On-Site Child Restraint System Investigation
Dynamic Science, Inc. (DSI)
Case Number DS10019
2002 Mercury Mountaineer
Utah
September 2010

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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 Child Restraint System (CRS) investigation focused on the occupants and the booster seat in 2002 Mercury Mountaineer that was involved in a single vehicle rollover crash. The vehicle was being driven by a restrained 32-year-old male. The front right seat was occupied by a restrained 11-year-old female. The second row left seat was occupied by a 4-year-old female seated in a booster seat. The second row middle seat was initially occupied by a 1-year-old female seated in a forward-facing CRS, but prior to the crash this occupant had been removed from the CRS and was being held by the 32-year-old female second row right occupant. The third row right seat was occupied by a 6-year-old female. The crash occurred in the northbound lanes of an interstate highway. The Mercury was traveling in the left travel lane and the vehicle drifted onto the left side shoulder and crossed over the rumble strip. The driver steered the vehicle to the right and back onto the travel lane, lost control, over-corrected back to the left, and began a counterclockwise rotation. The vehicle departed the roadway and entered the median while rotating. The vehicle then tripped and began a right side leading rollover. While rolling over the vehicle crossed the median, the southbound travel lanes, and an embankment adjacent to the southbound travel lanes. The vehicle continued rolling as it struck a barbed wire fence, traveled down a short embankment, and came to rest in the southbound travel lane of frontage road. The driver, front right seat occupant, and second row left seat occupant were fatally injured. The second row right occupant and the third row right occupant were ejected. The 1-year-old child remained in the vehicle.

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Dynamic Science, Inc.
Crash Investigation
Case Number: DS10019

BACKGROUND

This on-site Child Restraint System (CRS) investigation focused on the occupants and the booster seat in 2002 Mercury Mountaineer that was involved in a single vehicle rollover crash (**Figure 1**). The crash occurred in September 2010 at 0225 hours. The vehicle was being driven by a restrained 32-year-old male. The front right seat was occupied by a restrained 11-year-old female. The second row left seat was occupied by a 4-year-old female seated in a booster seat. The second row middle seat was initially occupied by a 1-year-old female seated in a forward-facing CRS, but prior to the crash this occupant had been removed from the CRS and was being held by the 32-year-old female second row right occupant (the child's mother). The third row right seat was occupied by a 6-year-old female.

Figure 1. 2002 Mercury Mountaineer at final rest (internet photo)

The crash occurred in the northbound lanes of an interstate highway. The Mercury was traveling in the left travel lane and the vehicle drifted onto the left side shoulder and crossed over the rumble strip. The driver steered the vehicle to the right and back onto the travel lane, lost control, over-corrected back to the left, and began a counterclockwise rotation. The vehicle departed the roadway and entered the median while rotating. The vehicle then tripped and began a right side leading rollover. While rolling over the vehicle crossed the median, the southbound travel lanes, and an embankment adjacent to the southbound travel lanes. The vehicle continued rolling as it struck a barbed wire fence, traveled down a short embankment, and came to rest in the southbound travel lane of frontage road.

The driver, front right seat occupant, and second row left seat occupant were fatally injured. The second row right occupant and the third row right occupant were ejected. The 1-year-old child remained in the vehicle.

This incident was identified by a DSI investigator from an internet news article reporting a crash with three fatalities.

On September 2, 2010 DSI forwarded the news article to the National Highway Traffic Safety Administration (NHTSA) for review. DSI was instructed to obtain permission to inspect the vehicle and child seats. On September 3, 2010 DSI obtained permission to inspect the vehicle and the inspections took place on September 6, 2010. The vehicle's Event Data Recorder (EDR) was not supported by the Bosch Crash Data Retrieval system. The police report was obtained on October 4, 2010.

SUMMARY

Crash Site

At the time of the crash it was dark and there were no streetlights present. The temperature at the nearest reporting station was 12 degrees C (53.6° F), the wind direction was east at 5.6 km/h (3.5 mph), and the visibility was 16.0 km (10 mi). The crash site was the northbound lanes of an interstate highway (**Figure 2**). The highway was configured with two lanes that were separated by dashed white lines. The asphalt roadway was straight with a positive 2 percent grade and was dry at the time of the crash. The roadway was bordered on both sides by asphalt shoulders with continuous rumble strips near the edge lines. Beyond the shoulder, the roadway was bordered on the west by a descending 13.7 m (45.0 ft) grass-covered median that terminated at the southbound lanes of the highway. To the west of the southbound travel lanes there was a 11.5 m (38.0 ft) descending embankment, a barbed wire fence, a 3.6 m (12.0 ft) descending embankment with a 38 degree downward slope, a 1.8 m (6.0 ft) section of level grass, and a two-lane frontage road. The asphalt frontage road was bordered on both sides by 1.2 m (4.0 ft) shoulders and had a negative 3.9 percent slope to the south. The posted speed limit for the interstate highway was 121 km/h (75 mph).

Figure 2. Northbound approach to left side roadway departure

Pre-Crash

The Mercury was traveling northbound in the left lane of the interstate highway. The vehicle drifted onto the left side shoulder and crossed over the rumble strip (**Figure 3**). The driver steered the vehicle to the right back onto the travel lane, lost control, over-corrected back to the left, and began a counterclockwise rotation. The vehicle departed the roadway and entered the median while rotating. The police calculated a speed of 138 km/h (86 mph)[1] at the area of roadway departure based on a tire yaw mark in the northbound travel lane.

Figure 3. Left side roadway departure

Crash

The vehicle then tripped and began a right side leading rollover (Event 1). While rolling the vehicle crossed the center median and the third row right occupant was ejected. The vehicle crossed the southbound travel lanes and the second row right occupant was ejected.

[1]Calculated with a 30.4 m (100 ft) chord, 0.6 m (2.0 ft) middle ordinate, and coefficient of friction of 0.8.

The vehicle continued rolling as it crossed a grass-covered embankment, impacted a barbed wire fence (Event 2), traveled down a short embankment, and came to rest in the southbound travel lane of frontage road (**Figure 4**).

Figure 4. Final rest and impacted barbed wire fence (looking east)

Post-Crash

The Mercury came to rest on its roof on the frontage road facing south. The vehicle was towed from the scene due to damage and declared a total loss by the insurance company.

The driver, front right occupant (02), and second row left occupant (03) were pronounced deceased at the scene at 0240 hours. Emergency medical workers extracted the bodies and they were transported to a local hospital. They were then transported to various funeral homes for subsequent burial. Certificates of death were obtained for each of the occupants. The cause of death for each was attributed to head injuries due to or as a result of multisystem trauma. No autopsies were conducted.

The second row right child occupant (04) came to rest within the vehicle. She sustained moderate injuries that included a supracondylar fracture and multiple abrasions and was transported to a local hospital for treatment. She was later transferred by helicopter to a children's trauma center.

The second row right adult occupant (05) was fully ejected from the vehicle. She came to rest on the shoulder of the southbound roadway. She was transported by helicopter to an area trauma center with serious injuries. The third row right occupant (06) was fully ejected from the vehicle. She initially came to rest on the inboard lane of the southbound roadway but was moved to the shoulder area by a bystander who feared she might be struck by southbound traffic. She was transported by helicopter to an area trauma center with serious injuries.

2002 MERCURY MOUNTAINEER

Description

The 2002 Mercury Mountaineer 4-door sport utility vehicle was identified by the Vehicle Identification (VIN): 4M2ZU86WX2Zxxxxxx. Its date of manufacture was June 2001. The vehicle was equipped with a 4.6-liter, 8-cylinder engine, automatic transmission, 4-wheel drive, 4-wheel disc anti-lock brakes, and power steering with tilt column functionality.

The vehicle manufacturer recommended P245/70R16 tires for the front and rear and the recommended cold tire pressure was 207 kPa (30 psi) for the front and 241 kPa (35 psi) for the rear. The vehicle was equipped with BF Goodrich Radial Long Trail T/A P245/70R16 tires on the front and rear and they were mounted on original equipment manufacturer (OEM) alloy rims. The specific tire information was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Tire Flat	7 mm (9/32 in)	No	De-beaded
LR	Tire Flat	7 mm (9/32 in)	No	None
RR	Tire Flat	7 mm (9/32 in)	No	De-beaded
RF	Tire Missing			

The Mercury's interior was equipped with leather-covered seven-passenger seating. The front row outboard bucket seats were separated by a center console and were equipped with adjustable head restraints, both of which contained a DVD player. The driver's seat at the time of the inspection was adjusted to 24.0 cm (9.4 in) aft of the A-pillar and the seat back was slightly reclined. The front right passenger seat had been detached from the floor board and rotated clockwise 90 degrees by rescue personnel. The second row was a 40-20-40 bench seat with folding backs. Storage space is provided underneath the center seat. The space is accessed by pulling up on strap toward the rear of the seat cushion at the seat bight. The third row was a bench seat with a folding back.

Exterior Damage

The Mercury sustained direct and induced damage to the right, left, front, and top planes (**Figure 5**). The right front rim was fractured and displaced and the tire was missing at the time of the inspection. The right and left plastic fender panels and the front bumper fascia were displaced. At the time of the inspection, all the doors including the hatch had been removed by rescue personnel.

Figure 5. 2002 Mercury Mountaineer rollover damage

The direct damage to the right side began at the right front bumper corner and extended rearward 420.0 cm (165.3 in) to the rear bumper corner. The damage extended from the frame to the roof rail and measured 119.0 cm (46.8 in) in height. The direct damage to the top began at the leading edge of the hood and extended rearward 414.0 cm (162.9 in) and measured 125.0 cm (49.2 in) in width. There was direct contact to the displaced front bumper fascia that began at the right front bumper corner and extended 50.0 cm (19.7 in) to the left. The maximum vertical crush was located at the left A-pillar and measured 48.0 cm (18.9 in) (**Figure 6**). The maximum lateral crush was located at the left B-pillar and measured 53.0 cm (20.8 in).

Figure 6. Maximum vertical crush

The Collision Deformation Classification (CDC) for the rollover (Event 1) was 00TDDO5.

Any damage caused by the impact with the barbed wire fence (Event 2) was masked by rollover damage.

Interior Damage

The Mercury sustained moderate interior damage from the impact forces, intrusion, and occupant loading. The windshield was cracked, holed, and out of place, and the remaining glazing was disintegrated. At the time of the inspection, all the doors and the hatch had been removed by rescue personnel due to the doors being jammed in place. The interior compartment was reduced due to vertical, longitudinal, and lateral intrusions. The specific intrusions into the passenger compartment are listed in the following table.

Location	Component	Magnitude	Direction
Left Front	Roof	35.0 cm (13.7 in)	Vertical
Left Front	B-pillar	29.0 cm (11.4 in)	Lateral
Third Row Middle	Roof	27.0 cm (10.6 in)	Vertical
Third Row Left	Roof	25.0 cm (9.8 in)	Vertical
Right Front	A-pillar	24.0 cm (9.4 in)	Vertical
Left Front	Roof side rail	23.0 cm (9.0 in)	Vertical
Right Front	Roof	20.0 cm (7.8 in)	Vertical
Second Row Left	Roof side rail	18.0 cm (7.0 in)	Lateral
Right Front	Roof side rail	18.0 cm (7.0 in)	Vertical
Left Front	A-pillar	17.0 cm (6.7 in)	Vertical
Second Row Right	Roof side rail	15.0 cm (5.9 in)	Vertical
Third Row Left	Roof side rail	14.0 cm (5.5 in)	Lateral
Second Row Left	C-pillar	12.0 cm (4.7 in)	Lateral
Second Row Left	Roof	12.0 cm (4.7 in)	Vertical
Left Front	Instrument panel	2.0 cm (0.8 in)	Longitudinal

The Mercury's frontal air bags deployed during the crash and the driver's air bag exhibited evidence of occupant loading in the form of blood and skin transfers. The seat belts were cut by rescue personnel at the front left, front right, second row left, and second row middle seat positions. The front left door and center console were deformed by occupant contact. There was a hair/blood contact to the second row left window frame and roof side rail. Hair was located at the rearmost right window. There were pooled blood deposits located in multiple locations on the interior surface of the roof.

Manual Restraint System

The Mercury's front row seating was equipped with 3-point manual lap and shoulder safety belts with sliding latch plates and adjustable D-rings. The driver's safety belt was equipped with an Emergency Locking Retractor (ELR) and the front right passenger's safety belt had a switchable ELR/Automatic Locking Retractor (ALR).

The driver's safety belt D-ring anchorage was in the full-up position, the latch plate was scratched indicating historical usage, and blood deposits were located on the lap portion of the belt. The latch plate was found inserted in the buckle and the belt webbing had been cut during extrication activities (**Figure 7**). The belt had been cut at the shoulder 122.0 cm (48.0 in) from the stop button and at the lap 27.0 cm (10.6 in) from the stop button. The shoulder portion of the belt was locked in place due to pretensioner actuation. Based on the vehicle inspection, the belt was used to restrain the driver during the crash.

Figure 7. Driver's safety belt

The front right passenger's safety belt had been cut during extrication activities at a point 130.0 cm (51.1 in) from the B-pillar anchorage. The latch plate was found inserted in the buckle. There were scuffs located along the entire length of the belt and it had been used to secure various vehicle parts during transport to the tow yard. Based on the vehicle inspection, the front right safety belt was used to restrain the front right occupant during the crash.

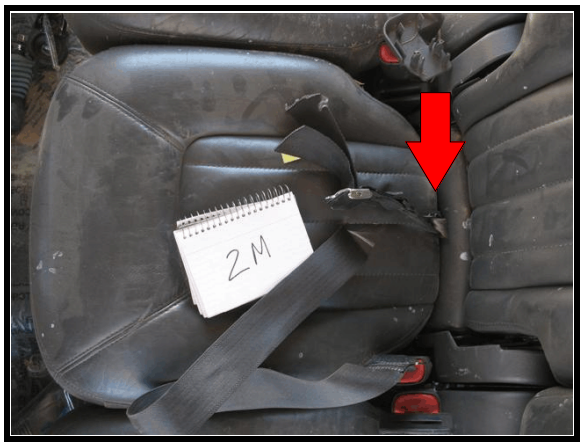

Figure 8. Top tether attached to compartment strap

The Mercury's second row manual restraints consisted of outboard lap and shoulder belts with continuous loop webbing and sliding latch plates and a center position lap belt with a sewn-on latch plate. The outboard belts were configured with switchable ELR/ALR retractors and adjustable D-rings. The left D-ring adjustment was in the full-up position and the right was in the full-down position. The center position lap belt was configured with an ELR retractor.

The left rear safety belt was being used in combination with a Graco TurboBooster belt positioning booster safety seat (BSS) to restrain the 4-year-old female occupant. There was a small amount of blood on the webbing and the webbing had been cut by rescue personnel 65.0 cm (25.5 in) from the stop button.

The center position lap belt was used to anchor the Dorel Safety 1st CRS in the forward-facing position. The lap belt was routed through the forward-facing belt path. The top tether strap was

hooked to the storage compartment strap (**Figure 8**). The lap belt and the tether strap had been cut by rescue personnel. The CRS was not occupied at the time of the crash.

The right rear safety belt was locked in the stowed position at the time of the vehicle inspection and was not in use in this crash.

The Mercury's third row manual restraints consisted of outboard lap and shoulder belts with continuous loop webbing and sliding latch plates. There was no indication of recent usage on the belts. Based on the vehicle inspection, these belts were not used in this crash.

Supplemental Restraint Systems

The Mercury was equipped with dual-stage redesigned driver and front right passenger air bags and front safety belt retractor pretensioners.

The left frontal air bag deployed from the steering wheel hub at an unknown point during the rollover sequence (**Figure 9**). It was circular in shape and measured 62.0 cm (24.4 in) in diameter from seam to seam. The air bag was configured with two vent ports on the back panel and a single internal tether attached to the center of the frontal panel. A skin oil transfer measuring 4.0 x 4.0 cm (1.6 x 1.6 in) was located in the bottom left quadrant 13.0 cm (5.1 in) from the center of the bag. A 2.0 x 2.0 cm (0.8 x 0.8 in) skin oil transfer was located near the center of the air bag face. A 4.0 x 3.0 cm (1.6 x 1.2 in) black scuff was located in the bottom right quadrant 15.0 cm (5.9 in) from the center.

Figure 9. Driver's frontal air bag

The right frontal air bag deployed from the top right IP (**Figure 10**). The air bag measured 44.0 cm (17.3 in) in width and 54.0 (21.2 in) in height. The air bag was configured with two vent ports on the side panels. There was no evidence of damage or occupant loading on the air bag.

Figure 10. Front right passenger air bag

Child Restraint Systems

Graco TurboBooster SafeSeat BSS

The Mercury's second row left seat position was occupied by a 4-year-old female seated in a gray Graco TurboBooster forward-facing belt positioning BSS (**Figure 11**). The vehicle lap and shoulder belt was being used in combination with the BSS. The TurboBooster is available with or without a detachable high back support. During the vehicle inspection, no back for the BSS was located and evidence of the back support being in use has never surfaced.

Figure 11. Graco TurboBooster BSS

The TurboBooster model number was 8498ASH and its date of manufacture was October 15, 2002. The BSS was equipped with adjustable padded armrests that were in the full-down position, a removable padded seat cushion, and retractable cup holders on the left and right sides. Based on the owner's manual, the TurboBooster was intended for children who meet the following requirements.

With back support:

- 3-10 years old
- 13.6-45 kg (30-100 lbs) in weight
- 96-145 cm (38-57 in) in height
- Child's ears below top of the booster seat.

Without back support:

- 4-10 years old
- 18-45 kg (40-100 lbs) in weight
- 101-145 cm (40-57 in) in height
- Child's ears below the top of the vehicle seat cushion/head rest.

Inspection of the BSS revealed dirt and fluid stains on the seat cushion indicating historical usage. There was mud on both sides of the BSS. There were scuffs across the top of both armrests that likely were a result of being in contact with the ground post-crash.

Based on the child's age, it was appropriate to use the BSS without the back support. It is not known if the child met the height and weight requirements.

Cosco/Dorel Safety 1st CSS

The 1-year-old child had been seated in a Cosco/Dorel Safety 1st Scenera convertible CRS (**Figure 12**), but had been removed from the seat by the second row right occupant prior to the crash. The seat was identified by the Model No. 22-160-WAL and was manufactured on July 28, 2004. The seat was designed to be used forward-facing or rear-facing. In the forward-facing orientation the seat was designed for children who weighed between 9-18 kg (20-40 lbs), whose height was between 73-103 cm (29-40 in), and who were older than one year. In the rear-facing orientation the seat was designed for children weighing between 2-16 kg (5-35 lbs) and whose height is between 48-91 cm (19-36 in). The seat was designed with a 5-point harness with 3 shoulder harness positions; at the time of the crash the shoulder harness straps were routed through the middle slots. The seat back was designed to be adjustable and could be raised or lowered depending upon the size of the child; at the time of the crash the seat back was locked into its lowest position. The seat was anchored to the vehicle using the vehicle lap belt. The top anchorage strap had been improperly attached to a looped strap that is used to open a storage area beneath the seat cushion.

Figure 12. Cosco/Dorel Safety 1st CRS

Graco TurboBooster BSS

The Graco TurboBooster was lying in the third row seat during the vehicle inspection (**Figure 13**). The police report indicated that the third row occupant was not using any restraints.

The seat was identified by the Model No. 1747293 and was manufactured on June 2, 2009. The BSS was equipped with adjustable padded armrests that were in the full-up position, a removable padded seat cushion, and retractable cup holders on the left and right sides. The TurboBooster is available with or without a detachable high back support. During the vehicle inspection, no back for the BSS was located. The seat was intended for children who meet the following requirements.

Figure 13. Graco TurboBooster BSS

With back support:

- 3-10 years old
- 13.6-45 kg (30-100 lbs) in weight
- 96-145 cm (38-57 in) in height

Without back support:

- 4-10 years old
- 18-45 kg (40-100 lbs) in weight
- 101-145 cm (40-57 in) in height
- Child's ears below the top of the vehicle seat cushion/head rest.

Inspection of the BSS revealed dirt and fluid stains on the seat cushion indicating historical usage. The cloth cover for the right armrest was missing and there were stress marks on the arm rest indicating that it had been damaged at some point during the crash (**Figure 14**).

Figure 14. Stress marks to right arm rest

Rollover

The Mercury had a Static Stability Factor (SSF) of 1.14. The SSF of a vehicle is an at-rest calculation of its rollover resistance, which is based on its track width and center of gravity. The vehicle had a rollover resistance rating of 3 out of 5 stars and had a 22% chance of rollover[2]. The vehicle was equipped with anti-lock brakes and power steering.

The Mercury was traveling northbound in the left lane of the interstate highway. The vehicle drifted onto the left side shoulder and crossed over the rumble strip. The driver steered the vehicle to the right back onto the travel lane, lost control, over-corrected back to the left, and began a counterclockwise rotation. The vehicle departed the roadway and entered the median while rotating. Based on the departure tire marks, the police calculated that the vehicle was traveling 138 km/h (86 mph)[3] just prior to leaving the roadway. The vehicle traveled halfway through the median before tripping and beginning a right side leading rollover. The vehicle rolled four quarter-turns before entering the southbound roadway, rolled four quarter-turns while crossing the roadway, and then rolled an additional six quarter-turns as it crossed the grass-covered embankment. The vehicle came to rest on its roof facing south on the frontage road. The estimated distance from the trip point at the middle of the median to final rest was 57.6 m (189.0 ft).

[2] www.safercar.gov

[3] Calculated using critical speed formula with coefficient of friction of 0.8, chord of 100 ft, and middle ordinate of 2 ft.

2002 MERCURY MOUNTAINEER OCCUPANTS

Driver Demographics

Age/Sex:	32/Male
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Type:	Bucket
Seat Track Position:	Between middle and rear most
Manual Restraint Usage:	Lap and shoulder belt
Usage Source:	Vehicle inspection
Air Bags:	Steering wheel mounted frontal air bag, deployed
Alcohol/Drug Involvement:	Unknown
Egress from Vehicle:	Came to rest in his seat, still restrained, upside down. Removed by EMS.
Transport from Scene:	Pronounced dead at scene
Medical Treatment:	None

Driver Injuries

Inj. No.	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Head injury	100999.9	Roof	Probable

Source: Certificate of Death

Driver Kinematics

The 32-year-old male driver was seated in an unknown posture and was restrained by the vehicle's lap and shoulder belt. The seat was adjusted to the mid-track position and the seat back was slightly reclined. The vehicle had drifted onto the left shoulder, and the driver actively steered the vehicle back onto the roadway. As the driver lost control of the vehicle, he began braking and steering the vehicle sharply to the left and the vehicle began a counterclockwise rotation. During rotation, the driver was displaced to the right and then was displaced in all directions as the vehicle tripped and began rolling over multiple times. The left side of his torso loaded the rear upper quadrant of the left door and his right hip deformed the center console. There was an area of scuffing along the roof and roof rail direct above the seat back that was attributed to a head contact. The driver came to rest in his seat, still restrained, and upside down. He was pronounced dead at the scene. The police reported that the area of injury was to his head. An autopsy was not conducted and a certificate of death was obtained. In the certificate the cause of death was listed as a head injury as a result of multisystem trauma.

Right Front Occupant Demographics (02)

Age/Sex:	11/Female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Type:	Bucket

Seat Track Position:	Unknown
Manual Restraint Usage:	Lap and shoulder belt
Usage Source:	Vehicle inspection
Air Bags:	Top instrument panel mounted frontal air bag, deployed
Alcohol/Drug Involvement:	None
Egress from Vehicle:	Came to rest in her seat, still restrained, and upside down. Removed by EMS.
Transport from Scene:	Pronounced dead at scene
Medical Treatment:	None

Right Front Occupant Injuries (02)

Inj. No.	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Head injury	100999.9	Roof	Probable

Source: Certificate of Death

Front Right Occupant Kinematics (03)

The 11-year-old female front right occupant was seated in an unknown posture and was restrained by the vehicle's lap and shoulder belt. As the vehicle began to roll, this occupant was displaced in multiple directions. Two areas of head contact related blood and scuffing were documented: the first measured 20.0 x 30.0 cm (7.8 x 11.8 in) and was located on the roof aft of the A-pillar and the second measured 25.0 x 40.0 cm (9.8 x 15.7 in) and was located on the roof 20.0 cm (7.8 in) aft of the first area (**Figure 15**). The front right restrained occupant came to rest in her seat upside down. She was pronounced dead at the scene. The police reported that the area of injury was to her head. An autopsy was not conducted and a certificate of death was obtained. In the certificate the cause of death was listed as a head injury as a result of multisystem trauma.

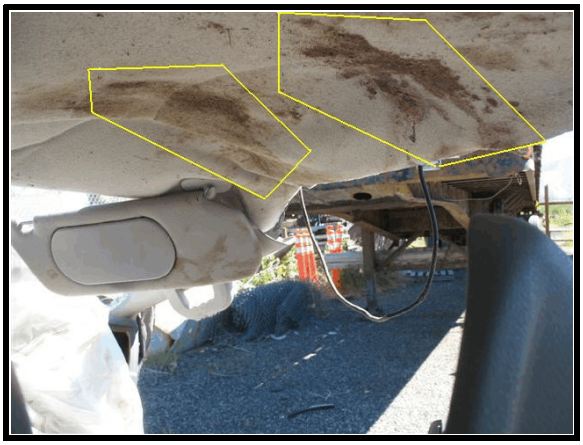

Figure 15. Scuffs and blood contacts to right side roof area

Second Row Left Occupant Demographics (03)

Age/Sex:	4/Female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Type:	Split bench with separate back cushion
Seat Track Position:	N/A
Manual Restraint Usage:	Lap and shoulder belt used with booster seat
Usage Source:	Vehicle inspection
Alcohol/Drug Involvement:	None

Egress from Vehicle:	Came to rest in her seat, still restrained, and upside down. Removed by EMS.
Transport from Scene:	Pronounced dead at the scene.
Medical Treatment:	None

Second Row Left Occupant Injuries (03)

Inj No	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Head injury	100999.9	Window Frame	Probable

Source: Certificate of Death

Second Row Left Occupant Kinematics (03)

The 4-year-old female second row left occupant was seated in an unknown posture on a belt-positioning BSS and was restrained by the vehicle's lap and shoulder belt. As the vehicle began to roll, this occupant was displaced in multiple directions. During the rollover, this occupant's head contacted the left roof, roof rail, and left window frame (**Figures 16-17**). The second row left restrained occupant came to rest in her seat upside down. She was pronounced dead at the scene. The police reported that the area of injury was to her head. An autopsy was not conducted and a certificate of death was obtained. In the certificate the cause of death was listed as a head injury or as a consequence of multisystem trauma.

Figure 16. Blood and hair transfer to left roof and side rail

Figure 17. Contact to left upper window frame

Second Row Right Occupant Demographics (04) (in lap of Occupant 05)

Age/Sex:	12 month/Female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Type:	Split bench separate back cushion
Seat Track Position:	N/A
Manual Restraint Usage:	None
Usage Source:	Vehicle inspection

Alcohol/Drug Involvement: None
Egress from Vehicle: Unknown
Transport from Scene: Transported by ground to local hospital and later transferred by helicopter to a children's trauma center.
Medical Treatment: Hospitalized for unknown number of days.

Second Row Right Occupant Injuries (04)

Inj No	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Left supracondylar fracture	751351.2,2	Unknown	Unknown
2	Abrasions, face	210202.1,0	Roof	Possible
3	Abrasions, right chest	410202.1,1	Roof	Possible
4	Abrasions, upper back	410202.1,6	Roof	Possible

Source: Clinical report

Second Row Right Occupant Kinematics (04)

The 1-year-old female second row right occupant was either being held or was in the lap of Occupant 04. During the rollover, she became separated from this occupant and probably contacted multiple interior surfaces.

Second Row Right Occupant Demographics (05)

Age/Sex: 32/Female
Height: Unknown
Weight: Unknown
Eyewear: Unknown
Seat Type: Split bench with separate back cusion
Seat Track Position: N/A
Manual Restraint Usage: Lap and shoulder belt not used
Usage Source: Vehicle inspection
Alcohol/Drug Involvement: None
Egress from Vehicle: Unknown
Transport from Scene: Transported by helicopter to trauma center
Medical Treatment: Hospitalized for unknown number of days

Second Row Right Occupant Injuries (05)

Inj No	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Head injury	100099.9	Unknown	Unknown

Source: Police report

Second Row Right Occupant Kinematics (05)

The 32-year-old female second row right occupant was seated in an unknown posture and was not restrained by the vehicle's lap and shoulder belt. Prior to the crash, she had taken Occupant 04 out of the CRS and was either holding the child or had her in her lap. She came out of her seat during the rollover. Near the conclusion of the eighth quarter roll she was fully ejected from the vehicle through the second row right window. There was contact to the forward upper quadrant of the door (**Figure 18**) and the window frame was bowed outward. She came to rest on the right shoulder of the southbound roadway. The police reported that the area of injury was to her head. She was transported by helicopter to an area trauma center with serious injuries.

Figure 18. Second row right door contacts

Third Row Right Occupant Demographics (06)

Age/Sex:	6/Female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Type:	Bench with folding back
Seat Track Position:	N/A
Manual Restraint Usage:	Lap and shoulder belt not used
Usage Source:	Vehicle inspection
Alcohol/Drug Involvement:	None noted
Egress from Vehicle:	Ejected
Transport from Scene:	Transported by ambulance
Medical Treatment:	Hospitalized unknown number of days

Third Row Right Occupant Injuries (06)

Inj No	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Abrasion, right elbow	710202.1,1	Ground	Probable
2	Abrasion, whole back	410202.1,6	Ground	Probable
3 4	Abrasions/laceration to 4th and 5th toes	810202.1,9 810402.1,9	Ground	Probable
5	Abrasion, abdominal wall	510202.1,9	Ground	Probable
6	Contusion, abdominal wall	510402.1,9	Unknown	Unknown

Source: Clinical report

Third Row Right Occupant Kinematics (06)

The 6-year-old female third row right occupant was seated in an unknown posture and was not restrained by the vehicle's lap and shoulder belt. She came out of her seat during the rollover. She was fully ejected from the vehicle through the side window (**Figure 19**) between the third and fourth quarter-turns. She initially came to rest on the inboard lane of the southbound roadway but was moved to the shoulder area by a bystander who feared she might be struck by southbound traffic. She was transported by helicopter to an area trauma center. She sustained abrasions to the right elbow, back, toes, and abdomen that were likely a result of contact with the ground after the ejection.

Figure 19. Hair deposit along upper window frame

SCENE DIAGRAM