Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (1999-75-110J)

1998 Ford Ranger & 1999 Mercury Tracer

Colorado

July/1999

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16. Abstract

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Ford Ranger pick up truck and a 1999 Mercury Tracer four-door sedan. This two vehicle obtuse front to front crash occurred during the early evening hours of July, 1999. This crash took place at a three-leg intersection in a suburban location and traffic volume was light/moderate. The bituminous roadway surface was travel worn, but dry and free of defects. The north leg of the intersection is an undivided two lane roadway that has an uphill grade (>2%). A posted stop sign controls traffic for this roadway. The adjoining east/westbound four lane roadway consisted of two westbound travel lanes and two eastbound travel lanes that are separated by double solid yellow (no passing) center lines. There are no traffic controls present for this roadway. Both roadways are bordered by curbing and the posted speed limit is 56 km/h (35 mph). Vehicle 1, a 1998 Ford Ranger pickup truck was driven by an 83 year-old-male (178 cm/ 70 in., 91 kg/201 lbs.) who was properly restrained by the available three-point manual lap and shoulder belt. Vehicle 1 was traveling southbound and the driver stopped at the intersection awaiting for traffic to clear. When the traffic appeared to be clear, Driver proceeded forward, in an attempt to turn left at the intersection. Vehicle 2, a 1999 Mercury Tracer four-door sedan, was being driven by a 53 year-old-male (180 cm/ 71 in., 104 kg/ 229 lbs.) who also was properly wearing the available three-point manual lap and shoulder belt. Driver 2 was proceeding westbound in lane 1 at a police reported speed of 56 km/h (35 mph). The front right corner of Vehicle 2 (01FREE7) impacted the front of Vehicle 1(70FDEW1-10 o'clock direction of force incremented 60 for endshift to the right). The frontal air bag systems in both vehicles deployed. The corner impact to Vehicle 2 (Mercury Tracer) violated an application of the WinSmash program, therefore, a Delta V could not be adequately derived. Vehicle 1 rotated clockwise approximately 18 degrees in clockwise direction before coming to rest facing south. Vehicle 2 continued in a forward trajectory and was deflected to the left. Vehicle 2 came to rest in the west leg of the intersection and was straddling the roadway centerlines. After Vehicle 1 (Ford Ranger) came to rest, the driver attempted to drive away from the crash scene. The front, right corner of Vehicle 1 subsequently impacted a retaining wall located on the south roadside. This secondary crash also altered the frontal crush profile of Vehicle 1 which further complicated an application of the WinSmash program. The 83 year-old-male driver of Vehicle 1 sustained an abrasion and contusion to his chin (AIS-1) due to contacting the deploying air bag. He also sustained a superficial laceration (AIS-1) to his tongue from the driver's air bag and a right forearm contusion (AIS-1). Driver 2 sustained a chest contusion, and a right forearm abrasion/contusion (AIS-1) to the ventral aspect due to contacting the deploying driver's air bag. He also sustained a right leg contusion from contacting the knee bolster. After the investigating police officer collected all of the pertinent information, two separate towing agencies removed the involved vehicles to their respective facilities.

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Summary

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Ford Ranger pick up truck and a 1999 Mercury Tracer four-door sedan. This two vehicle obtuse front to front crash occurred during the early evening hours of July, 1999. This crash took place at a three-leg intersection in a suburban location and traffic volume was light/moderate. The bituminous roadway surface was travel worn, but dry and free of defects. The north leg of the intersection is an undivided two lane roadway that has an uphill grade (>2%). A posted stop sign controls traffic for this roadway. The adjoining east/westbound four lane roadway consisted of two westbound travel lanes and two eastbound travel lanes that are separated by double solid yellow (no passing) center lines. There are no traffic controls present for this roadway. Both roadways are bordered by curbing and the posted speed limit is 56 km/h (35 mph).

Vehicle 1, a 1998 Ford Ranger pickup truck was driven by an 83 year-old-male (178 cm/ 70 in., 91 kg/201 lbs.) who was properly restrained by the available three-point manual lap and shoulder belt. Vehicle 1 was traveling southbound and the driver stopped at the intersection awaiting for traffic to clear. When the traffic appeared to be clear the driver proceeded forward in an attempt to turn left at the intersection.

Vehicle 2, a 1999 Mercury Tracer four-door sedan, was being driven by a 53 year-old-male (180 cm/ 71 in., 104 kg/ 229 lbs.) who also was properly wearing the available three-point manual lap and shoulder belt. Driver 2 was proceeding westbound in lane 1 at a police reported speed of 56 km/h (35 mph).

Figure 1. Vehicle 1's pre-impact trajectory showing point of impact and final rest

Figure 2. View showing Vehicle 2's point of impact and post-impact trajectory

Figure 3. Frontal damage to Vehicle 1 (Ford Ranger)

Crash Events

Figure 4. Front right corner damage to Vehicle 2 (Mercury Tracer)

The front right corner of Vehicle 2 (01FREE7) impacted the front of Vehicle 1 (70FDEW1-10 o'clock direction of force incremented 60 for endshift to the right[1]). The frontal air bag systems in both vehicles deployed. The corner impact to Vehicle 2 (Mercury Tracer) violated an application of the WinSmash program, therefore, a Delta V could not be adequately derived. Vehicle 1 rotated clockwise approximately 18 degrees in clockwise direction before coming to rest facing south. Vehicle 2 continued in a forward trajectory and was deflected to the left. Vehicle 2 came to rest in the west leg of the intersection and was straddling the roadway center lines.

After Vehicle 1 (Ford Ranger) came to rest, the driver attempted to drive away from the crash scene. The front, right corner of Vehicle 1 subsequently impacted a retaining wall located on the south roadside. This secondary crash also altered the frontal crush profile of Vehicle 1 which further complicated an application of the WinSmash program.

The 83 year-old-male driver of Vehicle 1 sustained an abrasion and contusion to his chin (AIS-1) due to contacting the deploying air bag. He also sustained a superficial laceration (AIS-1) to his tongue from the driver's air bag and a right forearm contusion (AIS-1).

The driver of Vehicle 2 sustained a chest contusion, and a right forearm abrasion/contusion (AIS-1) to the ventral aspect due to contacting the deploying driver's air bag. He also sustained a right leg contusion from contacting the knee bolster.

After the investigating police officer collected all of the pertinent information, two separate towing agencies removed the involved vehicles to their respective facilities.

[1]SCI altered CDC

Exterior of Case Vehicle's

Table 1. Vehicle Information

Model year, make and model	1998 Ford Ranger & 1999 Mercury Tracer
VIN	1FTZR11X9WP & 1MEFM10P6XW
CDC	70FDEW1 & 01FREE7

Table 2. Crush Measurements / Vehicle 1 (1998 Ford Ranger)

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.
Front Bumper	136	21	21	26	23	18	43
	53.5	8.3	8.3	10.2	9.1	7.1	16.9

Note: The above crush profile is inadequate for a Delta V determination due to overlapping damage from two separate crashes.

Table 3. Crush Measurements / Vehicle 2 (1999 Mercury Tracer)

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.
Front Bumper	139	3	2	2	2	2	18
	54.7	1.2	.8	.8	.8	.8	7.1

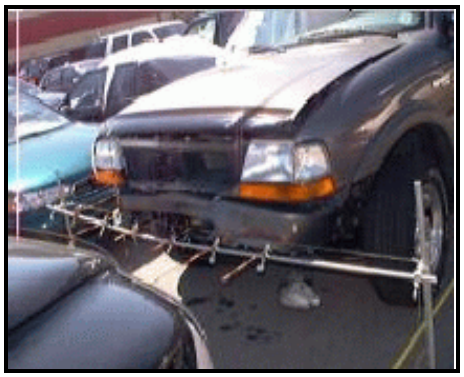

Figure 5. Front of Vehicle 1

Figure 6. Front right corner damage to Vehicle 2

Interior of Case Vehicle 1 (1998 Ford Ranger)

The interior of 1998 Ford Ranger pickup truck was undamaged as a result of the minor/moderate frontal impacts. The Ford Ranger maintained its integrity and there were no intruding components. The interior was void of any detectable occupant contact evidence. This vehicle is equipped with a split bench seat that has integral head restraints located at the outboard positions. The split bench folds forward so that access can be obtained to the small cargo space behind the seat. The front, left seat track was adjusted to the middle track position while the center and front, right positions were adjusted to the rearmost seat track position.

Interior of Case Vehicle 2 (1999 Mercury Tracer)

The interior of the 1999 Mercury Tracer sustained minor windshield damage that was associated with the deployed passenger air bag module cover flap. There were no intruding components and the vehicle maintained its integrity. There were no detectable areas of occupant contacts that were identified. The Tracer is equipped with front bucket seats that have adjustable head restraints while the second row is equipped with a bench seat. Both front seats were adjusted to their rearmost seat track position.

Case Vehicle Occupant Protection Systems (1998 Ford Ranger)

The 1998 Ford Ranger was equipped with the redesigned air bag systems. This system consists of a RCM (restraints control module) that is located at the front, right firewall region. The RCM sensor signals the inflators to deploy the air bags in the event of a deployable crash. The RCM is equipped with a safing sensor that communicates with the main module sensor to determine that deployment is required. The RCM includes a backup power supply that will provide sufficient backup power to deploy the air bags in the event of ignition circuit damage sustained in a crash before the safing sensor and air bag sensors determine that deployment is necessary. In addition, the RCM detects faults in the system and will illuminate the air bag indicator lamp located in the instrument cluster. If a fault in the system exists, then the lamp indicator will flash a two-digit lamp fault code (LFC). This system also comes with a passenger air bag deactivation (PAD) switch. This switch is located on the left hand side of the instrument panel, adjacent to the ash tray. The PAD switch allows the passenger air bag deployment circuit to be disabled utilizing the ignition key. The deactivation switch should be used whenever a child safety seat is being used in the front passenger seating position.

Figure 7. Driver's front air bag, Vehicle 1

Figure 8. Passenger front air bag, Vehicle 1

The driver's air bag is housed in the steering wheel hub and encases the nylon air bag unit. The double, horizontal module cover flaps are asymmetric in design and opened at their designated tear points. The circular air bag is tethered by one strap and equipped with two exhaust vent port holes that are located at the 11 and 1 o'clock positions respectively. The rigid plastic knee bolster was undamaged and did not reveal any detectable occupant contacts.

The front, right passenger air bag is located in the right hand side of the instrument panel (mid-mount). The single module deployment door is rectangular in shape and opened at its designated tear points. Upon deployment, the encased air bag fully deployed. The non-tethered air bag was undamaged and was equipped with two exhaust vent port holes.

Figure 9. View showing deployed driver's air bag, Vehicle 2

Case Vehicle Occupant Protection Systems (1999 Mercury Tracer)

The 1999 Mercury Tracer four-door sedan was equipped with redesigned air bag systems which consisted of a single, centrally located (fire wall mounted) electric crash sensor (ECS). Among other functions, the ECS signals the inflators to deploy in the event of a deployable crash. An air bag warning lamp is located in the front, left instrument panel area. There is an air bag module located in the front, left steering wheel hub and front right instrument panel (mid mount).

The driver's air bag is housed in the steering wheel hub and encases the nylon air bag, inflator unit, mounting plate, retainer ring and the air bag sliding contact. These components are concealed by the steering wheel trim cover which is equipped with standard horizontal tear seams. The circular air bag was tethered by two straps and two exhaust vent ports are present.

Figure 10. Passenger front air bag, Vehicle 2

The front, right passenger air bag was located on the instrument panel (mid-mount type). The module deployment door is rectangular in shape and was equipped with a tear seam that is designed to allow the door to hinge outward during deployment. The inflator unit is supported by a metal reaction housing unit. There was no residual damage to the air bag and the module cover deployment door opened at the designated tear point. The deployment door cover opened with enough force to break the laminated windshield glazing.

Case Vehicle Occupant Demographics

Vehicle 1 (1998 Ford Ranger Pickup)

	Occupant 1	
Age/Sex:	83/Male	
Seated Position:	Front, Left	
Seat Type:	Split bench	
Height (cm/in:):	178	70.08
Weight (kg/lbs).:	91	200.6
Pre-existing Medical Condition:	History significant for hypertension, intermittent arterial fibrillation, hernia operation	
Body Posture:	Upright facing forward	
Hand Position:	Both hands on steering wheel rim with the left hand at the 10 o'clock position and the right hand at the 2 o'clock position.	
Foot Position:	Left foot on floor, right foot on accelerator pedal	
Restraint Usage:	Manual, three-point lap and shoulder belt. worn in a normal fashion with the lap belt extending across his hips and shoulder belt extending across his chest.	
Air bag:	Driver's air bag deployed as a result of the frontal impact.	

Vehicle 2 (1999 Mercury Tracer)

	Occupant 1	
Age/Sex:	53/Male	
Seated Position:	Front, Left	
Seat Type:	Bucket	
Height (cm/in.):	180	70.87
Weight (kg/Lbs.):	104	229.28
Pre-existing Medical Condition:	Significant history of organic heart disease. History of prior myocardial infarction and coronary artery bypass surgery. History of hypertension, hypercholesterolemia, gastroesophageal reflux, chronic obstructive pulmonary disease, past hernia operation and also had a cholecystectomy.	
Body Posture:	Sitting upright and facing forward	
Hand Position:	Left hand on steering wheel rim (unknown position). Right hand holding cigarette.	
Foot Position:	Right foot on accelerator pedal and left foot on floor.	
Restraint Usage:	Manual, three-point lap and shoulder belt worn in a normal fashion with the lap belt extending across his hips and shoulder belt extending across his chest.	
Air bag:	Driver's air bag deployed as a result of the frontal impact	

Occupant Injuries

Driver, Vehicle 1, 1998 Ford Ranger

Table 4. Injuries

Injury	Injury Severity (AIS)	Injury Mechanism
Chin contusion	1	Air Bag
Chin abrasion	1	Air bag
Tongue laceration	1	Air bag
Right forearm contusion	1	Air bag

Occupant Injuries

Driver, Vehicle 2, 1999 Mercury Tracer

Table 5. Injuries

Injury	Injury Severity (AIS)	Injury Mechanism
Central chest contusion	1	Air bag
Right forearm abrasion (ventral aspect)	1	Air bag
Right forearm contusion (ventral aspect)	1	Air bag
Left lower leg abrasion	1	Knee bolster

Occupant Kinematics

Vehicle 1

The 83 year-old-male driver of the 1998 Ford Ranger was fully restrained and responded to the 300 principle direction of force by moving to his left and forward. He loaded the applied lap belt webbing which prohibited extended forward movement of his lower torso. His upper torso engaged the applied shoulder belt webbing at the approximate time frame that the driver's air bag deployed. His face/head pitched both forward and downward impacting the air bag fabric. Driver 1 sustained a chin abrasion/contusion (AIS-1) due to contacting the air bag. It appears that he bit his tongue as a result of his air bag interaction. The driver also sustained a right forearm contusion upon air bag deployment. The driver rebounded into the seatback support which did not result in further injury. He apparently remained there for an undetermined time period and then he attempted to flee the crash scene in the pickup truck. As he depressed the accelerator pedal, the case vehicle thrust forward mounting the curb and overriding the sidewalk. The front right corner of the pickup truck impacted a retaining wall.. He probably responded to this secondary corner impact by moving forward and to his right. The applied lap and shoulder belt maintained him in his respective seated position and he did not sustain any further injuries.

Vehicle 2

The 53 year-old-male driver of the 1999 Mercury Tracer was fully restrained by the available three-point manual lap and shoulder belt. He responded to the 1 o'clock impact force by moving forward and slightly to his right. He loaded the lap and shoulder belt webbing which restricted extended forward movement of his upper and lower torso. His right forearm (ventral aspect) sustained an abrasion and contusion when the driver's air bag deployed. Driver 2's chest contacted the air bag which resulted in a chest wall contusion (AIS-1). Apparently his left lower leg flailed upward contacting the lower portion of the knee bolster which resulted in an area of contusion (AIS-1). The driver rebounded into his respective seatback where he came to rest.

Scene Diagram