

Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (1998-049-807E)

1998 Saturn SL 4-door sedan

Texas

September, 1998

Technical Report Documentation Page

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<p>16. Abstract</p> <p>This remote investigation focused on the redesigned air bag system deployment of a 1998 Saturn SL 4-door sedan. This minor injury crash occurred in September, 1998 in the evening. The weather was clear and the bituminous roadway was dry. The road was lighted by street lights. The crash occurred in a four legged intersection. The southbound leg of the intersection is a two-way divided roadway and is comprised of seven travel lanes; three southbound lanes, one southbound left-turn lane, and three northbound lanes. The southbound lanes are separated from the northbound lanes by a raised concrete median. The speed limit for this road is 56 kmph (35 mph). It is controlled by overhead traffic signals. The road is level at this location. The eastbound leg of the intersection is comprised of seven travel lanes; three eastbound lanes, one eastbound left-turn lane, and three westbound lanes. The eastbound lanes are separated from the westbound lanes by a raised concrete median. The speed limit is 56 kmph (35 mph) for this road. It is controlled by overhead traffic signals. The slope is not known for this road. Vehicle 1, a 1998 Saturn SL 4-door sedan (case vehicle) driven by a 20 year old male (152 cm/60 in, 64 kg/141 lbs), was traveling south, in the southbound left-turn lane, approaching the intersection at an unknown speed, preparing to make a left turn at the intersection. The driver was unrestrained. There were no other occupants in the vehicle. Vehicle 2, a 1989 Mercury Grand Marquis 4-door sedan driven by a 28 year old female, was traveling north, in northbound lane three, approaching the intersection at a driver estimated speed of 72 kmph (45 mph), preparing to travel straight through the intersection. It is unknown if the driver was restrained. There were no other occupants in the vehicle. The driver of Vehicle 1 attempted a left turn at the intersection on a solid green traffic signal as Vehicle 2 approached from the opposite direction, also on a solid green traffic signal. The driver of Vehicle 1 failed to yield the right-of-way and entered the path of Vehicle 2. The front plane of Vehicle 1 (01FZEW2) struck the front plane of Vehicle 2 (12FYEW2) in the intersection. A Delta V was calculated for both vehicles, using WinSMASH, to be 32 kmph (20 mph) for Vehicle 1, and 21 kmph (13 mph) for Vehicle 2. As a result of the frontal impact, the supplemental restraint system (driver and passenger side redesigned air bags) of the case vehicle deployed. The impact caused Vehicle 1 to spin counter-clockwise approximately 140 degrees and come to rest in the northern end of the intersection facing north. Vehicle 2 rotated clockwise approximately 10 degrees after impact and came to rest near the center of the intersection facing northeast. The driver of Vehicle 1 sustained non-incapacitating injuries in the crash consisting of a fracture of the proximal phalange of the third digit of the left hand; maximum AIS equal to AIS-1. He was transported by land to a trauma center where he was treated and released. The driver of Vehicle 2 reportedly sustained non-incapacitating injuries of an unknown nature and severity. She was transported by land to a trauma center where her course of treatment is not known.</p>			
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Summary

This remote investigation focused on the redesigned air bag system deployment of a 1998 Saturn SL 4-door sedan. This minor injury crash occurred in September, 1998 in the evening. The weather was clear and the bituminous roadway was dry. The road was lighted by street lights. The crash occurred in a four legged intersection. The southbound leg of the intersection is a two-way divided roadway and is comprised of seven travel lanes; three southbound lanes, one southbound left-turn lane, and three northbound lanes. The southbound lanes are separated from the northbound lanes by a raised concrete median. The speed limit for this road is 56 kmph (35 mph). It is controlled by overhead traffic signals. The road is level at this location. The eastbound leg of the intersection is comprised of seven travel lanes; three eastbound lanes, one eastbound left-turn lane, and three westbound lanes. The eastbound lanes are separated from the westbound lanes by a raised concrete median. The speed limit is 56 kmph (35 mph) for this road. It is controlled by overhead traffic signals. The slope is not known for this road.

Vehicle 1, a 1998 Saturn SL 4-door sedan (case vehicle) driven by a 20 year old male (152 cm/60 in, 64 kg/141 lbs), was traveling south, in the southbound left-turn lane, approaching the intersection at an unknown speed, preparing to make a left turn at the intersection. The driver was unrestrained. There were no other occupants in the vehicle.

Vehicle 2, a 1989 Mercury Grand Marquis 4-door sedan driven by a 28 year old female, was traveling north, in northbound lane three, approaching the intersection at a driver estimated speed of 72 kmph (45 mph), preparing to



Figure 1. Exterior, Vehicle 1(Saturn SL)



Figure 2. Exterior, Vehicle 2 (Mercury Grand Marquis)

travel straight through the intersection. It is unknown if the driver was restrained. There were no other occupants in the vehicle.

Crash Events

The driver of Vehicle 1 attempted a left turn at the intersection on a solid green traffic signal as Vehicle 2 approached from the opposite direction, also on a solid green traffic signal. The driver of Vehicle 1 failed to yield the right-of-way and entered the path of Vehicle 2. The front plane of Vehicle 1 (01FZEW2) struck the front plane of Vehicle 2 (12FYEW2) in the intersection.

A Delta V was calculated for both vehicles, using WinSMASH, to be 32 kmph (20 mph) for Vehicle 1, and 21 kmph (13 mph) for Vehicle 2.

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

The impact caused Vehicle 1 to spin counter-clockwise approximately 140 degrees and come to rest in the northern end of the intersection facing north. Vehicle 2 rotated clockwise approximately 10 degrees after impact and came to rest near the center of the intersection facing northeast.

The driver of Vehicle 1 sustained non-incapacitating injuries in the crash consisting of a fracture of the proximal phalange of the third digit of the left hand; maximum AIS equal to AIS-1. He was transported by land to a trauma center where he was treated and released.

The driver of Vehicle 2 reportedly sustained non-incapacitating injuries of an unknown nature and severity. She was transported by land to a trauma center where her course of treatment is not known.

Both vehicles became 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	31.7	19.7	20.8	12.9
Longitudinal	-27.5	-17.1	-20.5	-12.7
Lateral	-15.9	-9.9	3.6	2.2
Barrier speed	19	11.8	33	20.5

Exterior of Case Vehicle

Table 2. Vehicle Information

Model year, make and model	1998 Saturn SL 4-door sedan
VIN	1G8ZK5274WZ
CDC	01FZEW2



Figure 3. Exterior, Vehicle 1 (1998 Saturn SL 4-door sedan)



Figure 4. Exterior, Vehicle 1 (1998 Saturn SL 4-door sedan)

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	106	0	3	10	16	20	27
	41.7	0	1.2	3.9	6.3	7.9	10.6

Interior of Case Vehicle

The interior of the Saturn SL was not damaged from occupant contact. There were no areas of intrusion into the passenger compartment. The only occupant contact evidence present in the vehicle was to the driver side air bag.

The case vehicle was equipped with bucket seats in the front left and front right seating positions. Both front seats were adjusted between the middle and rear most track positions. Both front seats were equipped with adjustable head restraints which were not damaged in the crash. The rear of the vehicle was equipped with bench seats with folding back(s) in all three seating positions. There were no head restraints for these seats.

Case Vehicle Occupant Protection Systems

The Saturn SL 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 symmetrical I-configuration cover flaps. The circular air bag was equipped with four tether straps and two vent ports and was not damaged in the crash. Smudges were found in various locations of the front of the bag indicative of occupant contact.

The front right air bag was housed in the mid-instrument panel position. The single air bag module cover flap was in the shape of an inverted “D”. The rectangular air bag showed no evidence of occupant contact and was not damaged in the crash.



Figure 5. Interior, case vehicle. Driver's side air bag.



Figure 6. Interior, case vehicle. Driver's side air bag flaps.

Case Vehicle Occupant Demographics

Table 4. Case Vehicle Occupant(s) Demographics

	Occupant 1
Age/Sex:	20/Male
Seated Position:	Front left
Seat Type:	Bucket - cloth covered
Height (cm/in.):	152 60
Weight (kg/lbs.):	64 141
Pre-existing Medical Condition:	None noted
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Right presumed to be on the accelerator
Restraint Usage:	None used
Air bag:	Deployed redesigned air bag system

Occupant Injuries

Table 5. Injuries

Injury	Injury Severity (AIS)	Injury Mechanism
Fracture of the proximal phalange of the third digit of the left hand.	1	Air bag

Occupant Kinematics

The driver of the Saturn SL was in a presumed upright posture in the front left position of the vehicle. He was not wearing the manual lap/shoulder restraint. The lack of belt usage was determined by visual inspection by the researcher. Pre-impact avoidance maneuvers are not known. There was no evidence of pre-impact braking.

At impact, the unrestrained driver initiated a forward trajectory in response to the frontal impact force. He engaged the deploying air bag with his face and chest. The air bag prevented the driver from striking the steering wheel, windshield, and instrument panel and prevented serious injuries. The driver's left hand was contacted by the deploying air bag-causing the fracture of the proximal phalange of the third digit. Several areas of smudges were found on the air bag from contact with the driver. There was no other evidence of substantial occupant contact in the vehicle.



Figure 7. Interior, case vehicle.



Figure 8. Interior, case vehicle.

