INDIANA UNIVERSITY
TRANSPORTATION RESEARCH CENTER
School of Public and Environmental Affairs
222West Second Street
Bloomington, Indiana 47403-1501
(812) 855-3908 Fax: (812) 855-3537

REMOTE AIR BAG DEPLOYMENT REPORT

CASE NUMBER - IN99-110
LOCATION - ILLINOIS
VEHICLE - 1998 SATURN SW2 WAGON
CRASH DATE - October 1998

Submitted:

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National Highway Traffic Safety Administration
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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 be 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.

Technical Report Documentation Page

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15. *Supplementary Notes*
Remote redesigned air bag report involving a 1998 Saturn SW2 Wagon, equipped with manual safety belts and dual, redesigned front air bags, a 1995 White GMC truck tractor pulling a semi-trailer, a 1994 Chevrolet Caprice Classic, and a 1997 Chevrolet Camaro Sport Coupe

16. *Abstract*

This report covers a remote investigation of an air bag deployment crash that involved a 1998 Saturn SW2 Wagon (case vehicle), a 1995 White-GMC truck tractor pulling a semi-trailer, a 1994 Chevrolet Caprice Classic, and a 1997 Chevrolet Camaro Sport Coupe. This crash is of special interest because the Saturn was equipped with redesigned air bags that deployed as a result of the collision events, and the restrained front right passenger (76-year-old male) sustained fatal cervical injuries. The restrained driver (74-year-old female) sustained police-reported "B" (non-incapacitating) injuries. The Saturn, the White-GMC, the Caprice, and the Camaro were all traveling west in the third westbound through lane of a seven-lane (six through lanes and a deceleration lane) roadway that was part of a 14-lane, divided, urban interstate trafficway. All of the collision events occurred in the third westbound through lane. The Saturn began slowing for traffic at the beginning of a construction zone and the White-GMC braked but was unable to avoid striking the Saturn's back plane. The front of the Saturn then struck the back of the Caprice, causing the Saturn's driver and front right passenger air bags to deploy. The Caprice's front left struck the back left of the Camaro. The Saturn's front right passenger was initially forced rearward, into his seat back, in response to the first impact. Almost instantly, he lurched forward in response to the second impact. This rapid back-and-forth motion probably caused hyperflexion of his neck and he sustained subluxation of cervical vertebrae C5-C6. The passenger contacted his deploying air bag, sustaining edematous conjunctivae, a forehead abrasion, and an abraded right parietal scalp. He was transported from the scene by ambulance to a medical facility. He was admitted to the hospital and died 32 hours and 50 minutes post-crash.

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BACKGROUND

This case was brought to the NHTSA's attention by a review of the 1998 Fatality Analysis Reporting System (FARS) in June 1999. The crash involved a 1998 Saturn SW2 station wagon (case vehicle), a 1995 White-GMC truck tractor pulling a semi-trailer (1st other vehicle), a 1994 Chevrolet Caprice Classic (2nd other vehicle), and a 1997 Chevrolet Camaro Sport Coupe (3rd other vehicle). The crash occurred in October 1998, at 11:35 p.m., in Illinois, and was investigated by the applicable state police agency. This case is of special interest because the Saturn was equipped with redesigned air bags that deployed as a result of the collision events and the restrained front right passenger (76-year-old male) sustained fatal cervical injuries. The Saturn's restrained driver (74-year-old female) sustained police-reported "B" (evident, non-incapacitating) injuries. The Police Crash Report was received in December 1999, the Medical Examiner's report of a non-invasive death examination was received in March 2000 and attorney-provided photographs were received in August 2000. This report is based on the Police Crash Report, attorney-provided photographs, the Medical Examiner's report, occupant kinematic principles, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

Figure 1: Westbound approach view for the Saturn, the White-GMC, the Caprice, and the Camaro; Note: the vehicle in the lower left corner is traveling in the third through lane (case photo #01)

The Saturn, the White-GMC, the Caprice, and the Camaro were all traveling west in the third westbound through lane of a seven-lane (six through lanes plus a deceleration lane) roadway that was part of a 14-lane, divided, urban interstate trafficway (**Figure 1**). The Camaro was farthest ahead, followed by the Caprice, the Saturn and the White-GMC, in that order. It was dark, lighted, the weather was clear, and no vision obstructions were noted. The roadway was concrete, dry, straight, level, and free of defects. Pavement markings visible in photographs were a single solid white (north) edge line and single broken white lane lines separating travel lanes. The posted speed limit is not known. Traffic density was estimated by police as medium-to-heavy because of road construction. The Caprice and the Camaro had slowed or stopped because of construction activity ahead.

The crash occurred on the roadway. The Saturn began to slow for traffic ahead and the White-GMC braked but was unable to avoid striking the Saturn. The back of the Saturn was impacted by the front of the White-GMC. The Saturn was pushed forward by the first impact and its front struck the back of the Caprice, causing the Saturn's driver and front right passenger air bags to deploy. The Caprice veered left, then right and the front left area of the Caprice struck the back left corner of the Camaro. The Police Crash Report diagram indicated that the Saturn and the White-GMC came to rest in their original travel lane, heading west. The Caprice came to rest heading northwest, diagonally across its travel lane. The Camaro is depicted as rotating less than five degrees counterclockwise and coming to rest heading west. The entire three-impact crash sequence occurred in the third westbound through lane.

The case vehicle was a front wheel drive, 1998 Saturn SW2 five-passenger, five-door station wagon (VIN: 1G8ZK5277WZ------) equipped with a 1.9 liter I-4 gasoline engine and a four-speed automatic transmission with a console-mounted shift lever. Four-wheel anti-lock brakes were an option for this vehicle, but it is not known if the case vehicle was so equipped. The case vehicle's wheelbase was 260 centimeters [102.4 inches]. No odometer reading was reported. The case vehicle was towed from the crash scene due to disabling damage.

Figure 2: Saturn's back plane damage; Note: left D-pillar pushed inside left C-pillar (case photo #02)

The Saturn sustained heavy underride damage across almost the entire back plane from the first impact (**Figure 2**). The back bumper fascia was torn off. The back left of the bumper reinforcement bar was pushed forward slightly more than the back right corner, with rear-to-front scratching on the top of the bar. The lower lip of the cargo area was displaced forward, as was the back left quarterpanel and everything but the sheet metal of the right rear quarterpanel. The left and right upper D-pillars were pushed forward. Visible induce damage to the Saturn included: the back roof rail pushed forward to the C-pillar, the back door glazing missing, the left roof rail buckled near the B-pillar, the left rear door panel buckled, and the left rear door glazing missing. A CDC for the Saturn's first impact in this crash sequence was estimated from photographs as **06-BDEW-5 (190)**. The WinSMASH reconstruction program was used to estimate Barrier Equivalent Speed (BES) based on the Saturn's CDC for the back plane impact. The result indicates a BES of 40 km.p.h. [25 m.p.h.]. This is a border line reconstruction, but the results appear reasonable. The crash severity for the Saturn from the first impact was on the high side of moderate (24-40 km.p.h. [15-25 m.p.h.]).

Photographs showing the Saturn's frontal damage from the second impact were not available. A CDC for the back plane damage on the Caprice, caused by the front of the Saturn, was estimated from the one available photograph (**Figure 5**) as **06-BDEW-2 (180)**. The WinSMASH reconstruction program, missing vehicle algorithm with CDC estimated crush profile (with the Saturn being the missing vehicle), provided a borderline reconstruction, and the results seem reasonable. The Saturn's estimated Total, Longitudinal, and Lateral Delta Vs are, respectively: 34 km.p.h. [21 m.p.h.], -34 km.p.h. [-21 m.p.h.], and 0 km.p.h. [0 m.p.h.]. The crash severity for the Saturn from the second impact, which caused the air bags to deploy, was moderate (24-40 km.p.h. [15 to 25 m.p.h.]).

Photographs verify that the Saturn's driver and front right passenger air bags deployed. The Saturn's front right passenger air bag module appears to have been located in a mid-mount position on the right side of the instrument panel and the driver's air bag module was located in the steering wheel hub. The passenger module appears to have been equipped with a single cover flap. The shape of the passenger's air bag is not known, and it is not known if the passenger air bag was equipped with tethers or vent ports. There are two areas of staining visible on the passenger's

air bag fabric but neither appears to be blood or other body fluid. The driver module's cover flaps were in the I-configuration. The left flap visible in the Saturn's interior photograph seems to have opened along its tear points; the right flap is not visible. The shape of the driver's air bag is unknown, and it is not known if the driver air bag was equipped with tethers or vent ports. Two small blood stains are visible in the one available interior photograph (**Figure 3**) but their location on the driver's air bag fabric cannot be specified.

Figure 3: Saturn's interior verifying dual air bag deployment; Note: arrows point to apparent blood stains (case photo #03)

CASE VEHICLE FRONT RIGHT PASSENGER

The Saturn's front right passenger (76-year-old male, white, unknown if Hispanic, 183 centimeters and 90 kilograms [72 inches, 199 pounds]) was reportedly wearing his available, manual, three-point, lap-and-shoulder safety belt system. His pre-crash seat adjustments and posture are not known. He was transported from the crash scene by ambulance to a medical facility. He was admitted to the hospital and died 32 hours and 50 minutes post-crash. The cause of death for the front right passenger, as listed on the medical examiner's report of a non-invasive postmortem examination, was "cervical injuries". The following discussion of the Saturn's front right passenger is based on that postmortem examination, vehicle photographs, and occupant kinematic principles.

The restrained front right passenger was probably seated in a normal passenger posture with his back against the seat back and his feet on the floor. The position of his hands is not known. As the Saturn began braking for traffic near a construction zone, he would have moved slightly forward. The first impact, when the front of White-GMC struck the back of the Saturn, caused the front right passenger to move rearward into his seat back. Almost instantly, the front of the Saturn impacted the back of the Caprice, causing him to lurch forward, but his forward motion was arrested by the safety belt system. This rapid rearward-then-forward motion probably caused hyperflexion of his neck resulting in subluxation of cervical vertebrae C5-C6 (not further specified). His face and head contacted the passenger's air bag, causing abrasions on his forehead and scalp, and contusions to both eyelids. His legs flailed and his left shin probably impacted the instrument panel, causing an abrasion. His left hip/abdomen contacted the center console, causing a contusion on his left flank. His post-impact posture must have been near normal as the investigating officer described conversing with this occupant but did not mention any out-of-place positioning. The front right passenger was transported via ambulance and hospitalized. The investigating officer described interviewing the front right passenger in his hospital bed a few hours after the crash, at which time he said he felt OK. The front right passenger died approximately 33 hours after the crash.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Subluxation of the 5th and 6th cervical vertebrae, NFS	650204.2 moderate	Inertial force	probable	non-invasive death exam
2.	Cervical injuries, NFS	615999.7 unknown	Inertial force	probable	non-invasive death exam
3. 4.	Edematous conjunctivae (bilateral)	240416.1 240416.1 minor	Passenger's air bag	probable	non-invasive death exam
5.	Abrasions, forehead	290202.1 minor	Passenger's air bag	probable	non-invasive death exam
6.	Abrasion, right parietal scalp	290202.1 minor	Passenger's air bag	probable	non-invasive death exam
7.	Contusion, left flank	590402.1 minor	Center console	possible	non-invasive death exam
8.	Abrasion, left shin	890202.1 minor	Center instrument panel	possible	non-invasive death exam

CASE VEHICLE DRIVER

The Saturn's driver (74-year-old female, race, ethnicity, height and weight unknown) was reportedly wearing her available, manual, three-point, lap-and-shoulder safety belt system. Her pre-crash seat adjustments, steering wheel position, and posture are not known. She was transported from the crash scene by ambulance to a medical facility. Police assessed her injuries as "B" (non-incapacitating). Her specific injures and treatment status are not known.

FIRST OTHER VEHICLE

Figure 4: Front of White-GMC (case photo #04)

The first other vehicle was a 1995 White-GMC Integral Sleeper ES, 6x4, Aero truck tractor (VIN: 4V1WDBRF45N------). It was towed from the scene due to disabling damage. Attached to the tractor was a 16.2 meter [53 foot] semi-trailer, with two axles. The overall length of the tractor and semi-trailer was 22.9 meters [75 feet]. Direct damage to the White-GMC cannot be fully assessed because its front bumper is missing in the only available photograph (**Figure 4**). There is possible horizontal direct damage to the right side of the front grille, perhaps 15 centimeters [six inches] up from the bottom. The right front turn signal lens is missing. Possible induced damage

included slight buckling of the right front fender, just forward of the wheel well. No TDC could be assigned. The White-GMC's driver (49-year-old male; race, ethnicity, height, and weight unknown) was reportedly restrained. Police assessed his injuries as "C" (reported, not evident). He declined to be transported from the scene.

SECOND OTHER VEHICLE

Figure 5: Back and right side of the Caprice, damage caused by the front of the Saturn (case photo #05)

The second other vehicle was a rear wheel drive, 1994 Chevrolet Caprice Classic, six passenger, four-door sedan (VIN: 1G1BL52W8RR------) equipped with a 4.3 liter, V-6 gasoline engine and a four-speed automatic transmission, with the shift lever at an unknown location. It was equipped with four-wheel anti-lock brakes. Its wheelbase was 294 centimeters [115.9 inches]. No odometer reading was recorded. The Caprice was outfitted as a taxi cab and was towed from the scene due to disabling damage. From the second event in this crash sequence, the Caprice's back plane sustained direct contact damage: the back bumper fascia and reinforcement bar were pushed forward, with a mid-bumper "V" at maximum crush; the right back taillight assembly was crushed; the left back taillight assembly lens was cracked; the rear trunk's lower lip was pushed forward and separated at its midpoint; and the back plane of the trunk lid was pushed forward and creased. Induced damage visible from the attorney-provided photographs was limited to buckling of the right rear quarterpanel (**Figure 5**). Based on the photographs, a CDC for Caprice was estimated as: **06-BDEW-2 (180)**. The WinSMASH reconstruction program, missing vehicle algorithm (with the Saturn being the missing vehicle), provided a borderline reconstruction, and the results appear reasonable. The Caprice's estimated Total, Longitudinal, and Lateral Delta Vs are, respectively: 22 km.p.h. [14 m.p.h.], 22 km.p.h. [14 m.p.h.], and 0 km.p.h. [0 m.p.h.]. The Caprice's front plane collided with the Camaro's back plane in the third and final event of this crash sequence. No further information concerning this third impact is available. The Caprice's driver (44-year-old male, race, ethnicity, height, and weight unknown) was reportedly restrained. Police assessed his injuries as "C" (reported, not evident). He was transported from the crash scene by ambulance to a medical facility. His specific injuries and treatment status are not known.

THIRD OTHER VEHICLE

The third other vehicle was a rear wheel drive, 1997 Chevrolet Camaro Sport Coupe, four passenger, two-door coupe (VIN: 2G1FP22K1V2------) equipped with a 3.8 liter, V-6 gasoline engine and an unknown transmission type. It was equipped with four-wheel anti-lock brakes. Its wheelbase was 257 centimeters [101.1 inches]. No odometer reading was recorded. The Camaro was driven away from the scene. The Camaro did not make contact with the Saturn. The Camaro's driver was indicated as not having sustained any injury.