

**TRANSPORTATION SCIENCES
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**REMOTE ADULT PASSENGER REDESIGNED AIR BAG FATALITY INVESTIGATION
SCI TECHNICAL SUMMARY REPORT**

VERIDIAN CASE NO. CA99-039

RABSS VEHICLE - 1998 MERCURY MYSTIQUE

LOCATION - STATE OF PENNSYLVANIA

CRASH DATE - MAY 1998

Contract No. DTNH22-94-D-07058

Prepared for:

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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 two-vehicle crash that involved a 1998 Mercury Mystique (subject vehicle) and 1998 Ford Windstar. The 1998 Mercury Mystique was equipped with redesigned frontal air bags that deployed as result of an offset frontal collision with the rear aspect of the 1998 Ford Windstar. The driver of the Mercury Mystique was operating the vehicle eastbound on a two-lane undivided state highway in a construction zone when she failed to detect the Ford Windstar which was almost stopped due to construction traffic. The front right area of the Mercury Mystique impacted the rear left area of the Ford Windstar, which deployed the frontal air bag system and resulted in moderate damage to the Mystique and minor damage to the Windstar. The Mystique was redirected in a counterclockwise (CCW) direction after the impact and traveled across the westbound lane, coming to rest on the shoulder near the concrete barrier. The Windstar was redirected forward a short distance, and rotated slightly in a counterclockwise (CCW) direction, coming to rest partially in the westbound lane. The 80-year-old female driver of the Mercury Mystique was not restrained by the available 3-point manual lap and shoulder belt system. She sustained contusions and abrasions on her arms from contact with the deploying air bag. She was treated at the scene and refused further treatment. The 85-year-old male front right passenger was not restrained by the available 3-point manual lap and shoulder belt system. He sustained head injuries and blunt force trauma to the chest as a result of the deploying front right passenger's air bag. He was transported by ambulance to a local hospital and transferred to a local regional trauma center where he expired five days later due to his injuries.</p>			
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CRASH DATE - MAY 1998**

BACKGROUND

This remote investigation focused on a two-vehicle crash that involved a 1998 Mercury Mystique (subject vehicle) and 1998 Ford Windstar. The 1998 Mercury Mystique was equipped with redesigned frontal air bags that deployed as result of an offset frontal collision with the rear aspect of the 1998 Ford Windstar. The driver of the Mercury Mystique was operating the vehicle eastbound on a two-lane undivided state highway in a construction zone when she failed to detect the Ford Windstar which was almost stopped due to construction traffic. The front right area of the Mercury Mystique impacted the rear left area of the Ford Windstar, which deployed the frontal air bag system and resulted in moderate damage to the Mystique and minor damage to the Windstar. The Mystique was redirected in a counterclockwise (CCW) direction after the impact and traveled across the westbound lane, coming to rest on the shoulder near the concrete barrier. The Windstar was redirected forward a short distance, and rotated slightly in a counterclockwise (CCW) direction, coming to rest partially in the westbound lane. The 80-year-old female driver of the Mercury Mystique was not restrained by the available 3-point manual lap and shoulder belt system. She sustained contusions and abrasions on her arms from contact with the deploying air bag. She was treated at the scene and refused further treatment. The 85-year-old male front right passenger was not restrained by the available 3-point manual lap and shoulder belt system. He sustained head injuries and blunt force trauma to the chest as a result of the deploying front right passenger's air bag. He was transported by ambulance to a local hospital and transferred to a local regional trauma center where he expired five days later due to his injuries.

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 May 1998 and was assigned to the Veridian Special Crash Investigation Team of 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 two-vehicle crash occurred during the daylight hours of May 1998. At the time of the crash, it was daylight with no adverse conditions as the concrete roadway was dry. The crash occurred in an active construction zone near the hillcrest of a bridge of a two-lane east/west undivided state highway. The roadside environment consisted of concrete shoulders and concrete barriers on the outboard edges of the roadway. An off-duty police officer/flagman was directing traffic flow through the active construction zone. The permanent posted speed limit was 72 km/h (45 mph); however, the temporary posted speed for the construction zone was unknown.

Pre-Crash

The 80-year-old female driver of the 1998 Mercury Mystique was operating the vehicle in an eastbound direction on a two-lane undivided state highway bridge (**Figure 1**) when she failed to detect the 1998 Ford Windstar slow to a near stop in the eastbound lane near the hillcrest of the bridge in an active construction zone. Upon recognition of the impending harmful event, the driver of the Mercury Mystique applied the brakes and steered left into the westbound lane as she continued in a forward direction of travel.



Figure 1. View of impact area looking east

Crash

As the Mercury Mystique traveled forward, the front right area impacted rear left area of the Ford Windstar. The impact resulted in moderate damage to the Mercury Mystique, and minor damage to the Ford Windstar. The directions of force were within the 12 o'clock sector for the Mystique and within the 6 o'clock sector for the Windstar. The impact induced deceleration was sufficient to deploy the frontal air bag system in the Mercury Mystique. The damage algorithm of the WinSMASH program computed total velocity changes of 12.9 km/h (8.1 mph) for the Mercury Mystique, and 10.2 km/h (6.4 mph) for the Ford Windstar based on the estimated crush profiles. The Mercury Mystique was deflected to the left, traveled forward across the westbound travel lane, and came to rest facing in a northeast direction on the north shoulder near the concrete barrier. The Ford Windstar was redirected forward a short distance and came to rest straddling the eastbound and westbound lanes, facing east.

Post-Crash

The driver of the Mercury Mystique was removed from the vehicle by rescue personnel and treated at the scene for minor injuries. She refused transportation to a medical facility. The right front passenger was treated by EMS personnel for a head injury and transported to a local hospital, then transferred to a regional trauma center where he expired five days later due to his injuries.

RABSS VEHICLE - 1998 Mercury Mystique

The 1998 Mercury Mystique was identified by the Vehicle Identification Number (VIN): 1MELM6533WK (production sequence omitted). The vehicle was a 5-passenger, 4-door sedan equipped with front-wheel drive and a 2.0 liter, 4 cylinder engine. The police report listed the driver as the owner of the vehicle. The seating was configured with bucket seats for the front positions with adjustable head restraints, and a 60/40 split bench seat with folding backs in the rear.

VEHICLE DAMAGE

Exterior Damage - 1998 Mercury Mystique

The 1998 Mercury Mystique sustained moderate damage as a result of the collision with the Ford Windstar. The Collision Deformation Classification (CDC) for this impact to the Mercury Mystique was 12-FREE-1. The direct contact damage began at the front right bumper corner and extended

approximately 36 cm (14") inboard (**Figure 2**). The combined direct and induced damage spanned the full width of the front bumper (**Figure 3**). Six crush measurements were estimated at the level of the radiator support: C1= 0, C2= 0, C3= 0, C4=0, C5= 5 cm (2"), C6= 11 cm (4"). The hood was displaced rearward approximately 11 cm (4") and slightly buckled from engagement with the Ford Windstar. Damage was also noted on the right front fender, as the leading edge was displaced rearward approximately 20 cm (8") (**Figure 4**).



Figure 2. Direct damage to the Mercury Mystique



Figure 3. Mercury Mystique direct and indirect frontal damage



Figure 4. Mercury Mystique right front damage

Interior Damage - 1998 Mercury Mystique

Interior damage to the Mercury Mystique was based on one interior police photograph (**Figure 5**) and was attributed solely to air bag deployment. There were no apparent intrusions or occupant contact evidence to the knee bolster (rigid plastic type) or steering wheel rim. Both air bag modules were removed from the vehicle.



Figure 5. Mercury Mystique interior view

Exterior Damage - 1998 Ford Windstar

The Ford Windstar sustained minor rear aspect damage as a result of the impact with the Mercury Mystique (**Figure 6**). The Collision Deformation Classification (CDC) for the Ford Windstar was 06-BLEE-1. The left side of the rear bumper was displaced forward and there was minor buckling of the sheet metal on the left side below the belt line aft of the rear axle which extended to the rearmost portion of the rear quarter panel. The maximum crush was located at the rear left bumper corner and was approximately 10cm (4").



Figure 6. Ford Windstar rear damage

REDESIGNED AIR BAG SYSTEM - 1998 Mercury Mystique

The 1998 Mercury Mystique was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bag system deployed as a result of the impact with the Ford Windstar. The air bags had been removed from the vehicle after the crash. The driver air bag was housed in the center

of the steering wheel with a horizontally oriented flap tear seam. Based on an inspection of an exemplar vehicle, the flaps were symmetrical in shape and the tear seam measured 19 cm (8") in length.

The front right passenger air bag deployed from the right instrument panel area with a single cover flap design hinged at the top aspect. Based on an inspection of an exemplar vehicle, the cover flap was rectangular in shape and measured 35 cm (14") wide.

OCCUPANT DEMOGRAPHICS

Driver

Age/Sex: 80-year-old female
 Height: Unknown
 Weight: Unknown
 Seat Track Position: Mid-track, estimated at 13 cm (5") rear of full forward
 Manual Restraint Use: None
 Usage Source: Police Report
 Eyewear: Unknown
 Type of Medical Treatment: Treated at scene and refused additional medical treatment

Driver Injuries

Injury	Injury Severity (AIS 90)	Injury Mechanisms
Multiple bilateral arm abrasions	Minor (790202.1,3)	Deploying driver's air bag
Multiple bilateral arm contusions	Minor (790402.1,3)	Deploying driver's air bag

Driver Kinematics

The 80-year-old female driver of the 1998 Mercury Mystique was presumed to be seated in an upright posture with the seat track adjusted approximately 13 cm (5") rear of full forward position and 8 cm (3") forward of full rear position. According to the police report, she was not restrained by the available 3-point lap and shoulder belt system. Based on the approximate seat position, the distance from the driver's side air bag flaps to the seat back was approximately 51 cm (20"). She sustained contusions and abrasions to her arms as a result of contact with the expanding air bag. She was treated at the scene and refused additional medical treatment.

Front right Passenger

Age/Sex: 85-year-old male
 Height: Unknown
 Weight: Unknown
 Seat Track Position: Estimated at 5 cm (2.0") forward of full rear
 Manual Restraint Use: None
 Usage Source: Police Report
 Eyewear: Unknown
 Type of Medical Treatment: Transported to local hospital, then transferred to a regional trauma center and expired 5 days later

Front right Passenger Injuries

Injury	Injury Severity (AIS 90)	Injury Mechanisms
Intra-cerebral hemorrhage	Severe (140638.4,9)	Right B-pillar
Left traumatic pneumothorax	Serious (442202.3,2)	Front right passenger's air bag
LeFort II fracture	Moderate (250806.2,4)	Front right passenger's air bag
Numerous facial lacerations (NFS)	Minor (290600.1,9)	Front right passenger's air bag
Facial abrasions (NFS)	Minor (290202.1,9)	Front right passenger's air bag
Left orbit contusion	Minor (290402.1,2)	Front right passenger's air bag
Right orbit contusion	Minor (290402.1,1)	
Bilateral elbow lacerations	Minor (790600.1,3)	Unknown
Left hand lacerations	Minor (790600.1,2)	Unknown
Fracture - left index finger	Minor (752404.1,2)	Unknown

*Injury source: Inter-facility transfer record, trauma center admission report, discharge summary

Front right Passenger Kinematics

The 85-year-old male passenger of the 1998 Mercury Mystique was presumed to be seated in an upright posture with the seat track adjusted approximately 16 cm (6") rear of full forward position and 5 cm (2") forward of full rear position. According to the police report, he was not restrained by the available 3-point lap and shoulder belt system. Based on inspection of an exemplar vehicle and approximate seat position, the distance from the leading edge of the passenger side air bag flap to the seat back was 80 cm (32"). The front right passenger was out-of-position forward due to pre-impact braking, which placed him in the path of the deploying front right passenger's air bag. At impact with the Ford Windstar, the passenger initiated a forward and slightly lateral trajectory in response to the 1 o'clock direction of force and contacted the

deploying air bag. He was redirected rearward, and probably struck his head on the right B-pillar as he rebounded against the seat back. He sustained numerous facial lacerations, LeFort II fracture through the maxillary sinus, intra-cerebral hemorrhage, left traumatic pneumothorax, elbow lacerations, left hand lacerations, and fracture of the left index finger. The passenger was transported by ambulance to a local hospital and transferred to a regional trauma center for treatment of his injuries, where he expired 5 days after the crash. According to medical records, the cause of death was blunt force trauma to the chest and intra-cerebral hemorrhage. The police report mentions a pre-existing heart condition as a contributory factor.