TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION

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VERIDIAN REMOTE REDESIGNED AIR BAG INJURY INVESTIGATION
SCI TECHNICAL SUMMARY REPORT

NASS CDS CASE NO. 1998-11-110E

VEHICLE - 1998 MERCURY SABLE

LOCATION - STATE OF MICHIGAN

CRASH DATE - JUNE, 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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16. *Abstract* This remote investigation focused on a two vehicle crash involving a 1998 Mercury Sable 4-door sedan (subject vehicle) and a 1997 Ford Taurus 4-door sedan. The Mercury Sable was equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of a frontal collision with the Ford Taurus. The driver of the Mercury was operating the vehicle southbound when she failed to observe the northbound Ford as she turned left (east) at a 4-leg rural intersection. As the Mercury crossed the northbound lane, the front right area impacted the front left area of the Ford resulting in moderate damage to both vehicles. The restrained 19 year old female driver of the Mercury Sable initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. She sustained bilateral knee contusions as a result of contact to the knee bolster with no other injury reported. The restrained 21 year old female front right passenger also initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned passenger air bag. Loading of the manual restraint resulted in a contusion to the left shoulder. Both occupants of the Mercury Sable were transported (along with the driver of the Ford) to a local hospital for treatment and released.			
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BACKGROUND

This remote investigation focused on a two vehicle crash involving a 1998 Mercury Sable 4-door sedan (subject vehicle) and a 1997 Ford Taurus 4-door sedan. The Mercury Sable was equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of a frontal collision with the Ford Taurus. The driver of the Mercury was operating the vehicle southbound when she failed to observe the northbound Ford as she turned left (east) at a 4-leg rural intersection. As the Mercury crossed the northbound lane, the front right area impacted the front left area of the Ford resulting in moderate damage to both vehicles. The restrained 19 year old female driver of the Mercury Sable initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. She sustained bilateral knee contusions as a result of contact to the knee bolster with no other injury reported. The restrained 21 year old female front right passenger also initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned passenger air bag. Loading of the manual restraint resulted in a contusion to the left shoulder. Both occupants of the Mercury Sable were transported (along with the driver of the Ford) to a local hospital for treatment and released.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as CDS case number 98-11-110E. The Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) assigned the Special Crash Investigation (SCI) team at Veridian the task of case review and final report preparation.

SUMMARY

Crash Site

This two vehicle crash occurred during the early evening hours of June, 1998. At the time of the crash, it was daylight with no adverse conditions as the roads were dry. The crash occurred at a rural/straight 4-leg intersection which had a positive grade for southbound traffic **(see Figure 7 - page 5)**. The asphalt roadways were bordered by narrow paved shoulders with a wooded area approximately 3.0 meters (9.8 feet) to the east. The posted speed limit at the crash site was 80 km/h (50 mph) with east/westbound traffic controlled by stop signs.

Pre-Crash

The 19 year old female driver of the 1998 Mercury Sable was operating the vehicle southbound **(Figure 1)** when she slowed in anticipation of the left turn (east) onto the rural connector. The driver reported to police that she became distracted by a stationary westbound vehicle as she initiated the left

turn. The 51 year old male driver of the 1997 Ford Taurus was operating the vehicle northbound **(Figure 2)** and proceeding straight when he observed the southbound Mercury cross his path of travel. Upon recognition of the impending harmful event, the driver steered right in avoidance.

Figure 1. Southbound approach for the 1998 Mercury Sable.

Figure 2. Northbound approach for the 1997 Ford Taurus.

Crash

As the Mercury Sable crossed the northbound lane of the 4-leg urban intersection, the front right area impacted the front left area of the Ford Taurus resulting in moderate damage to both vehicles. Although the impact-induced deceleration was sufficient to deploy the Mercury's redesigned frontal air bag system, WinSMASH computed velocity changes could not be generated due to the repair status of the Mercury and masking damage profile of the opposing Ford. At this point, the Ford was re-directed in a northeasterly direction and departed the roadway where the right side surface and frontal area struck two trees (respectively) resulting in moderate damage. The Mercury Sable rotated counterclockwise and came to rest in the intersection facing northeast as the Ford Taurus came to rest approximately 36.0 meters (118.1 feet) north of the intersection (against the trees) also facing northeast.

Post-Crash

The occupants of the Mercury Sable exited the vehicle under their own power. The exit status of the Ford driver was unknown. Treatment was rendered at the scene by fire department personnel and emergency medical technicians (EMTs). The occupants of both vehicles were transported by ambulance to a local hospital for treatment and released. Both vehicles were towed from the scene due to disabling damage.

VEHICLE DATA

The 1998 Mercury Sable was manufactured on 2/98 and identified by the Vehicle Identification Number (VIN): 1MEFM53S1WG (production sequence deleted). The vehicle was a 4-door sedan equipped with front wheel drive and a 3.0 liter, 6-cylinder engine. The vehicle's odometer reading was 12,147 km (7,548 miles) at the time of the crash. The police report did not specify the owner of the vehicle. The seating was configured with front bucket and rear bench seats (with folding backs). The driver reported no previous crashes or maintenance on the air bag system (original equipment). No cell phone was present or in-use at the time of the collision.

Exterior Damage

The 1998 Mercury Sable sustained moderate frontal damage as a result of the impact with the Ford Taurus. The direct contact damage and associated crush profile could not be obtained as the vehicle was under repair at the time of inspection **(Figure 3)**. Reduction in the right side wheelbase measured 4.0 cm (1.6 in). The windshield was fractured from (exterior) impact forces and the (interior) front right air bag module cover flap. All tempered glazing remained intact.

Figure 3. Dismantled 1998 Mercury Sable.

Figure 4. Overlapping frontal damage to the 1997 Ford Taurus.

The 1997 Ford Taurus also sustained moderate frontal damage as a result of the impact with the Mercury Sable **(Figure 4)**. The direct contact damage relating to this initial impact could not be identified due to masking by the subsequent tree impacts, however, paint transfers were noted along the front bumper. The hood was deformed up and rearward from engagement against the tree. The right fender was deformed rearward. Reduction in the right side wheelbase measured 3.0 cm (1.2 in).

Interior Damage

Damage to the interior surfaces of the Mercury Sable were minimal and attributed to occupant contact as scuff marks were documented on the left/right knee bolsters (rigid plastic type). No intrusions were found in the vehicle.

REDESIGNED AIR BAG SYSTEM

The 1998 Mercury Sable was equipped with redesigned frontal air bags for the driver and front right passenger positions **(Figures 5 & 6)**. The air bags had deployed as a result of the crash. The driver air bag was housed in the center of the steering wheel with a horizontally oriented flap tear seam (H-configuration). No contact evidence was identified on the air bag or exterior surface of the module cover flaps. The flaps were asymmetrical in shape. The bag was tethered by two internal straps and vented by two ports located at the 11 o'clock and 1 o'clock sectors on the rear aspect of the air bag.

The front right passenger air bag deployed from the right top instrument panel area with a single cover flap design hinged at the forward aspect. No contact evidence was identified on the air bag or exterior surface of the module cover flap. The cover flap was rectangular in shape. The bag was tethered by one internal strap. No vent ports or cutoff switch were reported for the front right passenger air bag.

Figure 5. 1998 Mercury Sable redesigned driver air bag.

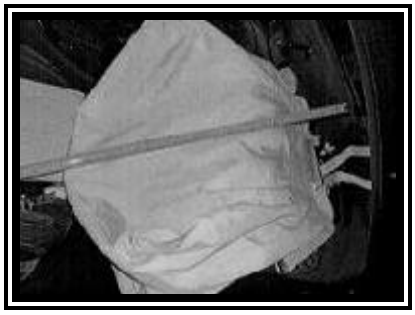

Figure 6. 1998 Mercury Sable redesigned passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex:	19 year old female
Height:	173 cm (68 in)
Weight:	68 kg (150 lb)
Seat Track Position:	Mid-to-forward position
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	NASS vehicle inspection, driver interview, police report
Eyeware:	Contact lenses
Type of Medical Treatment:	Transported to a local hospital and released

Driver Injuries

Injury	***Severity (AIS 90)***	***Injury Mechanism***
Bilateral knee contusions	Minor (890402.1,3)	Left knee bolster
Right knee sprain	Moderate (850826.2,1)	Left knee bolster

Driver Kinematics

The 19 year old female driver of the 1998 Mercury Sable was properly restrained by the available 3-point manual lap and shoulder belt system, seated in an upright posture with the seat track adjusted to the mid-to-forward position. The NASS interview stated she was belted, further evidenced by the lack of significant interior contacts and injury. At impact, the driver initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Contact to the knee bolster resulted in bilateral contusions to the knees (and associated right knee sprain) as evidenced by the scuff marks documented to this component. No other injury was reported. She was transported to a local hospital for treatment and released. The combination of restraint options provided protection against further contact to the steering wheel hub/rim and potential serious injury.

FRONT RIGHT PASSENGER DEMOGRAPHICS

Age/Sex:	21 year old female
Height:	163 cm (64 in)
Weight:	57 kg (126 lb)
Seat Track Position:	Middle position
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	NASS vehicle inspection, driver interview, police report
Eyeware:	Contact lenses
Type of Medical Treatment:	Transported to a local hospital and released

Front Right Passenger Injuries

Injury	***Severity (AIS 90)***	***Injury Mechanism***
Contusion left shoulder	Minor (790402.1,2)	Shoulder belt webbing

Front Right Passenger Kinematics

The 21 year old female front right passenger of the 1998 Mercury Sable was properly restrained by the available 3-point manual lap and shoulder belt system, seated in an upright posture with the arms reportedly extended forward in a bracing position. The NASS interview stated she was restrained, further evidenced by the lack of significant interior contacts and injury. At impact, she initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned passenger air bag. Loading of the manual restraint resulted in a contusion to the left shoulder with no other injury reported. She was transported by ambulance to a local hospital for treatment and released. The combination of restraint options provided protection against further contact to the instrument panel and potential serious injury.

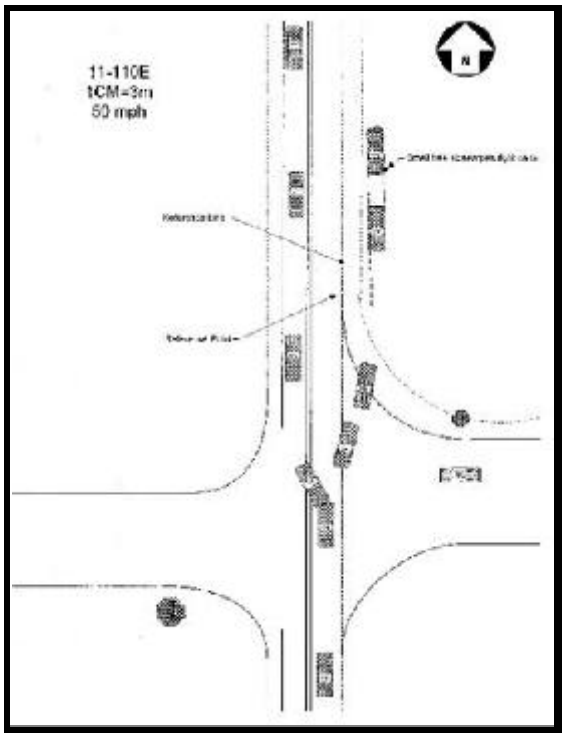

Figure 7. NASS Scene Diagram.