

**TRANSPORTATION SCIENCES  
CRASH DATA RESEARCH CENTER**

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**REMOTE REDESIGNED AIR BAG RELATED ADULT DRIVER FATALITY  
INVESTIGATION  
SCI TECHNICAL SUMMARY REPORT**

**VERIDIAN CASE NO. CA99-064**

**RABSS VEHICLE - 1998 MERCURY MOUNTAINEER**

**LOCATION - STATE OF NEW YORK**

**CRASH DATE - JULY 1998**

Contract No. DTNH22-94-D-07058

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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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<p>16. <i>Abstract</i> This remote investigation focused on a single vehicle crash that involved a 1998 Mercury Mountaineer sport utility vehicle. The Mercury Mountaineer was equipped with redesigned frontal air bags that deployed as a result of a collision with a luminaire with a frangible (breakaway) base. The driver of the Mountaineer was operating the vehicle westbound on approach to a 4-leg intersection. The vehicle departed the roadway on the right side and struck a luminaire with a frangible (breakaway) base with the front right area. The pole fractured at the base, and as the Mountaineer continued forward through the luminaire, the shaft of the luminaire struck the windshield header on the right side. The vehicle continued west across the north/south intersecting roadway onto the northwest corner where the front left area impacted a second luminaire with a frangible (breakaway) base. The Mountaineer came to rest against the second luminaire. The luminaire remained upright but the concrete base became dislodged from the ground which caused the luminaire to lean. Based on contact evidence and limited injury data, the 70-year-old male driver was probably not restrained by the available 3-point lap and shoulder belt system. The first luminaire impact displaced the driver forward and placed him in close proximity to the steering wheel. The frontal impact to the second luminaire deployed the Mountaineer's redesigned frontal air bag system. The driver loaded the steering wheel and was struck by the deploying driver's air bag. He was redirected rearward by the expansion of the air bag and came to rest in the front left seat area near the center arm rest. He sustained a bilateral hemopneumothorax, tension pneumothorax, and pericardial injury. He was transported by ambulance to a local trauma center where he expired 1.5 hours following the crash. The 69-year-old female front right passenger was restrained by the available 3-point lap and shoulder belt system. She initiated a forward trajectory in response to the frontal impact force and loaded the manual restraint. She sustained abrasions on her arms from contact with the deploying front right passenger's air bag. She was transported by ambulance to the emergency room of a local trauma center and treated and released.</p>			
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***BACKGROUND***

This remote investigation focused on a single vehicle crash that involved a 1998 Mercury Mountaineer sport utility vehicle. The Mercury Mountaineer was equipped with redesigned frontal air bags that deployed as a result of a collision with a luminaire with a frangible (breakaway) base. The driver of the Mountaineer was operating the vehicle westbound on approach to a 4-leg intersection. The vehicle departed the roadway on the right side and struck a luminaire with a frangible (breakaway) base with the front right area. The pole fractured at the base, and as the Mountaineer continued forward through the luminaire, the shaft of the luminaire struck the windshield header on the right side. The vehicle continued west across the north/south intersecting roadway onto the northwest corner where the front left area impacted a second luminaire with a frangible (breakaway) base. The Mountaineer came to rest against the second luminaire. The luminaire remained upright but the concrete base became dislodged from the ground which caused the luminaire to lean. Based on contact evidence and injury data, the 70-year-old male driver was probably not restrained by the available 3-point lap and shoulder belt system. The first luminaire impact displaced the driver forward and placed him in close proximity to the steering wheel. The frontal impact to the second luminaire deployed the Mountaineer's redesigned frontal air bag system. The driver loaded the steering wheel and was struck by the deploying driver's air bag. He was redirected rearward by the expansion of the air bag and came to rest in the front left seat area near the center arm rest. He sustained a bilateral hemopneumothorax, tension pneumothorax, and pericardial injury. He was transported by ambulance to a local trauma center where he expired 1.5 hours following the crash. The 69-year-old female front right passenger was restrained by the available 3-point lap and shoulder belt system. She initiated a forward trajectory in response to the frontal impact force and loaded the manual restraint. She sustained abrasions on her arms from contact with the deploying front right passenger's air bag. She was transported by ambulance to the emergency room of a local trauma center and treated and released.

This crash was identified through a search of the Fatality Analysis Reporting System (FARS) for fatalities that occurred in vehicles equipped with redesigned air bags. The crash occurred in July 1998 and was assigned to the Veridian Special Crash Investigation Team on September 2, 1999 as a remote investigation effort. Police photographs and medical data were obtained, which provided the basis for this narrative report.

***SUMMARY***

**Crash Site**

This single vehicle crash occurred during the nighttime hours of July 1998. At the time of the crash, it was dark and cloudy. The asphalt roadway surface was dry. The crash occurred at a 4-leg intersection of a 6-

lane east/west roadway and 2-lane north/south roadway. Traffic control consisted of 3-phase traffic signals for each leg of the intersection. The east/west roadway was also equipped with left turn lanes with left turn signals in each direction. The posted speed limit was 64 km/h (40 mph). The roadside environment consisted of concrete curbs and sidewalks. The east/west roadway was illuminated with luminaries located approximately 0.6 m (2.0') from the road edge.

### Pre-Crash

The 70-year-old male driver of the 1998 Mercury Mountaineer was operating the vehicle westbound in the outboard lane on approach to a 4-leg intersection (**Figure 1**). For unknown reasons, the driver lost control of the Mercury Mountaineer and it drifted to the right off of the roadway. The loss of control may have been due to a pre-crash medical episode however, it could not be confirmed. Based on the intersection configuration, lack of tire marks, and a witness statement, there was no attempted avoidance maneuver prior to impact. The 1998 Mercury Mountaineer was equipped with Firestone Wilderness AT tires on each wheel. Based on the on-scene photographs, all tires appeared to be inflated and intact post crash. Therefore, the tires do not appear to be a factor in the pre-crash loss of control.



**Figure 1. Westbound approach for the Mercury Mountaineer**

### Crash

As the Mercury Mountaineer departed the roadway, the front right area impacted a luminaire with a frangible (breakaway) base (**Figure 2**) that was mounted approximately 0.6 m (2.0') from the curb (**Figure 3**). The principal direction of force was within the 12 o'clock sector. The luminaire was fractured at the base and was displaced upward. The mid-shaft area of the luminaire struck the windshield header and roof on the right side of the Mountaineer as the bottom was displaced upward and forward. The Mountaineer continued in a forward direction with no steering inputs and crossed the intersecting north/south roadway.



**Figure 2. Fractured base of luminaire from the first impact**



**Figure 3. View showing location of the fractured base with respect to the roadway**

The luminaire came to rest across the north/south roadway (**Figure 4**). The Mountaineer over rode the northwest curb edge, as evidenced by tire marks on the curb edge. It traveled onto the northwest sidewalk and struck a second luminaire with the front left area (**Figure 5**). The principal direction of force was in the 12 o'clock sector. The impact with the second luminaire was sufficient to deploy the redesigned frontal air bag system in the Mountaineer. The concrete foundation of the luminaire was displaced forward in the loose soil which caused the luminaire to lean to the side. The Mountaineer rotated counterclockwise (CCW) around the luminaire approximately 10 degrees. As it rotated, it impacted a fire hydrant with the right rear area which stopped the rotation. The Mountaineer came to rest with the front left area against the luminaire and the right rear area against the fire hydrant (**Figure 6**).



**Figure 4. Intersection showing the fractured luminaire in the roadway**



**Figure 5. Impact with the second luminaire**



**Figure 6. Final rest position**

### **Post-Crash**

The occupants of the 1998 Mercury Mountaineer were removed from the vehicle by rescue personnel. The police report stated that the 70-year-old male driver was in cardiac arrest when removed from the vehicle. He was transported by ambulance to a local trauma center with a hemopneumothorax, tension pneumothorax, and cardiac tamponade. The 69-year-old female front right passenger sustained unspecified arm abrasions and was transported by ambulance to a local trauma center where she was treated and released. The Mountaineer was towed from the scene.

### ***RABSS VEHICLE - 1998 Mercury Mountaineer***

The 1998 Mercury Mountaineer was identified by the Vehicle Identification Number (VIN): 4M2ZU55P8WU (production sequence omitted). The police report listed the front right passenger as the owner of the vehicle. The odometer reading at the time of the crash was 6,352 km (3,947 miles). The Mountaineer was a 4-door sport utility vehicle equipped with a 5.0 liter, 8-cylinder engine, 4-wheel drive, automatic transmission, and 4-wheel anti-lock brakes. The Mountaineer was also equipped with an aftermarket front grille guard, side running boards, and tail grilles for both tail lights. The seating was configured with front bucket seats with power adjustment controls, and a 60/40 split-fold rear bench seat with adjustable head restraints. Both front seating positions were equipped with upper anchorage adjusters for the 3-point lap and shoulder belt system.

The 1998 Mercury Mountaineer was equipped with Firestone Wilderness AT tires on each wheel. Based on the on-scene photographs, all tires appeared to be inflated and intact post crash. It was not known if the tires were part of the national Firestone tire recall.

## **VEHICLE DAMAGE - 1998 Mercury Mountaineer**

### **Exterior Damage**

The Mercury Mountaineer sustained moderate damage as a result of the multiple impacts. Abrasions were noted on the front right aspect of the front grille guard. The bumper fascia, grille, and leading aspect of the hood on the right side were displaced rearward slightly from the rearward displacement of the grille guard (**Figure 7**). The Collision Deformation Classification (CDC) for the first event (initial luminaire impact) was 12-FREN-1. A depression was noted on the right windshield header and the windshield was cracked from the impact force on the right side. The CDC for the second event (shaft of luminaire striking windshield header) was 00-TYRN-2. The direct contact damage involved the front left corner of the Mountaineer. The front grille guard was crushed against the front right grille and headlamp. The grille guard had separated from the Mountaineer on the right side. The front bumper fascia was severed to the right of center, and the left and center aspects were separated from the Mountaineer. The hood was buckled on the left side. The maximum crush was estimated at approximately 10 cm (4") at the left bumper corner (**Figure 8**). The CDC for the third event (impact to second luminaire) was 12-FLEE-1. Abrasions were noted on the right rear quarter panel and the tail grille on the rear right tail light was displaced rearward from snagging on the fire hydrant. The rear right bumper corner sustained scratches and was displaced rearward approximately 3 cm (1") (**Figure 9**). The CDC for the fourth event (impact to the fire hydrant) was 03-RBEN-1.



**Figure 7. View showing the front right damage**



**Figure 8. View showing the front left damage**



**Figure 9. Damage from the fire hydrant**



**Interior Damage**

Interior damage was minor and attributed to occupant contact (**Figure 10**). There were no apparent intrusions. The knee bolster was displaced from occupant contact. The steering column appeared to be compressed based on comparison photographs of an exemplar vehicle. Blood was noted on the center arm rest and left aspect of the front right seat cushion.



**Figure 10. Interior view**

***REDESIGNED AIR BAG SYSTEM***

The 1998 Mercury Mountaineer was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags had deployed as a result of the front left impact with the second luminaire. The redesigned driver’s air bag was housed in the center of the steering wheel with a horizontally oriented flap tear seam (H-configuration). The cover flaps were asymmetrical in shape. No contact evidence was visible on the air bag or exterior surface of the module cover flaps. Two vent ports were noted in the 12 o’clock sector of the air bag.

The redesigned front right passenger’s air bag deployed from the right mid-instrument panel with a single cover flap design hinged at the top aspect. Blood drops were noted on the upper left and lower right aspects of the air bag. One vent port was noted on the top aspect.

***OCCUPANT DEMOGRAPHICS***

**Driver**

Age/Sex:	70-year-old male
Height:	Not reported
Weight:	Not reported
Seat Track Position:	Mid-track (on-scene police photographs)
Manual Restraint Use:	None
Usage Source:	Injury data, apparent interior contacts, police homicide report
Eyewear:	Not reported
Type of Medical Treatment:	Transported by ambulance to a local trauma center and expired 1.5 hours following the crash

### Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanisms
Cardiac tamponade	Serious (441604.3,4)	Result of chest trauma from the expansion of the driver's redesigned air bag
Bilateral hemopneumothorax	N/A (not coded under AIS 90/Update 98)	Result of chest trauma from the expansion of the driver's redesigned air bag
Tension pneumothorax	N/A (not coded under AIS 90/Update 98)	Result of chest trauma from the expansion of the driver's redesigned air bag

Injury source: Police homicide report

### Driver Kinematics

The 70-year-old male driver of the 1998 Mercury Mountaineer was presumed to be seated in an upright posture with the seat track adjusted to the mid-track position. A check box on the police accident report indicated the driver was restrained by the 3-point lap and shoulder belt system. However, the police homicide report states that the responding on-scene officer found the driver lying in the driver's seat across the center arm rest without a seatbelt. Based on the contact evidence and limited injury data, it was likely that the driver was unrestrained.

At impact with the first luminaire which fractured at its base, the unrestrained driver initiated a forward trajectory in response to the 12 o'clock impact force and was positioned forward in close proximity to the steering wheel. The Mountaineer over rode the northwest curb edge, as evidenced by tire marks on the curb edge, which displaced him further forward. The Mountaineer traveled onto the northwest sidewalk and struck a second luminaire with the front left area which displaced the driver further forward. At impact with the second luminaire, the out-of-position driver continued to move in a forward motion in response to the 12 o'clock impact force and loaded the knee bolster and steering wheel, evidenced by the displaced knee bolster and apparent compression of the steering column in the police photographs. The redesigned driver's air bag deployed against the driver's chest, and projected him rearward into the driver's seat back. He sustained a bilateral hemopneumothorax, tension pneumothorax, and cardiac tamponade as a result of blunt force chest trauma. As the Mountaineer quickly rotated counterclockwise (CCW) against the fire hydrant, the driver rebounded to the right and came to rest lying on the center arm rest. The driver was removed from the vehicle by rescue personnel. The police report stated that the driver was found to be in cardiac arrest when removed from the vehicle. He was transported by ambulance to a local trauma center where he expired 1.5 hours following the crash.

### Front Right Passenger

Age/Sex: 69-year-old female  
Height: Not reported  
Weight: Not reported  
Seat Track Position: Mid-track (on-scene police photographs)  
Manual Restraint Use: 3-point lap and shoulder belt  
Usage Source: Police accident report  
Eyewear: Not reported  
Type of Medical Treatment: Transported by ambulance to the emergency room of a local trauma center and treated and released

### Front Right Passenger Injuries

Injury	Injury Severity (AIS 90)	Injury Mechanisms
Arm abrasion, NFS	Minor (790202.1,9)	Front right passenger's air bag membrane

Injury source: Police accident report

### Front Right Passenger Kinematics

The 69-year-old front right passenger was presumed to be seated in an upright posture. She was restrained by the available 3-point lap and shoulder belt system. At impact with the first luminaire which fractured at its base, she initiated a forward trajectory in response to the 12 o'clock impact force, loaded the manual restraint system. The restraint system probably continued to hold tension throughout the remainder of the crash sequence which kept her in position. She probably extended her arms forward in an attempt to brace herself for the second impact. At impact with the second luminaire, she continued to load the manual restraint and contacted the deployed front right redesigned passenger's air bag. The combination of restraint systems provided additional crash protection to the front right passenger. She sustained an unspecified arm abrasion probably as a result of the expansion of the air bag membrane against her arm. She was transported by ambulance to the emergency room of a local trauma center where she was treated and released.