

**TRANSPORTATION SCIENCES
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**VERIDIAN ON-SITE INFLATABLE SAFETY CANOPY
CRASH INVESTIGATION
SCI TECHNICAL SUMMARY REPORT**

VERIDIAN CASE NO. CA02-059

VEHICLE: 2002 MERCURY MOUNTAINEER

LOCATION: VERMONT

CRASH DATE: NOVEMBER 2002

Contract No. DTNH22-01-C-17002

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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**VERIDIAN ON-SITE INFLATABLE ROLLOVER CANOPY
CRASH INVESTIGATION
VERIDIAN CASE NO. CA02-059
VEHICLE: 2002 MERCURY MOUNTAINEER
LOCATION: VERMONT
CRASH DATE: NOVEMBER 2002**

BACKGROUND

This on-site investigation focused on the performance of an inflatable rollover canopy air bag system that deployed during a lateral left side leading rollover of a 2002 Mercury Mountaineer sport utility vehicle (**Figure 1**). The Mercury was equipped with frontal air bags for the driver and right passenger positions, seat mounted side impact air bags, roof side rail mounted rollover canopy air bags, and front seat belt buckle pretensioners. The frontal and side impact air bags did not deploy in this rollover crash. The buckle pretensioners were incorporated into the rollover canopy system, therefore the pretensioners fired as a result of



Figure 1. Front left three-quarter view of the Mercury Mountaineer.

the rollover event. The Mountaineer was occupied by a 20-year old female driver and a 19 year old female front right passenger. Both occupants were properly restrained by the manual 3-point lap and shoulder belt systems. The driver lost control of the Mountaineer on a downhill right curve with a snow and ice build-up on the asphalt road surface. The vehicle rotated in a clockwise direction and departed the right road edge in a near broadside attitude. The Mountaineer engaged a snow bank with the left side tires which initiated a tripped lateral rollover sequence. The Mountaineer rolled down an embankment and struck a rock with the left upper D-pillar area of the roof. The left A-pillar and door area subsequently struck a tree cluster as the vehicle completed four quarter turns. As a result of the rollover, both canopy air bags deployed from the vehicle's roof side rails. The Mountaineer came to rest on its wheels straddling a shallow ditch. Both occupants exited the vehicle from their respective doors. They were subsequently transported by ambulance to a local hospital where they were treated for minor severity injures and released.

The leasor (owner) of the Mercury Mountaineer notified Ford's Safety Office of the November crash and of the deployment of the rollover canopy air bag. He removed the Restraints Control Module (RCM) from the vehicle and forwarded the RCM to Ford for download. Ford forwarded the notification of the crash to the NHTSA's Special Crash Investigations group and the crash was assigned to the Veridian SCI team on December 10, 2002 as an on-site investigation. Cooperation was established with the owner of the Mercury Mountaineer and the vehicle was scheduled for SCI inspection on December 18, following its transfer to an insurance salvage yard located in southern Massachusetts.

The scene of the crash, although covered by heavy snow, was inspected and documented on December 17.

SUMMARY

Crash Site

This rollover crash occurred was initiated on a three lane state route with a moderate right curve and a 3 percent negative grade for southbound traffic (**Figure 2**). The lanes were configured with two northbound and a single southbound lane. The outboard northbound lane was 3.2 m (10.5') in width, with a 3.4 m (11.2') wide inboard lane, and a 3.8 m (12.5') wide southbound lane. A 1 m (3.2') paved shoulder bordered the northbound lanes while a 1.2 m (3.9') wide asphalt shoulder bordered the southbound lane. Snow banks bordered both shoulders at the time of the crash. A negative



Figure 2. Southbound trajectory of the Mercury Mountaineer.

embankment, with a slope of approximately 30 degrees, bordered the southbound shoulder. The embankment terminated into a shallow drainage ditch with a treed embankment ascending from the ditch. Several large rocks were scattered throughout the embankment and within the ditch. A small diameter tree that was struck by the left side of the Mountaineer was located on the embankment on the far side of the ditch. Branches were broken from this tree.

At the time of the crash, the conditions were dark with no artificial illumination of the crash site. The weather was reported as overcast with light snow. The asphalt travel lanes were snow and ice covered with a build-up of snow and slush in the middle of the lanes. The posted speed limit in the area of the crash was 80 km/h (50 mph). Additional snow had fallen since the crash with a greater accumulation on the ground at the time of the SCI scene inspection.

Vehicle Data

The 2002 Mercury Mountaineer was a lease vehicle by a Ford Regional Executive. The Mountaineer was manufactured on 06/02 and was identified by Vehicle Identification Number (VIN) 4M2DU86W62U (production number deleted). At the time of the crash, the Mountaineer's odometer reading was 1,586 km (9,858 miles). The Mercury Mountaineer was a four-door sport utility vehicle with full-time four wheel drive. The drive train consisted of a 4.6 liter V-8 conventionally mounted gasoline engine linked to a 4-speed automatic overdrive transmission with a column mounted shift lever. The power-assisted braking system consisted of four-wheel disc brakes with anti-lock (ABS). The exterior was configured with a roof rack and optional running boards that spanned the sill between the wheelbases. A Class III, 5.1 cm (2.0") receiver hitch was mounted to the frame of the Mountaineer, under the rear bumper.

The interior of the Mountaineer was configured as a seven-passenger vehicle with front bucket seats, three individual forward folding second row seats, and a two passenger third row bench seat that folded into the cargo floor of the vehicle. At the time of this rollover crash, the third seat was folded into the floor and ski equipment was placed in the cargo area of the vehicle. All seats were leather trimmed. The Mountaineer was equipped with power windows, door locks, front seat adjustment, outside mirrors, and a tilt steering wheel. In addition, the vehicle was equipped with power adjustable pedals that were adjusted to the full rear position (toward driver). The jackscrew design adjusted the pedals in both a longitudinal and vertical direction. The total longitudinal movement as measured from the leading edge of the seat cushion was 6.7 cm (2.625”).

The Mountaineer’s safety systems consisted of manual 3-point lap and shoulder belts for the six outboard positions and a center, second seat lap belt. Automatic crash protection was provided by a frontal air bag system for the driver and right passenger positions, front seat mounted side impact air bags, front seat belt buckle pretensioners, and a rollover canopy air bag system that provided protection to the front and second seat outboard occupant positions. Due to the rollover crash event, the rollover canopies deployed and the buckle pretensioners fired. These safety systems are discussed in greater detail in this under the *Manual Safety Belts, Frontal Air Bag Systems, and Rollover Canopy Air Bag* subsections of this summary report.

Crash Sequence

Pre-Crash

The driver of the 2002 Mercury Mountaineer had driven this vehicle approximately 800 km (500) miles) prior to this crash event. Her driving experience was predominantly in a similar vehicle, a Ford Explorer with a four-wheel drive system. On the day of the crash, the driver and her passenger had departed a ski resort and were traveling in a southeasterly direction on a state route. Their departure from the ski resort was abrupt due to inclement weather. Both occupants of the Mountaineer were dressed in ski wear that consisted of jackets and ski pants. Their personnel effects and ski equipment were stored in the rear cargo area of the vehicle. The third seat was folded flat into the floor to accommodate the ski equipment.



Figure 3. Right side road departure.

The driver and her passenger had departed a ski resort and were traveling in a southeasterly direction on a state route. Their departure from the ski resort was abrupt due to inclement weather. Both occupants of the Mountaineer were dressed in ski wear that consisted of jackets and ski pants. Their personnel effects and ski equipment were stored in the rear cargo area of the vehicle. The third seat was folded flat into the floor to accommodate the ski equipment.

In the vicinity of the crash site, the roadway consisted on three lanes with a right curve respective for the Mountaineer’s path of travel and a negative grade with a 5 degree super-elevation. The driver stated that she had been driving the Mountaineer for approximately 15 minutes, en route to her residence in Massachusetts. She estimated her travel speed at 56 km/h (35 mph) due to the slippery road surface. As the driver entered the right curve, the vehicle broke traction and initiated a clockwise (CW) yaw. The driver estimated that the vehicle rotated approximately 180 degrees CW as it departed the

right road edge (**Figure 3**), leading with its left side. Due to the winter conditions and mountainous elevations of the crash site, a shallow snow bank was present at the edge of the shoulder. The left side tires and wheels probably furrowed through the snow bank, which tripped the Mountaineer into a lateral side-over-side rollover event. The Crash Schematic is attached as **Figure 12**, Page 14 of this Summary Report.

Crash

The Mountaineer overturned onto the negative embankment. At the onset of the rollover, the rollover canopy air bags deployed from the roof side rails, providing head protection to the driver and front right passenger. As the vehicle overturned onto its roof, the left D-pillar/backlight header area impacted a large rock, which crushed the roof to a maximum depth of 31.1 cm (12.25”). The Mountaineer rolled down the negative embankment that was sloped approximately 30 degrees. The embankment terminated in a shallow drainage ditch that was located



Figure 4. Struck tree and final rest area of the Mountaineer.

approximately 8 m (25') outboard of the roadway. At this point, the Mountaineer had completed 4-quarter turns and was in a near upright attitude. The left front door and A-pillar area impacted a small diameter tree that was located on a positive slope on the backside of the ditch. This impact fractured the tree branches and produced minor damage to the vehicle. The Mountaineer came to rest on its wheels, straddling the drainage ditch facing opposite of its original direction of travel (**Figure 4**).

Post-Crash

The driver and front right passenger unbuckled their safety belt systems, opened the front doors of the vehicle, and exited the Mountaineer unassisted. The driver immediately tried to call for assistance on her cellular telephone; however, due to the remote and mountainous location of the crash, she was unable to obtain a signal. A vehicle following the Mercury Mountaineer was equipped with the General Motor's OnStar system. This vehicle operator notified OnStar (satellite system) of the crash and requested that the OnStar operator notify the local police of the crash.

The driver stated that she and her passenger were ambulatory at the scene of the crash. They waited approximately 45 minutes for the local police and ambulance personnel to arrive on-scene. The driver refused treatment at the scene of the crash, however, the front right passenger complained of neck and back pain. She was placed on an ambulance cot and transported to a local hospital where she was treated for her injuries and released. The driver rode in the ambulance with the injured front right passenger. Although she sustained a contusion of the left lateral thigh, the driver did not seek treatment at the hospital. She stated that her vitals were checked by hospital staff as a precautionary measure to ensure no occult injuries were present.

Vehicle Damage

Exterior

The Mercury Mountaineer sustained moderate damage as a result of the rollover and impact with the rock, and minor damage from impact with the tree that was located on the back side of the drain ditch. Rollover damage was noted to the left (**Figure 5**), top, and right side of the vehicle. In addition, all four alloy wheels were damaged from the rollover. This damage is identified in the table under the heading of *Tires and Wheels* that follows this *Exterior Damage* section.



Figure 5. Left side rollover damage to the Mounatineer.

The hood of the Mountaineer remained closed and fully latched during the rollover. Both rear hinges and the hydraulic lift cylinders were intact and operational. There was no rollover damage associated to the hood of the vehicle. The battery had separated from its hold-down and was tilted approximately 45 degrees the right. The battery was not damage as power was maintained to the vehicle throughout the crash and at the time of the SCI inspection.

The front fenders of the Mountaineer were fiberglass. The top surface of the left front fender was fractured from an isolated impact with a small diameter tree or tree branch. The fiberglass fender was cracked over a length of 31.8 cm (12.5") that originated 8.9 cm (3.5") forward of the left front axle, extending forward. The damage extended laterally onto the hood, terminating 15.9 cm (6.25") inboard of the hood edge. Tree bark was noted in the forward 15.2 cm (6.0") of the fracture site. The Collision Deformation Classification (CDC) for this event was 00-LFMW-3.

A small series of longitudinally oriented abrasions were noted to the left front fender and the side aspect to the bumper fascia. The abrasions were located 43.8-50.2 cm (17.25-19.75") forward of the axle position.

The left outside rear view mirror was deflected forward; however, the mirror and housing were not damaged.

The mid aspect of the left front door skin was dented to a depth of 3.2 cm (1.25') over a diagonally measured span of 53.3 cm (21.0"). There was no direct contact damage associated with this dent as it appeared to be snow related (i.e. vehicle rolled onto a snow covered surface).

The upper third area of the left front door was damaged from contact with the tree. The direct damage extended 94.0-99.7 cm (37.0-39.25") aft of the left front axle with the

induced damage extending 71.0-109.2 cm (28.0-43.0") aft of the referenced axle position. Maximum crush was 0.9 cm (0.375"). Tree bark extended onto the forward aspect of the left front door window frame. This bark transfer began 94.0 cm (37.0") rearward of the referenced axle and extended 57.2 cm (22.5") rearward. Vertically oriented abrasions extended front-to-back onto the roof side rail. The CDC for this tree impact was 09-LPHW-3.

A large rock impact occurred to the top surface of the vehicle in the area of the upper left D-pillar, side rail, and roof juncture (**Figure 6**). The impact occurred during the rollover sequence which resulted in a non-horizontal impact force (00). The direct damage for this impact began 34.9 cm (13.75") left of the vehicle's centerline at the header and extended 24.1 cm (9.5') to the outboard corner. The impact crushed the backlight header and side rail area both downward and laterally right. The lateral damage length across the backlight header was 101.6 cm (40.0"). A crush profile was documented at the header and was as follows:



Figure 6. Rock impact damage to the roof, backlight header, D-pillar area of the vehicle.

C1 = 31.1 cm (12.25"), C2 = 29.2 cm (11.5"), C3 = 22.9 cm (9.0"), C4 = 15.6 cm (6.1"), C5 = 9.5 cm (3.75"), C6 = 3.8 cm (1.5"). The juncture of the left corner of the backlight header and upper D-pillar was crushed forward 43.8 cm (17.25"). The CDC for this impact was 00-TBLN-4.

The roof was abraded and crushed during the rollover event. The primary crush to the roof was located along the left roof side rail, extending rearward from the left B-pillar to the deformed D-pillar. This longitudinal distance on the damaged vehicle was 121.9 cm (48.0"). An isolated dent was noted to the center aspect of the roof between the windshield header and the sunroof. This dent was 1.9 cm (0.75") deep. The left roof rack rail was separated from the vehicle. It was unknown if the roof rack was equipped with lateral crossbars. None were present with the vehicle at the time of the SCI inspection. The CDC for the rollover event was 00-TZDO-2.

Isolated rollover damage was noted to the right side of the Mercury Mountaineer (**Figure 7**). The right rear corner of the bumper fascia was abraded. The right OEM running board was crushed laterally to a depth of 9.5 cm (3.75"), located 21.6 cm (8.5") rearward of the leading edge. There was 11.4 cm (4.5") of direct contact associated with this deformation. Superficial abrasions were noted to the mid and forward aspect of the right front fender. These abrasions were vertically oriented. A crack was noted on the fiberglass fender at the forward aspect of the wheel opening.

Longitudinally oriented abrasions were present of the top and side aspect of the right upper D-pillar. In addition, the pillar was dented to a depth of 2.5 cm (1.0”).

The four side doors of the Mountaineer remained closed during the crash events. The left front, right front, and right rear doors were fully operational post-crash. The locking system would not release at the left rear door, therefore the door would not open. There was no physical damage restricting its operation.

The tempered side glazing at all four doors was fully closed at the time of the crash. All side door glazing remained intact with the exception of the left front door, which shattered during the rollover. The rear quarter windows (aft of the C-pillars) in the area of the third seat were shattered. The Mountaineer was equipped with a tempered glass sunroof. The sunroof was closed at the time of the crash. The rear edge of the glazing was exposed 1.9 cm (0.75”) due to the deformation of the roof. The sunroof was not damaged.

The laminated windshield of the Mountaineer remained intact during this rollover event. A single crack was noted to the upper center area of the windshield, near the rear view mirror mounting point.

The rear liftgate of the Mountaineer was a single, top hinged door with an independent opening (top hinge) backlight glass. Access to the cargo area was accessible through the window opening, or the liftgate. The top aspect of the liftgate was crushed by the rock impact. Although severely damaged, the liftgate remained closed and latched. The backlight glazing was shattered.

Tires and Wheels

The Mercury Mountaineer was equipped with P245/65R17 105S mud and snow rated BF Goodrich Rugged Trail T/A tires mounted on 43x19 cm (17x7.5J) OEM 6-spoke alloy wheels. The recommended tire pressures were placarded on the left front door and were as follows: Front - 207 kPa (30 PSI), Rear – 241 kPa (35 PSI). The data for the OEM tires and wheels that were installed on the Mountaineer at the time of the rollover are identified in the following table:

| Position: | Tread Depth | Pressure | Tire Damage | Wheel Damage |
|------------------|--------------------|------------------------|--------------------|---|
| Left Front | 9.5 mm (12/32”) | 72.5 kPa (10.5 PSI) | None | Outer bead area fractured, 30x1.9 cm (12x0.75”) with bead of tire fully exposed |



Figure 7. Rollover damage to the right to the right front fender, right running board, right rear quarter window, and D-pillar.

| Position: | Tread Depth | Pressure | Tire Damage | Wheel Damage |
|------------------|--------------------|-------------------------|--------------------|--|
| Left Rear | 9.5 mm (12/32") | 6.9 kPa (1.0 PSI) | None | Outer bead area fractured 5.1x1.0 cm (2.0x0.4"), chunked and rolled upward |
| Right Front | 9.5 mm (12/32") | 193.2 kPa (28.0 PSI) | None | Two fractures w/dents and abrasions to bead area 16.5x2.9 cm (6.5x1.125" and 8.3x3.8 cm (3.25x1.5")) |
| Right Rear | (12/32") | 227.7 kPa (33.0 PSI) | None | Bead fracture 8.3x2.3 cm (3.25x0.9"), tire bead fully exposed, holding pressure |

Interior

The interior of the Mercury Mountaineer sustained moderate damage that was associated with the exterior deformation. This damage resulted in intrusion of the second seat area and the cargo area (third seat folded into floor). Maximum intrusion involved 43.2 cm (17.0") of vertical displacement of the backlight header, roof, and left D-pillar juncture. This cluster of components was also displaced laterally 16.5 cm (6.5") to the right. The intrusions are identified in the following table:

| Seat Position | Intruding Component | Magnitude of Intrusion | Direction of Intrusion |
|-------------------------|----------------------------------|-------------------------------|-------------------------------|
| Left rear, second row | Roof | 11.4 cm (4.5") | Vertical |
| Center rear, second row | Roof | 7.6 cm (3.0") | Vertical |
| Right rear, second row | Roof | 5.7 cm (2.25") | Vertical |
| Left rear, third row | Backlight header, roof, D-pillar | 43.2 cm (17.0") | Vertical |
| Left rear, third row | Backlight header, roof, D-pillar | 16.5 cm (6.5") | Lateral |
| Right rear, third row | Backlight header | 17.1 cm (6.75") | Vertical |
| Right rear, third row | Roof | 3.8 cm (1.5") | Vertical |

There was no evidence of occupant contact points within the vehicle. Minimal loading (webbing abrasion) of the front right lap belt webbing against the outboard aspect of the seat trim was noted. The rollover canopy air bag system deployed from roof side rail area as designed. There was no damage associated with this deployment event.

The center console and the Restraints Control Module (RCM) were removed from the vehicle prior to this SCI investigation. The RCM was shipped to Ford for download

purposes. In addition, the column mounted transmission shifter was removed and the ignition/steering column interlock cable was cut at the ignition switch.

Manual Safety Belt Systems

The seven passenger seating configuration of the 2002 Mercury Mountaineer utilized 3-point, continuous loop lap and shoulder belt systems with sliding latchplates for the six outboard seated positions and a lap belt for the center position of the second row. This manual lap belt was a fixed length adjustable with a cinching latchplate. The front right and the four rear outboard retractors were emergency locking (ELR) with switchable modes to automatic locking (ALR). The front left (driver) belt system retractor was exclusively an ELR. All outboard retractors were belt sensitive which locked during rapid spool-out of the webbing. The front and second seat outboard system utilized adjustable D-rings with 8.6 cm (3.375”) of vertical travel. The front left D-ring was adjusted to the full-up position while the right front was adjusted 2.5 cm (1.0”) below the full-up position. Both second seat D-rings were adjusted to the full-up positions, however, the left rear was partially jammed as it would not travel below 1.9 cm (0.75”) of the full-up position. The third seat D-rings were fixed to the D-pillars.

The front seat belt buckles were attached to the inboard aspect of the seat frames. Retractor pretensioners were installed in the front buckle systems and were designed to fire in conjunction with the frontal air bag system or the rollover canopy air bag system. The pretensioners fired during the rollover crash event which deployed the rollover canopy air bag system.

The front left latchplate exhibited routine wear marks that were consistent with the recorded odometer reading. There was no direct driver loading evidence on the belt system. The belt webbing was soiled due to its use to stabilize the steering wheel during the towing of the vehicle. The front right latchplate was faintly scratched from usage prior to the crash. The lower inboard aspect of the belt webbing exhibited a subtle transfer from passenger loading of the belt system against the plastic trim located at the outboard aspect of the seat cushion.

Frontal Air Bag System

The Mercury Mountaineer was equipped with a frontal air bag system that offered protection to the driver and right passenger positions. The air bags were redesigned and did not deploy during this rollover crash sequence. The system was controlled by a single point Restraints Control Module (RCM) that was mounted on the center tunnel under the center console. In addition to control functions, the RCM had a secondary function to record crash data in its Event Data Recorder (EDR). The frontal air bag system also utilized safety belt buckle pretensioners. These buckle pretensioners were also linked to the rollover canopy air bag system that deployed during this rollover crash. The buckle pretensioners fired with this system.

The driver air bag module was housed in a conventional configuration within the four-spoke steering wheel rim. The front right air bag was concealed by a single cover flap

within the right mid instrument panel. As previously noted, the frontal air bag system did not deploy.

Rollover Canopy Air Bag System

The 2002 Mercury Mountaineer was equipped with the optional rollover air bag canopy system. This system utilized a rollover sensor that was incorporated in the RCM. The system consisted of two curtain-type air bags that were housed along the roof side rail areas of the vehicle. At deployment, the canopy air bags inflated which separated the roof headliner from the side rail, thus deploying the canopy air bags (**Figures 8 and 9**). The RCM's detection of a rollover deploys the left and right side canopy air bags that offer head protection to the front and second seat outboard seat positions. These air bags remain inflated for a period of six seconds.

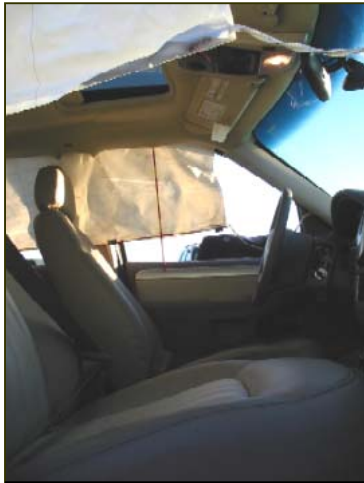


Figure 8. Deployed left side rollover canopy air bag.



Figure 9. Deployed right side canopy air bag.

The canopy air bags were rectangular in shape and measured 41.9 cm (16.5") vertically and 139.7 cm (55.0") in length. The forward aspect bags were tethered to the A-pillars by a loosely twisted flat cord that measured 36.8 cm (14.5") in length and was attached to the pillar approximately 16.5 cm (6.5") above the top of the instrument panel. The rear of the canopy air bags were tethered to the C-pillars with a cord that was 4.4 cm (1.75") in length. The tether was attached to the mid aspect of the pillar, 21.0 cm (8.25") below the roof side rail. **Figure 10** is an overall view of the deployed right side rollover canopy air bag.



Figure 10. Overall view of the deployed right side rollover canopy air bag.

The canopy air bags were constructed of two panels that were fused together. The air bag panels were fused to form air chambers for occupant protection. There was no damage to

the bag fabric or separation of the fused seams. Several transfers were noted to the bag membrane, however, these transfers appeared to be related to parts that were placed in the vehicle prior to towing from the scene.

The canopy air bags were identified by the following nomenclature that was embossed into the fabric of the bag.

LISA
TRW sealing technology
30335725E

The front safety belt buckle pretensioners fired as a result of the deployment of the canopy air bag system. The front left pretensioner barrel length was measured at 6.0 cm (2.375”) post-crash with equated to 4.8 cm (1.875”) of piston travel. The seat cushion fabric adjacent to the pretensioner was abraded in a serrated pattern from the convoluted sleeve of the buckle assembly. The right pretensioner barrel measured 5.7 cm (2.25”) which resulted in 5.1 cm (2.0”) of piston travel. **Figure 11** is a view of the front left buckle pretensioner.



Figure 11. Front left buckle pretensioner.

Occupant Demographics

Driver

Age/Sex: 20 year old female
 Height: 152.4 cm (60.0”)
 Weight: 54.4 kg (120 lb)
 Manual Belt Usage: 3-point lap and shoulder belt system
 Usage Source: Driver interview and vehicle inspection
 Seat Track Position: Forward; adjusted [8.3 cm (3.25”) rear of full forward or 16.5 cm (6.5”) forward of full rear)
 Eyewear: Contact lenses, remained in eyes
 Exit from Vehicle: Unassisted, opened left front door and walked from vehicle
 Mode of Transport
 From Scene: Ambulance to a local hospital
 Type of Medical
 Treatment: Treated and released

Driver Injuries

| Injury | Injury Severity (AIS90/Update 98) | Injury Mechanism |
|-------------------------------------|--|-------------------------|
| Contusion of the left lateral thigh | Minor (890402.1,2) | Left door armrest |

Driver Kinematics

The driver of the Mercury Mountaineer was seated in a forward track position with the seat adjusted 8.3 cm (3.25”) rear of the full forward track position and the seat back reclined 22 degrees aft of vertical. The adjustable head restraint was adjusted 1.9 cm (0.75”) above the top aspect of the seat back. The driver was restrained by the manual 3-point lap and shoulder belt system with the shoulder belt positioned over her shoulder and the lap belt positioned across her hips. She was dressed in a ski jacket, ski pants, and winter boots.

As the Mountaineer yawed in a clockwise direction, the driver was probably displaced laterally to her left, against the left door of the vehicle. As the Mountaineer tripped into a lateral side-over-side rollover, the rollover canopy air bag system deployed and the safety belt buckle pretensioner. The barrel length of the pretensioner was measured at 6.0 cm (2.375”) which equates to 4.8 cm (1.875”) of travel. The canopy air bag provided the driver with lateral head protection against the left roof side rail, B-pillar, and from possible ejection through the window opening. The driver probably loaded the manual belt system as she moved laterally to each side during the 4-quarter turn rollover event. The lateral aspect of her left thigh contacted the left door armrest which resulted in a minor severity contusion of the thigh. There was no contact evidence to support this contact point. The driver did note that during the crash, the rollover canopy prevented her from contact with shattered side glass.

As the vehicle came to rest, the driver unbuckled her safety belt, opened the left front door and exited the vehicle without assistance. She attempted to use her cellular telephone to call for police and rescue assistance; however, she could not receive a signal due to remote and mountainous location of the crash. A motorist who was following the Mercury Mountaineer used the vehicle’s OnStar satellite system to notify police of the crash. Although the driver sustained a minor severity contusion of the left lateral thigh, she refused treatment at the scene. She rode in the ambulance with the front right passenger to a local hospital where she was examined for possible injury and released.

Front Right Passenger

| | |
|----------------------|--|
| Age/Sex: | 19 year old female |
| Height: | 170.2 cm (67.0”) |
| Weight: | 63.5 kg (140 lb) |
| Manual Belt Usage: | 3-point lap and shoulder belt system |
| Usage Source: | Driver interview and vehicle inspection |
| Seat Track Position: | Unknown (seat moved to full forward prior to SCI inspection) |
| Eyewear: | None |
| Exit from Vehicle: | Inassisted, opened right front door and walked from vehicle |
| Mode of Transport | |
| From Scene: | Ambulance to a local hospital |
| Usage Source: | Treated and released |

Front Right Passenger Injuries

| Injury | Injury Severity (AIS90/Update 98) | Injury Mechanism |
|------------------------------------|--|-------------------------|
| Lower back injury, possible strain | Minor (640678.1,8) | Impact force |
| Neck pain, possible strain | Minor (640278.1,6) | Impact force |

Front Right Passenger Kinematics

The front right passenger of the Mercury Mountaineer was seated in an unknown track position. At the time of the SCVI inspection of the vehicle, the center console had been removed from the vehicle and the RCM was removed and shipped to Ford's Safety Office for download. The front right seat had been moved during this process. The adjustable head restraint was adjusted to a position that was 3.8 cm (1.5") above the top aspect of the seat back. The passenger was restrained by the manual belt system. Restraint usage was verified by the firing of the safety belt buckle pretensioner, loading marks on the webbing from interaction against the seat trim, and by the lack of occupant contact points within the vehicle interior. The passenger was dressed in a ski jacket, ski pants, and winter boots.

At the initiation of the clockwise yaw, the passenger was displaced laterally to her left with respect to the decelerating vehicle. At the on-set of the rollover, the safety belt buckle pretensioner fired and the rollover canopy deployed. The passenger probably moved laterally within the vehicle during the lateral rollover event. She loaded the belt system as evidence by the load induced transfer on the trim at the outboard aspect of the seat cushion. There were no distinct interior contact points from passenger involvement. She did complain of neck and lower back pain that resulted from the impact force of the crash.

Immediately following the rollover, the front right passenger unbuckled her safety belt and opened the front right door and exited the vehicle unassisted. She was subsequently transported on a cot by ambulance to a local hospital where she was treated for her injuries and released.

CRASH SCHEMATIC

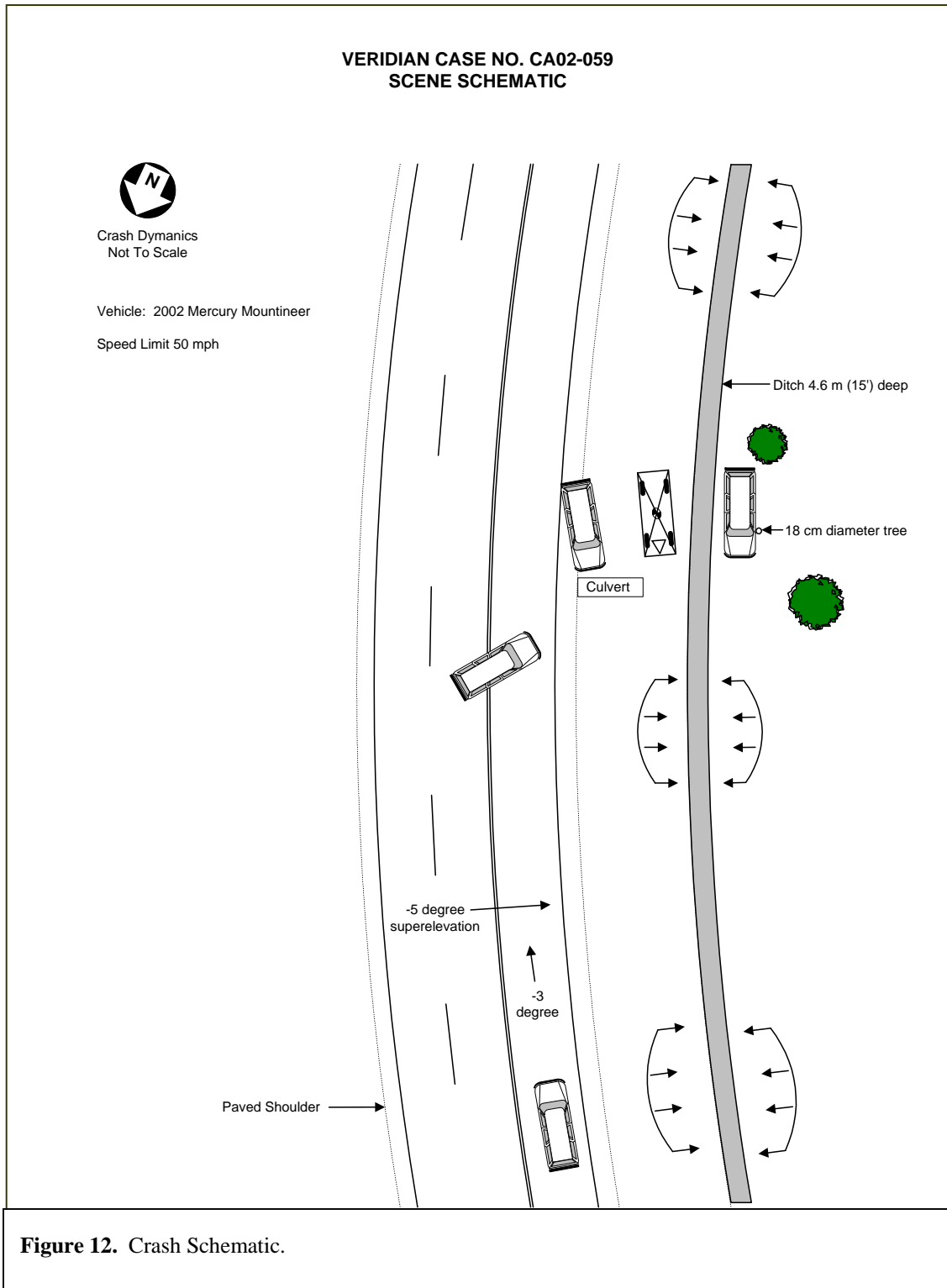


Figure 12. Crash Schematic.