

Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number ( 1999-79-031C)

1998 Toyota Tacoma pickup

California

March/1999

1. Report No. 1999-79-031C		2. Government Accession No.		3. Recipient Catalog No.	
4. Title and Subtitle				5. Report Date May 10, 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					
16. Abstract <p>This remote investigation focused on the redesigned air bag system deployment of a 1998 Toyota Tacoma 4 x2 regular cab pickup truck. This severe crash occurred in March, 1999 in the early morning. The weather was clear and the concrete roadway was dry and free of defects. The crash occurred on a six-lane, divided interstate highway. The speed limit is 105 km/h (65 mph).</p> <p>Vehicle 1, a 1998 Toyota Tacoma 4 x2 regular cab pickup truck driven by an restrained 22-year-old female (168 cm/66 in., 85 kg/187 lbs.), was traveling southbound in the #3 lane of the six-lane roadway at a driver reported speed of 80-88 km/h (50-55 mph). The front right seat was occupied by an restrained 31-year-old male (175 cm/69 in., 73 kg/161 lbs.). Vehicle 2, a 1985 Ford Thunderbird two-door sedan driven by a 61-year-old male (178 cm/70 in., 79 kg/174 lbs.), was traveling southbound behind Vehicle 1 in the #1 lane at a driver reported speed of 88 km/h (55 mph). There were no other occupants in Vehicle 2. The driver of Vehicle 1 intended to change lanes to the right. She looked to the right to see if it was clear. By the time she looked back, traffic in front of her was coming to a stop. The driver of Vehicle 1 braked hard and steered to the right. Vehicle 1 went out of control and began a clockwise rotation. Vehicle 1 crossed the lane line to the right and had rotated approximately 120 degrees so that its front end was facing northwest. The driver of Vehicle 2 saw Vehicle 1 go out of control. The driver began braking but was unable to stop in time. The front of Vehicle 2 (12FDEW2) struck the front of Vehicle 1 (81FZEW3). Vehicle 1 sustained a longitudinal delta v of -27 km/h (-17 mph). As a result of the frontal impact, the supplemental restraint system (driver's and passenger's frontal redesigned air bags) of the case vehicle deployed. Vehicle 1 came to rest on the west shoulder facing east. Vehicle 2 came to rest on the west shoulder facing northwest. Both vehicles were towed from the scene due to damage.</p> <p>The police found the driver of Vehicle 1 seated in the vehicle with the door open. She was removed from the vehicle by EMS personnel. According to the police report and the driver interview, she had sustained a deep cut to the right eyebrow, a 15 cm (6 in.) burn to the left side of the neck, 2.5-5 cm (1-2 in.) bruising along abdomen, a fractured left lateral malleolus, and a fractured right lower tibia. She was transported by ambulance to a local trauma center. She was hospitalized for 7 days and lost 43 days of work. The front right occupant of Vehicle 1 was able to exit the vehicle on his own. According to the driver interview, he had sustained a contusion to his abdomen, some internal bruising to the left lower rib area, and an abrasion to the left knee. He also complained of pain to his chest. He was transported to a local trauma center where he was treated and released. He lost 3 days of work. The driver of Vehicle 2 was able to exit his vehicle on his own. According to the driver interview, he sustained a contusion to the right knee and a scratch to his left hand. He also complained of pain to his chest.</p>					
17. Key Words Redesigned, air bag, unbelted occupants, moderate injuries			18. Distribution Statement		
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No of pages	22. Price		

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***Summary***

This remote investigation focused on the redesigned air bag system deployment of a 1998 Toyota Tacoma 4 x2 regular cab pickup truck. This severe crash occurred in March, 1999 in the early morning. The weather was clear and the concrete roadway was dry and free of defects. The crash occurred on a six-lane, divided interstate highway. The speed limit is 105 km/h (65 mph).

Vehicle 1, a 1998 Toyota Tacoma 4 x2 regular cab pickup truck driven by a restrained 22-year-old female (168 cm/66 in., 85 kg/187 lbs.), was traveling southbound in the #3 lane of the six-lane roadway at a driver reported speed of 80-88 km/h (50-55 mph). The front right seat was occupied by a restrained 31-year-old male (175 cm/69 in., 73 kg/161 lbs.).

Vehicle 2, a 1985 Ford Thunderbird two-door sedan driven by a 61-year-old male (178 cm/70 in., 79 kg/174 lbs.), was traveling southbound behind Vehicle 1 in the #1 lane at a driver reported speed of 88 km/h (55 mph). There were no other occupants in Vehicle 2.

***Crash Events***

The driver of Vehicle 1 intended to change lanes to the right. She looked to the right to see if it was clear. By the time she looked back, traffic in front of her was coming to a stop. The driver of Vehicle 1 braked hard and steered to the right. Vehicle 1 went out of control and began a clockwise rotation. Vehicle 1 crossed the lane line to the right and had rotated approximately 120 degrees so that its front end was facing northwest. The driver of Vehicle 2 saw Vehicle 1 go out of control. The driver began braking but was unable to stop in time. The front of Vehicle 2 (12FDEW2) struck the front of Vehicle 1 (81FZEW3). Vehicle 1 sustained a longitudinal delta v of -27 km/h (-17 mph). As a result of the frontal impact, the supplemental restraint system (driver's and passenger's frontal redesigned air bags) of the case vehicle deployed. Vehicle 1 came to rest on the



**Figure 1.** Front view, Vehicle 1 (case vehicle), Toyota Tacoma



**Figure 2.** Front left view, Vehicle 2, Ford Thunderbird

west shoulder facing east. Vehicle 2 came to rest on the west shoulder facing northwest. Both vehicles were towed from the scene due to damage.

The police found the driver of Vehicle 1 seated in the vehicle with the door open. She was removed from the vehicle by EMS personnel. According to the police report and the driver interview, she had sustained a deep cut to the right eyebrow, a 15 cm (6 in.) burn to the left side of the neck, 2.5-5 cm (1-2 in.) bruising along abdomen, a fractured left lateral malleolus, and a fractured right lower tibia. She was transported by ambulance to a local trauma center. She was hospitalized for 7 days and lost 43 days of work. The front right occupant of Vehicle 1 was able to exit the vehicle on his own. According to the driver interview, he had sustained a contusion to his abdomen, some internal bruising to the left lower rib area, and an abrasion to the left knee. He also complained of pain to his chest. He was transported to a local trauma center where he was treated and released. He lost 3 days of work.

The driver of Vehicle 2 was able to exit his vehicle on his own. According to the driver interview, he sustained a contusion to the right knee and a scratch to his left hand. He also complained of pain to his chest.

**Table 1. Delta V**

	Case Vehicle		Other Vehicle	
	km/h	mph	km/h	mph
Total	35	21.7	30.2	18.8
Longitudinal	-26.8	-16.7	-30.2	-18.8
Lateral	-22.5	-14	0	0

**Exterior of Case Vehicle**

**Table 2. Vehicle Information**

Model year, make and model	1998 Toyota Tacoma 4 x 2 regular cab pickup
VIN	4TANL42N1WZxxxxxx
CDC	81FZEW3



**Figure 3.** Front left view, Vehicle 1



**Figure 4.** Left side, Vehicle 1

**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.
Bumper	158	48	27	30	31	30	37
	62.2	18.9	10.6	11.8	12.2	11.8	14.6

***Interior of Case Vehicle***

The interior of the Toyota Tacoma sustained moderate damage from occupant contacts. The mirror had been displaced and the upper steering wheel rim was deformed 3 cm forward. There were knee contact deformations to both sides of the left instrument panel. The brake pedal had been deformed by the driver's right foot. On the passenger side there were bilateral contacts to the right instrument panel as a result of interaction with the front right passenger's knees.

The case vehicle was equipped with a tilt-forward cloth bench seat that had been adjusted to between the forward most and middle track position. The bench seat was equipped with integral headrests at the outboard positions.

The case vehicle did not sustain any intrusion or integrity loss.



**Figure 5.** Driver's seated position



**Figure 6.** Passenger's seated position



### *Case Vehicle Occupant Protection Systems*

The Toyota Tacoma 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 H-configuration cover flaps that were not damaged. The circular air bag was equipped with four tethers and two vent holes. No contact evidence was found on the air bag and the air bag was not damaged.

The front right air bag was housed in the mid instrument panel. The air bag was equipped with two vent ports, but did not come equipped with tethers. Neither the air bag nor the module covers were damaged. The passenger air bag had a shut off switch; the switch was in the "ON" position.



**Figure 7.** Driver's frontal air bag



**Figure 8.** Passenger's frontal air bag

## Case Vehicle Occupant Demographics

	Occupant 1	Occupant 2
Age/Sex:	22/Female	31/Male
Seated Position:	Front left	Front right
Seat Type:	Tilt-forward cloth bench seat. Seat between forward most and middle track position.	Tilt-forward cloth bench seat. Seat between forward most and middle track position.
Height (cm/in.):	168 66	175 68.9
Weight (kg/lbs):	85 187	73 161
Pre-existing Medical Condition:	Unknown	Unknown
Body Posture:	Normal, upright	Normal, upright
Hand Position:	Both hands were on the steering wheel—the position is not known	Interviewee indicated that one arm (presumably the right) was out the window
Foot Position:	Right foot was on brake, left on floorboard	Unknown
Restraint Usage:	Lap and shoulder belt used	Lap and shoulder belt used
Air bag:	Deployed	Deployed

## Occupant Injuries

**Table 4. Injuries (Occupant #1)**

Injury	Injury Severity (AIS)	Injury Mechanism
Lateral malleous fracture, left	2	Clutch pedal
Comminuted fracture right lower tibia	3	Brake pedal
Laceration, right eyebrow	1	Unknown
Abrasion, left side of neck	1	Seat belt
Contusion, abdomen	1	Seat belt

**Table 5. Injuries (Occupant #2)**

Injury	Injury Severity (AIS)	Injury Mechanism
Contusion, abdomen	1	Seat belt
Contusions, left lower rib area	1	Unknown
Abrasion, left knee	1	Lower instrument panel

## *Occupant Kinematics*

Both occupants were initially seated in a normal, upright fashion. Both were using the available lap and shoulder belts and both were wearing sunglasses. The driver had both hands on the steering wheel; the right foot was on the brake. As the driver began to take evasive maneuvers (braking and steering sharply), and the vehicle went into rotation, both occupants would have loaded their seat belts to some degree and would also have been leaning to left. At impact, both occupants reacted to the 40 degree principal force direction by pitching forward and to the left and then loading the seat belt—causing the “seat-belt” injuries to both occupants (the abdominal contusion and neck abrasion for the driver, and the abdominal contusion for the passenger). The driver’s right foot deformed the brake pedal and likely slipped off, causing the tibia fracture as it twisted. The driver’s left foot may have become involved with the clutch pedal, but it appears more likely that the foot was on the floorboard and the loading forces caused the left lateral malleous fracture.



**Figure 9.** Contacts to left lower instrument panel and deformation of brake pedal



**Figure 10.** Contacts to right instrument panel



Scene Diagram

