

Remote, Redesigned Air Bag Special Study

FOR NHTSA'S INTERNAL USE ONLY

Dynamic Science, Inc., Case Number (1998-082-801E)

1998 Mercury Tracer

Washington

July/1998

Technical Report Documentation Page

1. Report No. 1998-082-801E	2. Government Accession No.	3. Recipient Catalog No.	
4. Title and Subtitle		5. Report Date May 5, 2000	
		6. Performing Organization Report No.	
7. Author(s) Dynamic Science, Inc.		8. Performing Organization Report No.	
9. Performing Organization name and Address Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401		10. Work Unit No. (TRAIS)	
		11. Contract or Grant no. DTNH22-94-D-27058	
12. Sponsoring Agency Name and Address U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590		13. Type of report and period Covered [Report Month, Year]	
		14. Sponsoring Agency Code	
15. Supplemental Notes			
<p>16. Abstract</p> <p>This remote investigation focused on the redesigned air bag system deployment of a 1998 Mercury Tracer 4-door sedan. This minor injury crash occurred in July, 1998 in the evening. It was raining at the time and the concrete roadway was wet. The crash occurred on a two way, undivided road. The road contains two lanes; one northbound lane and one southbound lane. The speed limit for this road is 48 kmph (30 mph). There are no traffic controls and there is a >2% downhill grade for northbound traffic at the area of impact. The crash occurred at a northbound leftward curve in the roadway. Vehicle 1, a 1985 Toyota Camry 5-door hatchback driven by a 28 year old female (unknown ht/wt), was traveling south in the southbound travel lane negotiating a rightward curve in the roadway at an unknown speed approaching Vehicle 2. It is unknown if the driver was restrained. There were no other occupants in the vehicle. Vehicle 2, a 1998 Mercury Tracer 4-door sedan (case vehicle) driven by a 31 year old female (163 cm/ 64 in, 68 kg/150 lbs), was traveling north in the northbound travel lane negotiating a leftward curve in the roadway at a driver estimated speed of 16-24 kmph (10-15 mph) approaching Vehicle 1. The driver was unrestrained. The front right seat was occupied by an unrestrained 31 year old male (190 cm/75 in, 84 kg/185 lbs). A 9 month old male child (51 cm/20 in, 10 kg/22 lbs) was sitting unrestrained in the lap of the front right occupant. The back left seat was occupied by an unrestrained 12 year old female (158 cm/62 in, 50 kg/110 lbs). The back right seat was occupied by an unrestrained 57 year old female (158 cm/62 in, 86 kg/190 lbs). As Vehicle 1 approached Vehicle 2, it drifted over the double yellow painted line and entered the northbound travel lane. The front plane (12FLEE3) of Vehicle 1 struck the left plane (11LZEW3) of Vehicle 2 in the northbound lane (event 1). This impact caused Vehicle 1 to strike the right curb with the right wheels (event 2) causing rim damage to the right rear wheel (01RBWN3). Vehicle 2 then continued onto the sidewalk where it rolled over two quarter turns to the right (event 3) and came to rest on the roof (00TDDO3). A Delta V was calculated for event 1 for Vehicle 2, using the Damage Only Algorithm of WinSMASH, as 14 kmph (9 mph). As a result of the first impact, the supplemental restraint system (driver's and passenger's frontal redesigned air bags) of the case vehicle deployed. Vehicle 1 came to final rest in the northbound lane facing southeast. Vehicle 2 came to final rest upside down on the east roadside facing northwest. The medical status/disposition of the driver of Vehicle 1 is not known. All five passengers of Vehicle 2 sustained non-incapacitating injuries and were transported from the scene to a trauma center where they were all treated and released. Both vehicles were disabled due to damage sustained in the crash and were towed from the scene.</p>			
17. Key Words Redesigned air bag system, unrestrained child in front of PAB on lap of adult		18. Distribution Statement	
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No of pages	22. Price

Remote, Redesigned Air Bag Special Study
FOR NHTSA'S INTERNAL USE ONLY
Dynamic Science, Inc., Case Number (1998-082-801E)
1998 Mercury Tracer
Washington
July/1998

Summary

This remote investigation focused on the redesigned air bag system deployment of a 1998 Mercury Tracer 4-door sedan. This minor injury crash occurred in July, 1998 in the evening. It was raining at the time and the concrete roadway was wet. The crash occurred on a two way, undivided road. The road contains two lanes; one northbound lane and one southbound lane. The speed limit for this road is 48 kmph (30 mph). There are no traffic controls and there is a >2% downhill grade for northbound traffic at the area of impact. The crash occurred at a northbound leftward curve in the roadway.

Vehicle 1, a 1985 Toyota Camry 5-door hatchback driven by a 28 year old female (unknown ht/wt), was traveling south in the southbound travel lane negotiating a rightward curve in the roadway at an unknown speed approaching Vehicle 2. It is unknown if the driver was restrained. There were no other occupants in the vehicle.

Vehicle 2, a 1998 Mercury Tracer 4-door sedan (case vehicle) driven by a 31 year old female (163 cm/ 64 in, 68 kg/150 lbs), was traveling north in the northbound travel lane negotiating a leftward curve in the roadway at a driver estimated speed of 16-24 kmph (10-15 mph) approaching Vehicle 1. The driver was unrestrained. The front right seat was occupied by an unrestrained 31 year old male (190 cm/75 in, 84 kg/185 lbs). A 9 month old male child (51 cm/20 in, 10 kg/22 lbs) was sitting unrestrained in the lap of the front right occupant. The back left seat was occupied by an unrestrained 12 year old female (158 cm/62 in, 50 kg/110 lbs). The back right seat was occupied by an unrestrained 57 year old female (158 cm/62 in, 86 kg/190 lbs).



Figure 1. Exterior, Vehicle 1 (Toyota Camry)



Figure 2. Exterior, Vehicle 2 (Mercury Tracer)

Crash Events

As Vehicle 1 approached Vehicle 2, it drifted over the double yellow painted line and entered the northbound travel lane. The front plane (12FLEE3) of Vehicle 1 struck the left plane (11LZEW3) of Vehicle 2 in the northbound lane (event 1). This impact caused Vehicle 1 to strike the right curb with the right wheels (event 2) causing rim damage to the right rear wheel (01RBWN3). Vehicle 2 then continued onto the sidewalk where it rolled over two quarter turns to the right (event 3) and came to rest on the roof (00TDDO3).

A Delta V was calculated for event 1 for Vehicle 2, using the Damage Only Algorithm of WinSMASH, as 14 kmph (9 mph).

As a result of the first impact, the supplemental restraint system (driver’s and passenger’s frontal redesigned air bags) of the case vehicle deployed.

Vehicle 1 came to final rest in the northbound lane facing southeast. Vehicle 2 came to final rest upside down on the east roadside facing northwest.

The medical status/disposition of the driver of Vehicle 1 is not known. All five passengers of Vehicle 2 sustained non-incapacitating injuries and were transported from the scene to a trauma center where they were all treated and released.

Both vehicles were disabled due to damage sustained in the crash and were towed from the scene.

Table 1. Delta V

	Case Vehicle		Other Vehicle	
	km/h	mph	km/h	mph
Total	14	8.7	16	9.9
Longitudinal	-13	-8.1	-16	-9.9
Lateral	5	3.1	-3	-1.9
Barrier speed	15	9.3	13	8.1



Figure 3. Crash scene, Vehicle 1 approach path

Exterior of Case Vehicle

Table 2. Vehicle Information

Model year, make and model	1998 Mercury Tracer
VIN	1MEFM10P2WW
CDC	11LZEW3



Figure 4. Exterior, Vehicle 2 (1998 Mercury Tracer)



Figure 5. Exterior, Vehicle 2 (1998 Mercury Tracer)

Table 3. Crush Measurements

Plane of Impact	Field L cm/in.	C1 cm/in.	C2 cm/in.	C3 cm/in.	C4 cm/in.	C5 cm/in.	C6 cm/in.
Mid-door	246	0	12	13	7	11	0
	96.9	0	4.7	5.1	2.8	4.3	0

Interior of Case Vehicle

The interior of the Mercury Tracer sustained moderate damage from intrusion and occupant contact. There was a substantial amount of intrusion of the roof, A-pillar, windshield header, and doors. The intruded values are reported in Table 4. There was occupant contact evidence to the air bags, roof, instrument panel, steering column, mirror, and door panels.

This vehicle was equipped with bucket seats in the front left and front right seating positions. The front left seat was adjusted to the middle track position. The front right seat was adjusted to the rear most track position. Both front seats were equipped with adjustable head restraints which were not damaged. The rear of the vehicle was equipped with bench seats with no head restraints in all three seating positions. The back seats are not adjustable.

Table 4. Intrusions

Intruded Component	Location of Intrusion	Intruded Value cm/in.		Dominant Crush Direction
Roof	Front left	19	7.5	Vertical
Roof	Front center	17	6.7	Vertical
A-pillar	Front left	13	5.1	Vertical
Roof	Front right	13	5.1	Vertical
Windshield header	Front left	12	4.7	Vertical
Windshield header	Front center	11	4.3	Vertical
Door panel	Back left	9	3.5	Lateral
Door panel	Front left	9	3.5	Lateral
B-pillar	Front left	6	2.4	Lateral
Windshield header	Front right	5	2	Vertical
Roof side rail	Front left	2	0.8	Lateral
A-pillar	Front right	1	0.4	Vertical

Case Vehicle Occupant Protection Systems

The Mercury Tracer 4-door sedan was equipped with a redesigned air bag system which consisted of front left and front right air bag modules which housed air bags and depowered inflator units.

The front left air bag was housed in the steering wheel hub and was concealed by asymmetrical H-configuration cover flaps which were not damaged in the crash. The circular air bag was equipped with four tether straps and two vent ports. Contact evidence consisting of “black smears” and blood spots was found on the front of the bag. A small tear was also found on the upper left quadrant of the front of the bag possibly as a result of contact with glass from the



Figure 6. Driver's air bag damage

front left glazing.

The front right air bag was housed in the mid-instrument panel position and was concealed by a rectangular cover flap. The flap had partially split horizontally along a seam as the bag deployed, but did not become detached. The rectangular air bag was equipped with no tether straps and two vent ports. Contact evidence consisting of two blood spots was found on the front of the air bag. The bag was not damaged in the crash.



Figure 7. Passenger's air bag cover flap damage

Case Vehicle Occupant Demographics

Table 5. Case Vehicle Occupant(s) Demographics

	Occupant 1		Occupant 2		Occupant 3		Occupant 4		Occupant 5	
Age/Sex:	31/Female		31/Male		9 months/Male		12/Female		57/Female	
Seated Position:	Front left		Front right		Front right		Back left		Back right	
Seat Type:	Bucket - cloth covered		Bucket - cloth covered		Bucket - cloth covered		Bench - cloth covered		Bench - cloth covered	
Height (cm/in.):	163	64	190	75	51	20	158	62	158	62
Weight (kg/lbs):	68	150	84	185	10	22	50	110	86	190
Pre-existing Medical Condition:	None noted		None noted		None noted		None noted		None noted	
Body Posture:	Normal - upright in seat facing forward		Abnormal - had occupant 3 in lap		Abnormal - sitting in the lap of occupant 2		Normal - upright in seat facing forward		Normal - upright in seat facing forward	
Hand Position:	Both on steering wheel		Holding occupant 3		Unknown		Unknown		On lap	
Foot Position:	On floor or foot controls		On floor		Unknown		On floor		On floor	
Restraint Usage:	None used		None used		None used		None used		None used	
Air bag:	Deployed redesigned air bag system		Deployed redesigned air bag system		None		None		None	

Occupant Injuries

Table 6. Injuries

Occupant #	Injury	Injury Severity (AIS)	Injury Mechanism
1	Facial lacerations	1	Roof
1	Scalp lacerations	1	Roof
1	Left knee contusion	1	Knee bolster
2	Right elbow laceration	1	Right side window glass
2	Thoracic strain	1	Roof
3	Lower lip laceration	1	Air bag
4	Facial laceration	1	Roof
5	Unconscious <1 hour	2	Roof
5	Scalp laceration	1	Roof
5	Left shoulder contusion	1	Roof
5	Left upper arm contusion	1	Roof
5	Left lower leg contusion	1	R/F seat back

Occupant Kinematics

The driver of the Mercury Tracer was sitting in a normal upright posture in the front left position of the vehicle. Occupant 03 was sitting in the lap of occupant 02 in the front right position of the vehicle. Occupants 04 and 05 were sitting in normal upright postures in the back left and back right positions of the vehicle. None of the occupants were wearing seat belts at the time of the crash. The lack of belt usage was determined from contact evidence throughout the vehicle, observations by the investigating police officer at the scene of the crash, and statements by the driver in the interview. Prior to impact, the driver appears to have steered to the right but there was no indication of pre-impact braking.

At impact #1, the unrestrained occupants moved forward and to the left in response to the 340 degree principle direction of force. The driver struck the knee bolster with his left knee-causing the contusion. Occupant 03 came into contact with the deploying passenger's frontal air bag-causing the lower lip laceration. Occupant 05 moved forward and struck the back of the front right seat-causing the left lower leg contusion. As Vehicle 1 rolled over onto its roof, the occupants were thrown upward into the roof. Impact with the roof caused the facial and scalp lacerations to the driver. Occupant 02 sustained a thoracic strain. Occupant 04 sustained a facial laceration. Occupant 05 sustained contusions to the left shoulder and left upper arm. Impact with the right side window glass caused the right elbow laceration of occupant 02. All five occupants were transported from the scene to a trauma center where they were treated and released.

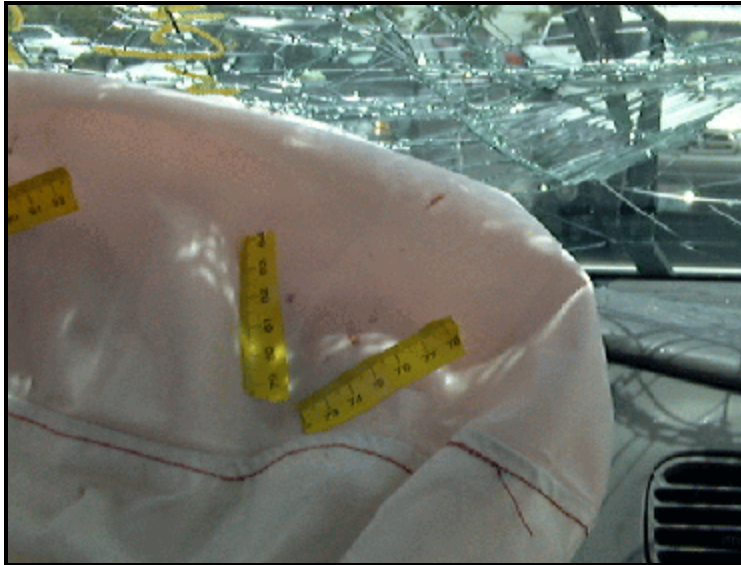


Figure 8. Driver's air bag contact evidence

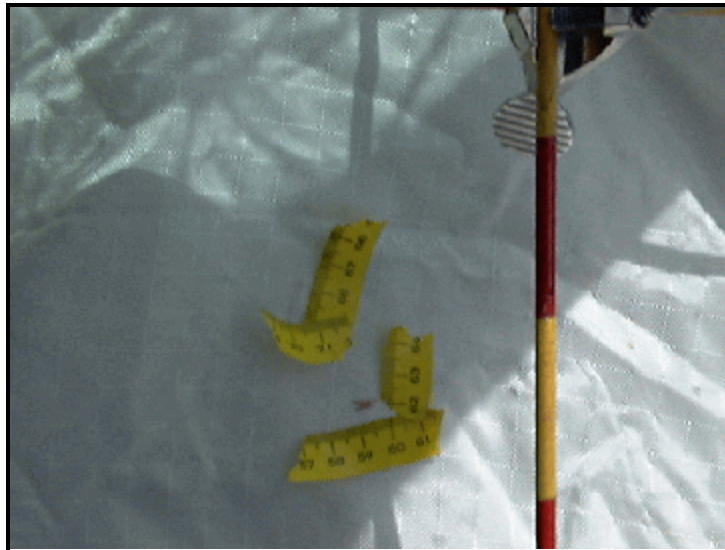


Figure 9. Passenger's air bag contact evidence

Scene Diagram

