TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER

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REMOTE REDESIGNED AIR BAG DEPLOYMENT INVESTIGATION
SCI TECHNICAL SUMMARY REPORT

VERIDIAN CASE NO. CA99-061

RABSS VEHICLE - 1998 CHRYSLER CIRRUS

LOCATION - STATE OF NEW YORK

CRASH DATE - JULY 1998

Contract No. DTNH22-94-D-07058

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

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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 are 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.

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16. *Abstract* This remote investigation focused on a two vehicle crash that involved a 1998 Chrysler Cirrus (subject vehicle) and a 1989 Chevrolet Corsica. The Chrysler Cirrus was equipped with redesigned frontal air bags that deployed as a result of an intersection collision with the Corsica. The driver of the Cirrus was operating the vehicle westbound on approach to a 4-leg intersection when he failed to detect the stop sign or northbound Corsica as he attempted to turn left (south). As the Cirrus entered the intersection, the front left area impacted the front right area of the Corsica. Impact resulted in moderate damage to both vehicles and deflected the Cirrus in a clockwise (CW) rotation. Both the 81-year-old male driver and 73-year-old female front right passenger of the Cirrus were restrained by the available 3-point lap and shoulder belt system. Both occupants initiated a forward and lateral trajectory in response to the 11 o'clock impact force and loaded the manual restraints. The driver sustained brain herniation, bilateral cerebral hemorrhage, subdural hematoma, cerebellar hemorrhage, and a lip laceration. He was lethargic at the scene and was transported to a local hospital where his condition deteriorated. The front right passenger was also transported by ambulance to a local hospital and admitted for her injuries. The driver expired 48 hours after the crash. Due to the remote nature of this investigation and the lack of detailed photographs, the specific injury mechanisms were unknown. The driver's closed head injuries probably resulted from the rapid CW rotation of the vehicle that was induced from the impact with the Corsica.			
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BACKGROUND

This remote investigation focused on a two vehicle crash that involved a 1998 Chrysler Cirrus (subject vehicle) and a 1989 Chevrolet Corsica. The Chrysler Cirrus was equipped with redesigned frontal air bags that deployed as a result of an intersection collision with the Corsica. The driver of the Cirrus was operating the vehicle westbound on approach to a 4-leg intersection when he failed to detect the stop sign or northbound Corsica as he attempted to turn left (south). As the Cirrus entered the intersection, the front left area impacted the front right area of the Corsica. Impact resulted in moderate damage to both vehicles and deflected the Cirrus in a clockwise (CW) rotation. Both the 81-year-old male driver and 73-year-old female front right passenger of the Cirrus were restrained by the available 3-point lap and shoulder belt system. Both occupants initiated a forward and lateral trajectory in response to the 11 o'clock impact force and loaded the manual restraints. The driver sustained brain herniation, bilateral cerebral hemorrhage, subdural hematoma, cerebellar hemorrhage, and a lip laceration. He was lethargic at the scene and was transported to a local hospital where his condition deteriorated. The front right passenger was also transported by ambulance to a local hospital and admitted for her injuries. The driver expired 48 hours after the crash. Due to the remote nature of this investigation and the lack of detailed photographs, the specific injury mechanisms were unknown. The driver's closed head injuries probably resulted from the rapid CW rotation of the vehicle that was induced from the impact with the Corsica.

This crash was identified through a search of the Fatality Analysis Reporting System (FARS) for fatalities that occurred in vehicles equipped with redesigned air bags. The crash occurred in July 1998 and was assigned to the Veridian Special Crash Investigation Team on September 2, 1999 as a remote investigation effort. Insurance photographs and a death certificate were obtained, as well as a brief telephone interview with the front right passenger of the Cirrus. These inputs provided the basis for this narrative report.

SUMMARY

Crash Site

This two vehicle crash occurred during the daylight hours of July 1998. At the time of the crash, there were no adverse conditions as the asphalt roads were dry. The crash occurred at a rural 4-leg intersection of a state roadway, county roadway, and local roadway **(Figure 1)**. At the intersection, the northbound state roadway continued from the south leg by turning onto the east leg **(Figure 2)**, the county road began on the north leg, and the local road began on the west leg. The north/south roadway consisted of two travel lanes and a right turn lane leading to the east leg of the intersection (the continuation of the state roadway) **(Figure 3)**. A gore area separated the main travel lanes from the right turn lane. The travel lanes were straight and level and bordered by soft shoulders. The east leg roadway was identical in composition to the north/south roadway. The west leg consisted of a two-lane roadway with no markings. The roadside

environment consisted of fields, wooded areas and some residences. Traffic control at the intersection included a stop sign for westbound traffic and a yield sign with white stop line for traffic turning eastbound from the north or west legs of the intersection. The state roadway had a posted speed of 88 km/h (55mph).

Figure 1. (East leg) Westbound approach for the Chrysler Cirrus

Figure 2. (South leg) Northbound approach for the Chevrolet Corsica

Figure 3. South leg showing the right turn lane for eastbound traffic

Pre-Crash

The 81-year-old male driver of the 1998 Chrysler Cirrus was operating the vehicle westbound on an approach to the rural 4-leg intersection when he failed to detect the stop sign or northbound Corsica as he initiated a left turn (south) across the path of the Corsica. Police reported the Cirrus to have been traveling approximately 16 km/h (10 mph) at the time of the collision. The 22-year-old female driver of the 1989 Chevrolet Corsica was operating the vehicle northbound on an approach to the same intersection at a driver reported speed of 80 km/h (50 mph). Upon recognition of the impending harmful event, the driver of the Corsica steered left and applied the brakes in an attempted avoidance maneuver, and traveled into the southbound lane. Due to the nature of the available photographs, skid marks in the vehicles trajectories could not be determined.

Crash

As the Chrysler Cirrus entered the intersection, the front left area impacted the front right area of the Chevrolet Corsica. Impact resulted in moderate damage to both vehicles. The principal direction of force was in the 11 o'clock sector for the Cirrus. The damage algorithm of the WinSMASH program computed velocity changes of 21.0 km/h (13.0 mph) for the Cirrus based on an estimated crush profile. The longitudinal and lateral components were -16.1 km/h (-10.0 mph) and 13.5 km/h (8.4 mph), respectively. The impact induced deceleration was sufficient to deploy the frontal redesigned air bag system in the Chrysler Cirrus. The principal direction of force was in the 1 o'clock sector for the Corsica. The damage algorithm of the WinSMASH program computed velocity changes of 27.0 km/h (-16.8 mph) for the Corsica based on an estimated crush profile. The longitudinal and lateral components were -25.4 km/h (-15.8 mph) and -9.2 km/h (-5.7 mph) respectively. The Cirrus rotated clockwise approximately 90 degrees and came to rest in the west leg of the intersection in the northwest corner. The Corsica rotated counterclockwise approximately 25 degrees and traveled northwest, coming to rest in the west leg of the intersection, northwest of the Cirrus. Both vehicles came to rest facing northwest.

Post-Crash

The driver and front right passenger of the Chrysler Cirrus were removed from the vehicle by rescue personnel. The driver was reported to be semi-conscious and the passenger was reported to be in shock. Both were transported by ambulance to a local hospital and admitted. The driver died 48 hours following the crash. The driver and passengers of the Chevrolet Corsica were also removed from the vehicle by rescue personnel and transported by ambulance to a local hospital where they were treated and released. Both vehicles were towed from the scene.

***RABSS VEHICLE* - 1998 Chrysler Cirrus**

The 1998 Chrysler Cirrus was identified by the Vehicle Identification Number (VIN) 1C3EJ56HXWN (production sequence omitted). The Cirrus was a 4-door sedan equipped with front-wheel drive, automatic transmission, tilt steering column, and a 2.5 liter V-6 engine. The police report listed the driver as the owner of the vehicle. The seating was configured with front bucket seats and rear bench. The driver's seat was equipped with a power seat track adjustment.

VEHICLE DAMAGE

Exterior Damage - 1998 Chrysler Cirrus

Black-and-white photocopies of insurance photographs provided the basis for damage notation. The 1998 Chrysler Cirrus sustained moderate frontal damage as a result of the impact with the Chevrolet Corsica **(Figure 4 and Figure 5)**. The CDC for this impact to the Chrysler Cirrus was 11-FYEW-2. The direct contact damage began at the left bumper corner and extended laterally approximately 100 cm (40"). The combined direct and induced damage involved the entire frontal width of the Cirrus. Six crush measurements were estimated at the level of the bumper: C1 = 40 cm (16"), C2 = 35 cm (14"), C3 = 25cm (10"), C4 = 10 cm (4"), C5 = 5 cm (2"), C6 = 0 cm. The hood was displaced rearward and laterally from engagement against the front corner surface of the Chevrolet Corsica. Both front fenders were buckled from impact forces.

Figure 4. Frontal damage to the 1998 Chrysler Cirrus

Figure 5. Frontal damage to the 1998 Chrysler Cirrus

Figure 6. Interior view of the 1998 Chrysler Cirrus

Interior Damage - 1998 Chrysler Cirrus

Interior damage to the 1998 Chrysler Cirrus was based on one black-and-white photocopied insurance photograph **(Figure 6)**. Interior damage appeared to be related solely to air bag deployment. No deformation was identified on the knee bolsters (rigid plastic type) or steering wheel hub/rim (tilt column set to center position in photos). No intrusions were noted in the vehicle.

Exterior Damage- 1989 Chevrolet Corsica

Black-and-white photocopies of insurance photographs provided the basis for damage notation. The 1989 Chevrolet Corsica sustained moderate damage as a result of the impact with the Cirrus **(Figure 7)**. The CDC for this impact to the Chevrolet Corsica was 01-FREE-2. The direct damage began at approximately 35 cm (14") to the right of the center of the bumper and extended laterally to the right bumper corner. The right fender and front right corner of the hood were buckled rearward from the frontal impact forces. Six crush measurements were estimated at the level of the bumper: C1 = 0 cm, C2 = 5 cm(2"), C3 = 10 cm (4"), C4 = 15 cm (6"), C5 = 30 cm (12"), C6 = 40 cm(16").

Figure 7. Frontal damage to 1989 Chevrolet Corsica

***REDESIGNED AIR BAG SYSTEM* - 1998 Chrysler Cirrus**

The 1998 Chrysler Cirrus was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags had deployed as a result of the impact with the Chevrolet Corsica. The driver's air bag was housed in the center of the steering wheel with a horizontally oriented flap tear seam (H-configuration). No contact evidence was visible on the air bag or exterior surface of the module cover flaps. The flaps were symmetrical in shape.

The front right passenger's air bag deployed from the right upper-instrument panel with a single cover flap design hinged at the top aspect. No contact evidence was identified on the air bag or exterior surface of the module cover flap.

***OCCUPANT DEMOGRAPHICS* - 1998 Chrysler Cirrus**

Driver

Age/Sex:	81-year-old male
Height:	168 cm (66")
Weight:	88 kg (195 lb)
Seat Track Position:	Mid-track
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	Police report/phone interview with front right passenger
Eyewear:	Prescription eyeglasses
Type of Medical Treatment:	Transported by ambulance to local hospital and died 48 hours following the crash

Driver Injuries

Injury	Injury Severity (AIS 90)	Possible Injury Mechanisms
Brain herniation	Critical (140202.5,9)	Unknown - possibly acceleration related from rapid CW vehicle rotation
Bilateral cerebral hemorrhage	Critical (140634.5,3)	Unknown - possibly acceleration related from rapid CW vehicle rotation
Sub-dural hematoma	Severe (140650.4,9)	Unknown - possibly acceleration related from rapid CW vehicle rotation
Cerebellar hemorrhage	Severe (140410.4,6)	Unknown - possibly acceleration related from rapid CW vehicle rotation
Lethargic at scene with decreased responses	Moderate (160699.2,0)	Unknown - possibly acceleration related from rapid CW vehicle rotation
Lip laceration	Minor (290600.1,9)	Unknown - possibly self-inflicted during the CW vehicle rotation

Injury source: Insurance agent (verbal)

Driver Kinematics

The 81 year old male driver of the Chrysler Cirrus was seated in an upright posture pre-crash and was alert according to his wife, the front right passenger of the vehicle. He was wearing prescription eyeglasses. Based on his reported height and weight, the driver was probably seated in a mid track position. He was reportedly (police and passenger interview) restrained by the manual 3-point lap and shoulder belt system.

At impact, the frontal air bag system deployed. The driver would have responded to the 11 o'clock direction of force by moving laterally to his left and forward. He would have loaded the manual belt webbing and based on his estimated seated position, possibly contacted the deployed redesigned driver air bag and/or the left side interior surfaces. He was subsequently thrust to his left by the CW rotation of the vehicle as it was deflected to the right and rearward by the Corsica.

Due to the lack of adequate photographs of the vehicle, an accurate reconstruction of the driver's kinematics could not be made.

A non-contact injury mechanism was probably the most plausible for this crash. The driver's closed head injuries probably resulted from the rapid CW rotation of the vehicle that was induced following the impact with the Corsica. His lip laceration may have been self-inflicted during this event. The driver's wife stated during the interview that his prescription eyeglasses remained on is face and were not damaged by the crash. It was unlikely the eyeglasses would have remained on his face if he was contacted by the expanding driver's air bag. The driver's face was also free of abrasion, thus minimizing the possibility of an air bag-related injury mechanism.

The driver was removed from the vehicle by rescue personnel and transported by ambulance to a local hospital where his condition deteriorated over the next 48 hours when he expired. The death certificate identified the manner of death as natural, not crash related and no autopsy was performed

Front Right Passenger

Age/Sex:	73-year-old female
Height:	163 cm (64")
Weight:	54 kg (118 lb)
Seat Track Position:	Mid-to-full rear
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	Police report/phone interview
Eyewear:	Prescription eyeglasses
Type of Medical Treatment:	Transported by ambulance to local hospital and admitted

Front Right Passenger Kinematics

The 73-year-old female front right passenger was presumed to be seated in an upright posture. According to the brief telephone interview, her seat was located between the mid and full-rear positions. She was restrained by the available 3-point manual lap and shoulder belt system. Belt usage was also reported by

the police.

At impact with the Chevrolet Corsica, the front right passenger initiated a forward and lateral trajectory in response to the 11 o'clock impact force and loaded manual restraint system and the deployed front right passenger's air bag. She stated that she was wearing prescription eyeglasses at the time of the crash, which were knocked off of her face and onto the floor. She was removed from the vehicle by rescue personnel. She had a complaint of chest pain and was transported by ambulance to a local hospital. She stated that she was admitted to the hospital due to an irregular heart beat.