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590				13. Type of report and period Covered	
				14. Sponsoring Agency Code	
15. Supplemental Notes					
16. Abstract <p>This single vehicle crash occurred in May 2006 at 1739 hours in a mountainous area of Arizona. The case vehicle was a 2006 Ford Freestar minivan rental vehicle being driven by a 30-year-old male. There were six additional occupants in the vehicle. There was a 55-year-old female seated in the front right seat, a 24-year-old female in the second row left seat, a 7-year-old male in the second row right seat, a 4-year-old female in the third row left seat, a 13-month-old female in the third row center seat, and a 3-year-old male in the third row right seat. The 2006 Freestar was traveling at a witness estimated speed of 129 km/h (80 mph) as it traveled north in the left lane of a two-lane freeway. According to the witness, who was traveling north in the right lane, the case vehicle was passing him on the left when it departed the freeway to the left and drove onto a dirt median. The driver overcorrected and the vehicle turned sideways as it traveled back onto the freeway. The Ford Freestar began to roll over with its left side leading. It rolled an unknown number of times and came to final rest on its left side. During the rollover event, the unrestrained 24-year-old female and the 3-year-old male passenger were both fully ejected from the vehicle. The 24-year-old was fatally injured.</p>					
16. Abstract (continued)					
17. Key Words Air bag, deployment, advanced air bag, child safety seat, injury, ejection, fatality, pregnant occupant, rollover, cell phone			18. Distribution Statement		
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No of pages	22. Price		

Dynamic Science, Inc.
Crash Investigation
Case Number: DS06021

TABLE OF CONTENTS

Background	
Description	1
Summary	
Crash Site	3
Pre-Crash	3
Crash	4
Post-Crash	4
Vehicle Data - 2006 Ford Freestar Minivan	6
Vehicle Damage - 2006 Ford Freestar	
Exterior Damage	7
Interior Damage	9
Manual Restraints	11
Supplemental Restraint Systems	12
Child Safety Seats - 2006 Ford Freestar	14
Occupant Demographics - 2006 Ford Freestar	15
Occupant Injuries - 2006 Ford Freestar	18
Occupant Kinematics - 2006 Ford Freestar	24
Attachment 1. Scene Diagram	31

Background

This single vehicle crash occurred in May 2006 at 1739 hours in a mountainous area of Arizona. The case vehicle was a 2006 Ford Freestar minivan being driven by a 30-year-old male (see Figures 1-2). There were six additional occupants in the vehicle. There was a 55-year-old female seated in the front right seat, a 24-year-old female in the second row left seat, a 7-year-old male in the second row right seat, a 4-year-old female in the third row left seat, a 13-month-old female in the third row center seat, and a 3-year-old male in the third row right seat.

According to the police report, the driver, the right front passenger, the 7-year-old male and the 3-year-old male were all restrained with lap and shoulder belts. The 3-year-old male was reportedly secured in a child safety seat. The right front passenger reported that the young boy had removed his seat belt just before the crash occurred. Per an investigating officer, this child's safety seat was not properly used. The 4-year-old and 13-month-old female passengers were also reportedly restrained in child safety seats. There is very little known information about any of the three child safety seats, but the driver reported to police that the 13-month-old's seat was secured in the vehicle in a forward facing fashion.

The second row, 24-year-old female passenger was approximately 9 weeks pregnant and was not restrained with the available lap and shoulder belt.

The 2006 Freestar was traveling at a witness estimated speed of 129 km/h (80 mph) as it traveled north in the left lane of a two-lane freeway. The case vehicle's right front passenger reported that just before the vehicle left the roadway, the driver was doing something with his cell phone. She was not sure what he was doing with the phone, but said he was not making a call. According to the witness, who was traveling north in the right lane, the case vehicle was passing him on the left when it departed the freeway to the left and drove onto a dirt median. The witness reported that the driver overcorrected and the vehicle turned sideways as it traveled back onto the freeway. The Ford Freestar began to roll over with its left side leading. It rolled an unknown number of times and came to final rest on its left side, facing southeast, with its front half on the east shoulder and the back half in the right travel lane. During the rollover event, the unrestrained 24-year-old female and the 3-year-old male passenger were both fully ejected from the vehicle.



Figure 1. Front of case vehicle - 2006 Ford Freestar



Figure 2. Front, exemplar vehicle (2007 Ford Freestar; 2006 model not available)

The driver of the Ford Freestar reported to police that he was not injured and refused medical treatment at the scene. The right front passenger was transported by ambulance to an area hospital where she was hospitalized for 14 days with multiple fractures, a severe head laceration, chipped teeth, and contusions and abrasions to both knees. Per the police report, two registered nurses and a paramedic stopped at the crash scene and performed CPR on the 24-year-old ejected passenger until rescue personnel arrived. Life saving efforts continued as this passenger was transported by helicopter to an area hospital. At 1835 hours, she was pronounced dead from her injuries. The 7-year-old male passenger sustained serious injuries to several fingers on his left hand and was transported by ambulance to the hospital where he was hospitalized for six days. The 4-year-old female passenger was transported by ambulance and was hospitalized for three days with a bruised lung and a minor head laceration. The 13-month-old child sustained multiple contusions and was transported by ambulance to the hospital where she was hospitalized for three days. The ejected 3-year-old male passenger was found on a hillside by a passing motorist. He was initially transported by ambulance to the hospital but approximately an hour later, was transported by helicopter to a hospital equipped with a pediatric intensive care unit. He was hospitalized for three days with a head injury, contused lungs and multiple minor lacerations.

The 2006 Ford Freestar comes equipped with dual stage Certified Advanced 208-Compliant front air bags with intelligent occupant sensors and front row seat belt pretensioners. The dual front air bags deployed during the crash. The case vehicle did not come equipped with the optional side impact curtains or Ford's electronic stability control feature, AdvanceTrac.

The focus of this on site investigation was on the rollover event and the three child safety seats that were reportedly being used to secure the youngest occupants. This on-site investigation was initially identified by NHTSA. A partial police report was faxed to DSI on October 5, 2006 with instructions to locate the vehicle and child safety seats. DSI was instructed to pursue the case as a rollover investigation even if the child seats could not be located. Every effort was made to find and inspect the child safety seats but they were not able to be located. Police on-scene photographs were requested and received, but they show only one of the three safety seats. DSI located and obtained permission to inspect the case vehicle on October 11, 2006. The vehicle was inspected on October 12, 2006.

SUMMARY

Crash Site

This single vehicle crash occurred in May 2006 at 1739 hours in a mountainous area of Arizona (see Figure 3). The crash occurred in the northbound lanes of a divided, two-way interstate freeway. The north and southbound freeways each have two asphalt travel lanes and are separated by a depressed dirt and grass median. The two northbound travel lanes are divided by a painted white dashed lane line. There was an asphalt emergency lane bordering the highway on the right, separated from the traffic lanes by a painted solid white line. There was an asphalt shoulder on the left, separated from the travel lanes by a solid yellow line. Both traffic lanes are bordered by rumble strips. According to the police report, the northbound lanes have a “sweeping left turn” and a downhill grade. Based on the on-scene police photographs and SCI scene inspection, it was determined that the Ford Freestar’s precrash travel lanes curve to the right.



Figure 3. Precrash and rollover area

According to the police report, the northbound lanes have a “sweeping left turn” and a downhill grade. Based on the on-scene police photographs and SCI scene inspection, it was determined that the Ford Freestar’s precrash travel lanes curve to the right.

The crash occurred during daylight hours under cloudy conditions. The travel lanes were dry and the investigating officers found no visibility issues or roadway defects. The posted speed limit on this section of the interstate was 121 km/h (75 mph).

Pre-Crash

The case vehicle was a 2006 Ford Freestar minivan being driven by a 30-year-old male. There were six additional occupants in the vehicle. There was a 55-year-old female seated in the front right seat, a 24-year-old female in the second row left seat, a 7-year-old male in the second row right seat, a 4-year-old female in the third row left seat, a 13-month-old female in the third row center seat, and a 3-year-old male in the third row right seat. According to the police report, the driver, the right front passenger, the 7-year-old male and the 3-year-old male were all restrained with lap and shoulder belts.

The 3-year-old male was reportedly secured in a child safety seat, but the right front passenger reported to police that the boy had removed his seat belt just before the crash occurred. Per an investigating officer, this child’s safety seat was not properly used. The 4-year-old and 13-month-old female passengers were also reportedly in child safety seats, but the makes and models of the seats are unknown. The driver reported to police that the 13-month-old’s safety seat was secured to the vehicle in a forward facing fashion. The second row 24-year-old female passenger, who was approximately 9 weeks pregnant, was not restrained with the available lap and shoulder belt.

The 2006 Freestar was traveling at a witness estimated speed of 129 km/h (80 mph) as it headed north in the left lane of the two-lane freeway. According to the witness, who was traveling north in the right lane, the case vehicle was passing him on the left when it departed the freeway to the left and drove onto the dirt median. The case vehicle's right front passenger reported that the driver was doing something with his cell phone just before the vehicle departed the roadway.



Figure 4. Rollover area

Crash

The witness reported that after departing the freeway, the driver overcorrected and the Ford Freestar turned sideways as it traveled back onto the northbound travel lanes.

The minivan began to roll over (00TDDO3) as it continued north while in a clockwise yaw. It rolled an unknown number of times (see Figure 4). During the rollover event, the unrestrained 24-year-old female and 3-year-old male passengers were fully ejected. The female passenger's body came to rest on the solid white line separating the right lane from the right shoulder. The ejected child came to rest on a hillside adjacent to the freeway. The case vehicle came to final rest on its left side, facing southeast, with its front end on the east shoulder and its back end partially blocking the right lane (see Figures 5-6).



Figure 5. Vehicle at final rest (police photo)

Post-Crash

The witness who was driving the car being passed by the case vehicle reported to police that as the Freestar rolled over, he watched the event in his rearview mirror. He then pulled over and ran back to the crash scene. He found the ejected 3-year-old male on the hillside and told police that when he approached the overturned minivan, he found "three kids buckled in" the vehicle.



Figure 6. Final rest and debris field (police photo)

According to the police report, the driver of the Ford Freestar was able to get out of the vehicle on his own. He went to help the ejected adult female passenger, but returned to the minivan after hearing one of the children calling for him. He removed the three remaining children from the case vehicle.

The driver was ambulatory at the scene and refused medical treatment. The right front passenger was able to crawl out of the overturned minivan on her own. She was transported by ambulance to a local hospital where she was hospitalized for 14 days with multiple fractures, a severe head laceration, chipped teeth, and contusions and abrasions to both knees.

The 24-year-old ejected female passenger sustained serious head injuries. Per the police report, two registered nurses and a paramedic stopped at the crash scene and performed CPR on her until rescue personnel arrived. Life saving efforts continued as she was transported by helicopter to an area hospital. She was pronounced dead at 1835 hours. The cause of death was determined to be blunt force injuries of the head. Some of this occupant's more serious injuries included a brainstem laceration and brain hemorrhaging. The medical examiner reported that this occupant was nine weeks pregnant at the time of the crash.

The second row 7-year-old male passenger sustained serious injuries to several fingers on his left hand and was transported by ambulance to the hospital. He underwent multiple hand surgeries and was hospitalized for six days.

The third row 4-year-old female passenger was transported by ambulance to the hospital where she was hospitalized for three days with a bruised right lung, a minor head laceration and multiple contusions and abrasions.

The 13-month-old child sustained contusions to her upper chest, right pelvis, left leg and left arm. She was transported by ambulance and was hospitalized for three days.

The ejected 3-year-old male passenger was found on a hillside by a passing motorist. He was initially transported by ambulance to the hospital but approximately an hour later, was transported by helicopter to a hospital equipped with a pediatric intensive care unit. He was hospitalized for three days with a head injury, contused lungs and multiple minor lacerations.

Vehicle Data - 2006 Ford Freestar Minivan

The 2006 Ford Freestar four-door minivan was identified by the Vehicle Identification Number (VIN: 2FMZA52236Bxxxxxx). The vehicle was equipped with a 4.2 liter 6 cylinder engine, a 4-speed automatic transmission, front wheel drive, a four wheel anti-lock braking system, four disc brakes with electronic brake distribution and a tilt steering column. The vehicle mileage could not be obtained from the digital odometer because the vehicle had no power. According to a Carfax vehicle history report, the last reported odometer reading for this vehicle was 11,759 km (7,307 miles). The vehicle was equipped with Goodyear Integrity P235/60R16 tires. The recommended cold tire pressure was 241 kPa (35 psi) for the front and rear. The right front tire was sold by the wrecking yard prior to the vehicle inspection. In the police on-scene photographs, the right front tire can be seen still attached to the overturned Ford Freestar. The specific tire information for the case vehicle was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Flat	8 mm (10/32 in)	Yes	Rim damaged; sidewall holed (see Figure 7)
LR	Flat	7 mm (9/32 in)	No	Tire debeaded; rim damaged (see Figure 8)
RR	Flat	7 mm (9/32 in)	No	Tire debeaded
RF	Unknown	Unknown	No	Unknown; tire sold/no longer with the vehicle



Figure 7. Left front tire/rim damage



Figure 8. Left rear tire/rim damage

Vehicle Damage

Exterior Damage - 2006 Ford Freestar

The case vehicle sustained vertical and lateral crush to the roof. The maximum vertical and lateral crush location was to the right A pillar. At this location, there was 19.0 cm (7.5 in) of vertical crush, the maximum crush for the rollover event (see Figure 14). The associated Collision Deformation Classification (CDC) for this event was 00TDDO3 (see Figures 9-10). The rollover was the only crash event (see Figures 11-13 for right side damage).

The left front door remained closed and operational. The right front door, left rear sliding door and rear liftgate were jammed shut post-crash. The right rear sliding door was able to be opened approximately 7.6 - 10.2 cm (3.0 - 4.0 in). As a result of the rollover damage, there were gaps present between the right roof rail and the upper right front and right rear door window frames.

The two front row side windows were closed precrash; the second row side windows were fixed. The third row side windows can be partially opened but it is not known if they were opened or closed during the precrash phase. The rear hatch window was fixed.

There was windshield integrity loss, although some of the damage may have been a result of the driver's post-crash passenger extrication efforts. The driver reported to police that he got out of the vehicle on his own and due to the fact the Freestar was laying on its left side, it is likely he exited the minivan through the windshield area. With the exception of the left front window, the back glazing and all of the side glazing disintegrated during the rollover event. The majority of the direct damage to the vehicle's top was to the right side pillars and to both roof side rails.



Figure 9. Rollover damage & opening at upper right rear door



Figure 10. Windshield damage at the scene (police photo)

CDC:	00TDDO3	
Delta V:	Total	Not Applicable
	Longitudinal	Not Applicable
	Latitudinal	Not Applicable
	Energy	Not Applicable



Figure 11. Right rear rollover damage



Figure 12. Right side passenger compartment rollover damage



Figure 13. Right front rollover damage (RF tire removed/sold by wrecking yard)



Figure 14. Location of max crush from the rollover event (right A pillar)

Interior Damage - 2006 Ford Freestar

The case vehicle sustained moderate interior damage due to occupant contacts, intrusion and normal air bag deployment related damage.

There were very few signs of occupant contact evidence in the passenger compartment. There was evidence of occupant loading to both front row seat belts. Blood was found on the back center section of the deployed driver's air bag and on both front row seat back cushions. There were blood splatters above the second row right window glazing (see Figures 15-16) and blood streaks and spatters found on the second row left seat back, seat cushion, and head restraint (see Figures 17). Blood was also found on the second row left seat belt webbing and left C pillar area. Given the direction of the blood streaks and the fact there was blood found both inside and outside of the second row right window frame, it is likely that the 24-year-old female passenger was ejected through the second row right side window. The third row right passenger was likely ejected through the third row right side window. The glazing in both of these windows had disintegrated during the rollover event.

The vehicle sustained vertical intrusion of the roof, the right roof side rail, and the right A, B, C and D pillars (see Figures 18-19). The right D pillar also intruded laterally. The air vent located on the right side of the instrument panel was damaged due to the intruding right A pillar. Field measurements were obtained during the vehicle inspection and an exemplar vehicle was located in order to obtain comparative, undamaged measurements.



Figure 15. Blood - 2nd row right side window frame & roof side rail (police photo)



Figure 16. Blood splatter above second row right window glazing

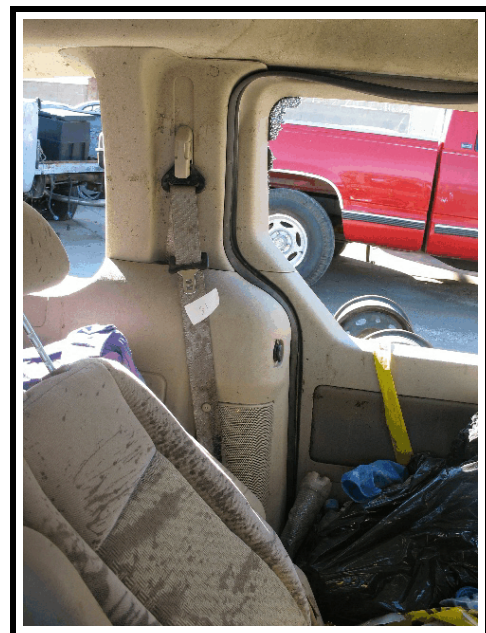


Figure 17. Blood found in the second row left seating area

The specific passenger compartment intrusions were documented as follows:

Row/Position	Intruded Component	Magnitude of Intrusion	Direction
1R	A Pillar	15.0 cm (5.9 in)	Vertical
1R	Roof side rail	14.0 cm (5.5 in)	Vertical
1R	B Pillar	7.0 cm (2.8 in)	Vertical
2R	Roof side rail	7.0 cm (2.8 in)	Vertical
2R	Roof	9.0 cm (3.5 in)	Vertical
3R	C Pillar	10.0 cm (3.9 in)	Vertical
3R	Roof side rail	11.0 cm (4.3 in)	Vertical
3R	Roof	17.0 cm (6.7 in)	Vertical
3R	D pillar	12.0 cm (4.7 in)	Vertical
3R	D pillar	10.0 cm (3.9 in)	Lateral



Figure 18. Passenger compartment intrusion - RF seating area (police photo)

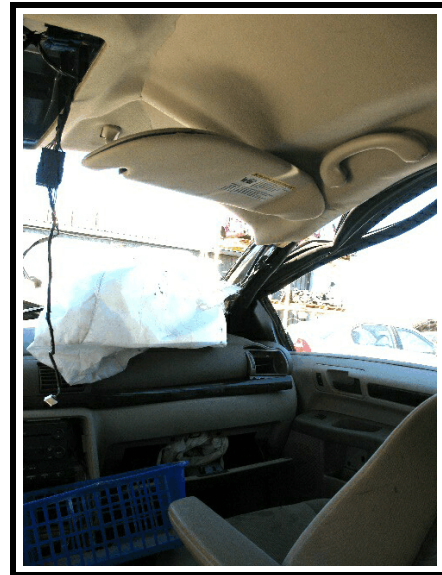


Figure 19. Intrusion into RF seating area

Manual Restraints - 2006 Ford Freestar

The case vehicle was equipped with two fabric covered bucket seats with adjustable head restraints in the front seating area, two fabric covered bucket seats with adjustable head restraints in the second seating row, and a fabric covered bench seat with a folding back cushion in the third row. The third row seating positions were all equipped with adjustable head restraints.

All seven of the Freestar's seating positions were equipped with manual 3-point lap and shoulder belts. The two front row seat belts were equipped with retractor pretensioners. The driver's shoulder belt anchorage adjustment was found in the full up position and the right front passenger's adjustment was found fully down. The two second row seat belt anchorage adjustments were set to the full down position. None of the third row safety belts were equipped with anchorage adjustments.

The driver's seat belt was equipped with a sliding latchplate and an Emergency Locking Retractor (ELR). The seat belt exhibited signs of usage during the crash; no failures were noted (see Figure 20). The remaining six passenger belts were equipped with sliding latchplates and switchable ELR/Automatic Locking Retractors (ALR). There was blood found on the right front seat belt webbing. This belt showed signs of being used during the crash and was found locked in the D-ring (see Figure 21). The second row left seat belt showed no visible signs of loading that would have been consistent with its having been used during the crash. The second row right seat belt showed signs of occupant loading and blood was found on both the lap and shoulder portions. The distance between the seat belt stop button and the evidence of occupant loading to this belt was 51.0 cm (20.1 in).

None of the third row seat belts showed signs of being used during the crash. A witness who stopped at the scene told police that he saw three children "buckled in" the case vehicle and found the ejected 3-year-old male passenger "down a hill, approximately 30 feet from the van".



Figure 20. Driver's seat belt



Figure 21. Right front passenger seat belt

According to information contained on the police report, the 4-year-old female seated in the third row left seat was not restrained, but was “in a child restraint” at the time of the crash. The 13-month-old female in the third row center seat was secured in an unknown type of child safety seat. As viewed in a police on-scene photograph, the seat was secured forward facing in the vehicle by the available lap and shoulder belt (see Figure 22). The 3-year-old male passenger seated in the third row right seating position was not restrained at the time of the crash and was fully ejected from the vehicle. The right front passenger reported that the boy had removed his seat belt just before the crash occurred.



Figure 22. Child safety seat secured forward facing in the 3rd row center seat (arrow points to buckled seat belt - police photo)

One of the investigating officers indicated on the police report that this 3-year-old passenger had been “in a car seat, unrestrained” and “the car seat was not properly used”. At the time of the vehicle inspection, the seat belt retractor in this location was found to be in the ALR mode.

Supplemental Restraint Systems - 2006 Ford Freestar

The 2006 Ford Freestar was equipped with advanced occupant protection systems. The systems included dual stage driver and front right passenger Certified Advanced 208-Compliant air bags with occupant sensors intelligent.

During the crash sequence, the driver and right front passenger air bags deployed. The driver’s air bag deployed from the center of the steering wheel hub through I-configuration cover flaps (see Figure 23). There was a third flap located at the top of the side flaps that measured 13.5 cm (5.3 in) wide by 6.0 cm (2.4 in) high. The top and bottom sections of the left and right cover flaps measured 8.0 cm (3.1 in) wide and both flaps were 9.5 cm (3.7 in) high. The deployed driver air bag measured 42.0 cm (16.5 in) in diameter in its deflated state. The air bag was tethered by a single internal strap and there were two circular vent ports located at the 11 and 1 o’clock positions on the rear of the air bag. There was blood on the lower center section of the back of the air bag which may have been a result of post-crash contact by one or more of the vehicle occupants (see Figure 24). There was no damage or occupant contact visible on the cover flaps.



Figure 23. Deployed driver front air bag

The passenger front air bag deployed from a top mounted single air bag module cover flap (see Figures 25-26). The cover flap was rectangular in shape and measured 32.0 cm (12.6 in) wide by 12.5 cm (4.9 in) high. The air bag was also rectangular in shape and measured 54.0 cm (21.3 in) seam to seam laterally and 49.0 cm (19.3 in) in height in its deflated state. There was one internal tether and four circular vent ports on the sides of the air bag at the 3 and 9 o'clock positions. The material on the top center section of the bag was torn (see Figure 27); the opening measured 14.0 cm (5.5 in) wide by 15.0 cm (5.9 in) high. This damage may have been caused by the deploying passenger air bag coming in contact with the damaged windshield. There was no occupant contact evidence visible on the cover flap or air bag.



Figure 24. Blood on back/lower section of the driver's deployed front air bag



Figure 25. Location of right vent ports



Figure 26. Deployed passenger front air bag



Figure 27. Damage to deployed passenger front air bag

Child Safety Seats - 2006 Ford Freestar

According to the driver of the 2006 Ford Freestar, the only child that was secured in a child safety seat was the 13-month-old female. According to information contained in the police report, the 4-year-old female passenger was also “in a child restraint at the time of the collision”, but the type, make and model of seat are unknown. Investigating officers also reported that the 3-year-old male seated in the third row right seat was “in a car seat, unrestrained” and that “the car seat was not properly used”.

There were no child safety seats with the vehicle at the time of the inspection. All of the parties who had possession of the vehicle post-crash were contacted in attempts to locate the seats. The investigating police agency had no information on the location of the seats and verified that the seats had never been logged as evidence in this case. The tow company that towed the Ford Freestar from the crash scene to an impound lot, and later transported the vehicle from the lot to the rental car company was also contacted, but did not have the child seats and did not know their location. The rental car agency did not know what had happened to the seats. The wrecking yard that purchased the case vehicle at auction reported that when they purchased the Freestar, there were no child safety seats in the vehicle. The emergency room and pediatric unit of the hospital where the children were taken for medical treatment were contacted, but did not know the location of the seats. It is possible that the child seats may have been thrown away when the vehicle was cleaned up for auction at the rental car company. Relatives of the crash victims were contacted in order to obtain more information about the seats, but these attempts were not successful.



Figure 28. Child safety seat - 3rd row center seat (police photo)

It appears from an on-scene police photograph that at least one of the child safety seats was still in the vehicle after all of the occupants had been removed (see Figure 28). There were multiple items that had been thrown outside of the vehicle during the rollover, but no child safety seats are visible in the debris field. The third row center seating position contained a child safety seat that was positioned in a forward facing fashion. In the police photographs, the seat had visible bloodstains on its left side and appears to have been equipped with harness straps that were also stained with blood.

Child Safety Seat Installation

According to the driver of the case vehicle, the 13-month-old’s child safety seat was installed forward facing. This was verified in police on-scene photographs. Relatives of the crash victims were contacted in order to obtain more information about the seats and their installation, but the attempts were not successful.

Occupant Demographics - 2006 Ford Freestar

	<u>Driver</u>	<u>Occupant 2</u>
Age/Sex:	30/Male	55/Female
Seated Position:	Front left	Front right
Seat Type:	Fabric covered bucket seat	Fabric covered bucket seat
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Not Applicable
Pre-existing Medical Condition:	None noted	Multiple pre-existing conditions; see the Occupant Injury section of this report for more information.
Alcohol/Drug Involvement:	Police report indicated the driver "had been drinking". Report also indicated the "use of illicit drugs" (specifically marijuana). Blood drawn for drug/alcohol screen; results unknown.	Not Applicable
Driving Experience:	Unknown	Not Applicable
Body Posture:	Presumed to be upright, forward facing	Presumed to be upright, forward facing
Hand Position:	Presumed to be on the steering wheel, actively steering	Unknown
Foot Position:	Presumed to be on the foot controls and/or floorboards	Presumed to be on the floorboards
Restraint Usage:	Manual 3-point lap and shoulder belt available - used	Manual 3-point lap and shoulder belt available - used
Air bag:	Front air bag available - deployed.	Front air bag available - deployed.

	<u>Occupant 3</u>	<u>Occupant 4</u>
Age/Sex:	24/Female (9 weeks pregnant)	7/Male
Seated Position:	Second row left	Second row right
Seat Type:	Fabric covered bucket seat	Fabric covered bucket seat
Height:	170 cm (67 in)	Unknown
Weight:	129 kg (285 lb)	Unknown
Occupation:	Not Applicable	Not Applicable
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	Not Applicable. Blood toxicology screen completed during autopsy - negative for drugs and alcohol.	Not Applicable.
Driving Experience:	Not Applicable	Not Applicable
Body Posture:	Presumed to be upright, forward facing	Presumed to be upright, forward facing
Hand Position:	Unknown	Unknown
Foot Position:	Presumed to be on the floorboards	Unknown
Restraint Usage:	Manual 3-point lap and shoulder belt available - not used	Manual 3-point lap and shoulder belt available - used
Air bag:	No air bags available	No air bags available

	<u>Occupant 5</u>	<u>Occupant 6</u>	<u>Occupant 7</u>
Age/Sex:	4/Female	13 months/Female	3/Male
Seated Position:	Third row left	Third row center	Third row right
Seat Type:	Fabric covered bench seat with folding back	Fabric covered bench seat with folding back	Fabric covered bench seat with folding back
Height:	Unknown	Unknown	Unknown
Weight:	Unknown	Unknown	Unknown
Occupation:	Not Applicable	Not Applicable	Not Applicable
Pre-existing Medical Condition:	None noted	Bilateral otitis media (ear infection) and a heart murmur	None noted
Alcohol/Drug Involvement:	Not Applicable	Not Applicable	Not Applicable
Driving Experience:	Not Applicable	Not Applicable	Not Applicable
Body Posture:	Presumed to be upright, forward facing	Seated in a child safety seat, forward facing	Presumed to be upright, forward facing
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
Restraint Usage:	Manual 3-point lap and shoulder belt available - unknown if used. Per the police report, this child was "in a child restraint at the time of collision".	Manual 3-point lap and shoulder belt available - used to secure a forward facing child safety seat (CSS). Unknown if belt or CSS used properly.	Manual 3-point lap and shoulder belt available - not used. Per police, he was in a child safety seat that had been improperly used and the child was not restrained.
Air bag:	No air bags available	No air bags available	No air bags available

Occupant Injuries - 2006 Ford Freestar

Driver: Not injured per the police report. This driver refused medical treatment at the scene and reported no injuries at the time of the investigation.

Front Right Occupant: Injuries obtained from the ER report, operative and radiology reports and the discharge summary.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Laceration, scalp, major (50 cm, into subcutaneous tissue), with superficial soft tissue loss (avulsion), right temporal region	190604.2,1	Window frame, glazing	Possible
Open fracture, right humerus, lateral epicondyle, with avulsion laceration to soft tissue	752604.3,1	Right door panel	Probable
Fracture, sternum, with retrosternal hematoma	450804.2,4	Right door panel	Possible
Fracture, rib, R#3, posterior	450212.1,1	Right door panel	Probable
Multiple fractures (chipped areas), teeth	251404.1,8	Unknown	Unknown
Closed head injury NFS	115099.7,0	Right window frame	Possible
Mediastinal hematoma, chest, left side	490402.1,2	Seat belt webbing	Possible
Abrasions, bilateral, knees	890202.1,3	Instrument panel	Possible
Contusions, bilateral, knees	890402.1,3	Instrument panel	Possible

Pre-existing conditions:

Hyperamylasemia secondary to traumatic pancreatitis

Diabetes

Hypertension

Raynaud's Disease

Pre-existing conditions(continued):

Osteoarthritis of the bilateral knees

Uremia secondary to diabetic nephropathy

Degenerative neck changes to the cervical spine

Stress urinary incontinence

Hypophosphatemia

Hypomagnesemia

Flexor tendinitis, bilateral fingers

Atelectasis

Second Row Left Occupant: Injuries obtained from the autopsy and toxicological report.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Abrasion, forehead	290202.1,7	Ground	Probable
Contusion, nose	290402.1,4	Ground	Probable
Contusion, forehead	290202.1,7	Ground	Probable
Subarachnoid hemorrhage, cerebellum	140466.3,6	Ground	Probable
Subdural hemorrhage cerebellum (basilar) NFS	140438.4,6	Ground	Probable
Laceration, brainstem	140212.6,8	Ground	Probable
Basilar fracture, complex (ring), middle to posterior cranial fossa; with occipital subscapular hemorrhage	150206.4,8	Ground	Probable
Multiple contusions, right breast	490402.1,1	Ground	Probable
Multiple contusions, left breast	490402.1,2	Ground	Probable

Multiple abrasions, upper abdomen	590202.1,7	Ground	Probable
Laceration (minor), upper abdomen	590602.1,7	Ground	Probable
Multiple abrasions, back	690202.1,0	Ground	Probable
Multiple contusions, back	690402.1,0	Ground	Probable
Laceration (minor), middle back	690602.1,4	Ground	Probable
Multiple abrasions, right gluteal area	590202.1,1	Ground	Probable
Multiple abrasions, left upper arm	790202.1,2	Ground	Probable
Contusion, left upper arm	790402.1,2	Ground	Probable
Multiple abrasions, left hand and digits	790202.1,2	Ground	Probable
Multiple contusions, left hand and digits	790402.1,2	Ground	Probable
Contusion, right wrist	790402.1,1	Ground	Probable
Multiple abrasions, right hand and digits	790202.1,1	Ground	Probable
Multiple contusions, right anterior thigh	890402.1,1	Ground	Probable
Abrasion with overlying laceration (minor), right knee	890202.1,1 890602.1,1	Ground Ground	Probable
Contusion, right posterior thigh	890402.1,1	Ground	Probable
Multiple abrasions, dorsal right foot	890202.1,1	Ground	Probable
Multiple lacerations (minor), dorsal right foot	890602.1,1	Ground	Probable
Multiple abrasions, right ankle	890202.1,1	Ground	Probable

Second Row Right Occupant: Injuries obtained from the ER report, operative and radiology reports and the discharge summary.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Degloving injury to second, third and fourth fingers of left hand, resulting in open fractures and tendon loss. Lacerations total 20 cm.	794004.2,2	Unknown	Unknown
Open fractures, middle and distal phalanx, of the left index finger with extensor tendon injury	752404.1,2	Unknown	Unknown
Open fractures, middle and distal phalanx, of the left middle finger with flexor and extensor tendon injuries	752404.1,2	Unknown	Unknown
Open laceration (avulsion) to left ring finger, with open joint injury	750240.2,2	Unknown	Unknown
Multiple contused abrasions, forehead	290202.1,7	Displaced cargo	Possible
Swelling to scalp, right frontal region	Not codable	Displaced cargo	Possible
Contusion, upper lip	290402.1,8	Displaced cargo	Possible
Abrasions, right shoulder	790202.1,1	Seat belt webbing	Probable
Multiple contusions, arms, bilateral	790402.1,3	Displaced cargo	Possible
Multiple contusions, chest	490402.1,4	Seat belt webbing	Probable
Multiple contusions, abdomen (pelvic area)	590402.1,8	Seat belt webbing	Probable
Multiple contusions, legs, bilateral	890402.1,3	Unknown	Unknown

Third Row Left Occupant: Injuries obtained from the ER and radiology reports.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Laceration, minor (6 cm), right scalp	190602.1,1	Unknown	Unknown
Contusion, upper lip	290402.1,8	Unknown	Unknown
Contusions, chest, right side	490402.1,1	Child safety seat harness or seat belt webbing	Possible
Abrasions, chest, right side	490202.1,1	Child safety seat harness or seat belt webbing	Possible
Contusion, right lung	441406.3,1	Child safety seat harness or seat belt webbing	Possible
Multiple contusions, arms, bilateral	790402.1,3	Unknown	Unknown
Multiple contusions, legs, bilateral	890402.1,3	Unknown	Unknown

Third Row Center Occupant: Injuries obtained from the ER reports, and the consultation and radiology reports.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Contusion, upper chest	490402,1,4	Child safety seat harness/webbing	Probable
Contusion, left arm	790402.1,2	Child safety seat	Probable
Contusion, pelvis, right side	590402.1,1	Child safety seat	Probable
Contusion, left leg	890402.1,2	Unknown	Unknown

Pre-existing conditions:

Bilateral otitis media (ear infection)

Heart murmur

Third Row Right Occupant: Injuries obtained from the ER report, radiology records and discharge summary.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Contusion, scalp, right temple	190402.1,1	Ground	Probable
Multiple lacerations, minor (4 total), scalp	190602.1,9	Ground	Probable
Subarachnoid hemorrhage, cerebrum	140466.3,6	Ground	Probable
Abrasion, left chest, extending down to hip	490202.1,2	Ground	Probable
Contusion, lungs, bilateral	441410.4,3	Ground	Probable

Occupant Kinematics - 2006 Ford Freestar

Driver Kinematics

The 30-year-old male driver was likely seated in an upright posture. He was wearing the 3-point manual lap and shoulder belt. The shoulder belt anchorage adjustment was in the full up position. The fabric covered bucket seat was adjusted to the fully rearward track position. The seat back was positioned 23 degrees from vertical and the seat bottom was 13 degrees from horizontal.

According to the right front passenger, this driver was doing something with his cell phone just before the vehicle departed the roadway and may have only had one hand on the steering wheel during the precrash phase.



Figure 29. Evidence of occupant loading to driver's seat belt

When the Freestar departed the freeway to the left, the driver began to actively steer to the right but overcorrected, causing the vehicle to go into a clockwise rotation. He was likely leaning to his left to some degree in response to centrifugal forces. As the vehicle rolled with the left side leading, the driver's body pitched even further towards the left front door panel. During the rollover he likely remained within his general seating area, held somewhat in place by his seat belt. There were no visible occupant contact points found anywhere in the driver's general seating area. There was blood found on the back center section of the deployed driver's air bag, but this transfer likely occurred post-crash.

After the rollover event was over, this driver was able to crawl out of the vehicle on his own. He reported to police that, with the exception of the 3-year-old boy who had been fully ejected, he removed all of the children from the overturned minivan. He told police that he was not injured and refused medical treatment at the scene.

Front Row Right Occupant Kinematics

This 55-year-old female passenger was likely seated in an upright posture. She was wearing the available 3-point manual lap and shoulder belt. The shoulder belt anchorage adjustment was in the full down position. The fabric covered bucket seat was adjusted to the center track position. The seat back was positioned 22 degrees from vertical and the seat bottom was 13 degrees from horizontal.

When the Freestar departed the freeway to the left, the driver began to actively steer to the right but overcorrected, causing the vehicle to go into a clockwise rotation. This passenger was likely leaning to her left to some degree in response to centrifugal forces. As the vehicle rolled with the left side leading, this passenger's body pitched even further to the left, but likely remained within her general seating area because of her seat belt. Her seat belt retractor was found locked in place, which may have been due to either the actuation of the retractor pretensioner or due to the right B pillar rollover damage.

As the Freestar continued to rollover, this passenger's head may have come in contact with the displaced, roof-mounted light, possibly resulting in her head laceration.

After the vehicle came to final rest, this occupant was able to crawl out of the minivan on her own. She was transported by ambulance to an area hospital where she was hospitalized for fourteen days with multiple fractures, a severe head laceration, chipped teeth, and contusions and abrasions to both knees.



Figure 30. Right front seat belt



Figure 31. RF passenger's seating area & displaced roof-mounted light

Second Row Left Occupant Kinematics

This 24-year-old female passenger was likely seated in an upright posture but was not wearing the available 3-point manual lap and shoulder belt. She was nine weeks pregnant. The fabric covered bucket seat was adjusted to the center track position. At the time of the inspection, the seat back was positioned 42 degrees from vertical and the seat bottom was 16 degrees from horizontal.

When the Freestar departed the freeway to the left, the driver began to actively steer to the right but overcorrected, causing the vehicle to go into a clockwise rotation. This passenger was likely leaning to her left in response to centrifugal forces. As the vehicle rolled with the left side leading, this passenger's body pitched even further to the left, likely coming in contact with the left rear door panel and window frame.

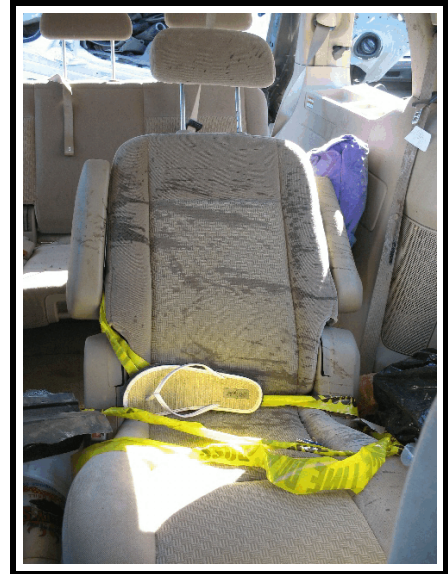


Figure 32. Second row left seat

As the Freestar continued to rollover, this occupant was thrown around inside the passenger compartment. During the rollover event, this pregnant occupant was fully ejected from the vehicle. It is likely that she was ejected through the second row right window glazing, which had disintegrated during the crash. There was blood found on the right rear window frame and to the top outer portion of the right rear door and roof side rail.



Figure 33. Blood on the RR door and window frame (police photo)

According to the police report, two registered nurses and a paramedic stopped at the crash scene and performed CPR on this passenger until rescue personnel arrived. Life saving efforts continued as she was transported by helicopter to an area hospital. She was pronounced dead at 1835 hours. The cause of death was determined to be blunt force injuries of the head. Some of this occupant's more serious injuries included a brainstem laceration and brain hemorrhaging.

Second Row Right Occupant Kinematics

This 7-year-old male passenger was likely seated in an upright posture. He was wearing the available 3-point manual lap and shoulder belt. The shoulder belt anchorage adjustment was set to the full down position. The fabric covered bucket seat was adjusted to the fully rearward track position. At the time of the inspection, the seat back was positioned 36 degrees from vertical and the seat bottom was 18 degrees from horizontal.

When the Freestar departed the freeway to the left, the driver began to actively steer to the right but overcorrected, causing the vehicle to go into a clockwise rotation. This passenger was likely leaning to his left in response to centrifugal forces. As the vehicle rolled with the left side leading, this passenger's body pitched even further to the left, likely coming in contact with the left armrest that was attached to his seat back.



Figure 34. Second row right seat

As the Freestar continued to rollover, this passenger remained within his general seating area, somewhat held in place by his seat belt.

This passenger was removed from the vehicle by the driver and was transported by ambulance to a hospital where he was hospitalized for six days. He sustained serious injuries to several fingers on his left hand and had to undergo multiple hand surgeries.

Third Row Left Occupant Kinematics

This 4-year-old female passenger was likely seated in a semi-upright posture, possibly in a child safety seat. The police report listed her as being “in a child restraint” but there is no other known information on the type of seat or how it may have been secured inside the vehicle.

The third row fabric covered seat back was positioned 18 degrees from vertical and the seat bottom was 6.5 degrees from horizontal.

When the Freestar departed the freeway to the left, the driver began to actively steer to the right but overcorrected, causing the vehicle to go into a clockwise rotation. This passenger was likely leaning to the left in response to centrifugal forces. As the vehicle rolled with the left side leading, her body pitched even further to the left. As the Freestar continued to rollover, this passenger likely came in contact with the child safety seat that was secured in the third row center seating area.



Figure 35. Third row left seating area

This passenger was removed from the vehicle by the driver and was transported by ambulance to the hospital where she was hospitalized for three days with a bruised right lung, a minor head laceration and multiple contusions and abrasions.

Third Row Center Occupant Kinematics

This 13-month-old female passenger was seated in a forward facing child safety seat. It was determined from on-scene police photographs that her child safety seat was secured to the vehicle by the available 3-point manual lap and shoulder belt. The type, make and model of seat is not known.

The third row fabric covered seat back was positioned 18 degrees from vertical and the seat bottom was 7 degrees from horizontal.

When the Freestar departed the freeway to the left, the driver began to actively steer to the right but overcorrected, causing the vehicle to go into a clockwise rotation. This passenger was likely leaning to her left in response to centrifugal forces.

As the vehicle rolled with the left side leading, this passenger's body pitched even further to the left, likely coming in contact with the padding on the inside of the safety seat. As the Freestar continued to rollover, this passenger remained within her child safety seat, but it is not known how she was restrained. She was removed from the vehicle by the driver and was transported by ambulance to the hospital where she was hospitalized for three days with contusions to her upper chest, right pelvis, left leg and left arm.



Figure 36. Third row center seating area

Third Row Right Occupant Kinematics

This 3-year-old male passenger was likely seated in an upright posture in an unknown type of child safety seat. According to police, this 3-year-old male passenger had been in a safety seat that was being used improperly. There is no other known information on the type of seat or how it may have been secured inside the vehicle. According to the right front passenger, the 3-year-old had removed his seat belt just before the rollover event began.

The third row fabric covered seat back was positioned 18 degrees from vertical and the seat bottom was 7 degrees from horizontal.

When the Freestar departed the freeway to the left, the driver began to actively steer to the right but overcorrected, causing the vehicle to go into a clockwise rotation. This passenger was likely leaning to the left in response to centrifugal forces.



Figure 37. Third row right seating area

As the vehicle rolled with the left side leading, this unrestrained 3-year-old passenger pitched even further to the left and likely came in contact with the right side of the child safety seat that was secured in the seat to his left.

As the vehicle continued to rollover, this child was fully ejected. The avenue of ejection was likely through the third row right side window, which had disintegrated during the rollover event.

A passing motorist found the child on a hill adjacent to the freeway. He was initially transported by ambulance to the hospital but approximately an hour later, was transported by helicopter to a hospital equipped with a pediatric intensive care unit. He was hospitalized for three days with a head injury, contused lungs and multiple minor lacerations.

Attachment 1. Scene Diagram

