CRASH DATA RESEARCH CENTER

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VERIDIAN ON-SITE REDESIGNED AIR BAG DEPLOYMENT INVESTIGATION

VERIDIAN CASE NO. CA00-031

VEHICLE - 2001 CHRYSLER PT CRUISER

LOCATION - STATE OF NEW JERSEY

CRASH DATE - AUGUST, 2000

Contract No. DTNH22-94-D-07058

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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 on-site investigation focused on a two vehicle crash involving a 2001 Chrysler PT Cruiser (subject vehicle) and a 1996 Ford Econoline 150 cargo van. The Chrysler PT Cruiser was equipped with redesigned frontal air bags for the driver and front right passenger positions which deployed as a result of an acute angle collision with the Ford van. The driver of the Ford was operating the vehicle northbound on a multi-lane urban roadway when he attempted to turn left (west) at a 4-leg intersection. As the Ford crossed the southbound lanes of the intersection, the right side surface was struck by the frontal area of the southbound Chrysler which resulted in moderate damage to both vehicles. The restrained 47 year old female driver of the Chrysler PT Cruiser initiated a forward trajectory in response to the 11 o'clock impact force as the expanding air bag contacted the anterior aspect of her upper arms resulting in abrasions and contusions. She loaded the manual restraint which resulted in contusions across the chest and abdomen. Loading of the knee bolster resulted in bilateral knee contusions. The driver was transported by ambulance to a local hospital for treatment and released.			
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BACKGROUND

This on-site investigation focused on a two vehicle crash involving a 2001 Chrysler PT Cruiser (subject vehicle) and a 1996 Ford Econoline 150 cargo van. The Chrysler PT Cruiser was equipped with redesigned frontal air bags for the driver and front right passenger positions which deployed as a result of an acute angle collision with the Ford van. The driver of the Ford was operating the vehicle northbound on a multi-lane urban roadway when he attempted to turn left (west) at a 4-leg intersection. As the Ford crossed the southbound lanes of the intersection, the right side surface was struck by the frontal area of the southbound Chrysler which resulted in moderate damage to both vehicles. The restrained 47 year old female driver of the Chrysler PT Cruiser initiated a forward trajectory in response to the 11 o'clock impact force as the expanding air bag contacted the anterior aspect of her upper arms resulting in abrasions and contusions. She loaded the manual restraint which resulted in contusions across the chest and abdomen. Loading of the knee bolster resulted in bilateral knee contusions. The driver was transported by ambulance to a local hospital for treatment and released.

The crash was identified by NASS PSU 04 during normal sampling activities on August 22, 2000. Although not selected as a CDS case, the police crash report was forwarded to the Veridian SCI team with subsequent notification provided to NHTSA. Due to the new vehicle type and deployment of the redesigned frontal air bag system, the crash was assigned as an on-site investigative effort on August 23. The on-site investigator completed the investigation on Thursday, August 24, 2000.

SUMMARY

Crash Site

This two vehicle crash occurred during the afternoon hours of August, 2000. At the time of the crash, it was daylight with no adverse conditions as the roads were dry. The crash occurred in the southbound lanes of a 4-leg (straight) urban intersection **(see Figure 11 - page 7)** with a negative grade for southbound traffic. The north/southbound lanes consisted of four asphalt travel lanes bordered by barrier curbs. The east/westbound lanes consisted of two level/asphalt travel lanes also bordered by barrier curbs. Traffic flow through the urban intersection was controlled by an overhead signal system in a green phase for north/southbound traffic. The posted speed limit at the crash site was 72 km/h (45 mph).

Pre-Crash

The 54 year old male driver of the 1996 Ford Econoline 150 cargo van was operating the vehicle northbound on the inboard lane when he slowed to a stop in preparation of a left turn (west) at the

urban 4-leg intersection **(Figure 1)**. As he approached the signalized intersection, a southbound (non-contact) large truck was stopped on the inboard travel lane waiting to turn left onto the local street. The Ford driver reported to police that the large truck blocked his view of the oncoming traffic as he proceeded west at a (driver reported speed) of 16 km/h (10 mph). The 47 year old female driver of the 2001 Chrysler PT Cruiser was operating the vehicle southbound in the outboard lane **(Figure 2)** at a (driver reported) speed of 64 km/h (40 mph) when she observed the Ford van cross her path of travel. The Chrysler driver reported no avoidance maneuvers in anticipation of the impending crash.

Figure 1. Northbound approach for the 1996 Ford E-150 cargo van.

Figure 2. Southbound approach for the 2001 Chrysler PT Cruiser.

Crash

As the Ford van crossed the southbound lanes of the 4-leg intersection, the right side surface was impacted by the frontal area of the Chrysler resulting in moderate damage to both vehicles. The impact deployed the frontal air bag systems in each vehicle. The damage algorithm of the WinSMASH reconstruction program computed velocity changes of 22.0 km/h (13.7 mph) for the subject vehicle and 13.6 km/h (8.5 mph) for the struck Ford. Respective longitudinal components were -20.7 km/h (-12.9 mph) and -10.4 km/h (-6.5 mph). Both vehicles came to rest in the southwest sector of the intersection with the Ford van facing northwest and the Chrysler PT Cruiser facing southwest.

Post-Crash

Both drivers exited their respective vehicles through the left front door under their own power. Treatment was rendered at the scene by fire department personnel and emergency medical technicians (EMTs). Both drivers were transported by ambulance to a local hospital for treatment and released. Both vehicles were towed from the scene due to disabling damage.

VEHICLE DATA

The 2001 Chrysler PT Cruiser was manufactured on 6/00 and identified by the vehicle identification number (VIN): 3C8FY4BB31T (production number deleted). The driver was reported by police as the owner of the vehicle. The 4-door station wagon *(per NASS description)* was equipped with front wheel drive, ABS and a 2.4 liter, 4 cylinder engine. At the time of the crash, the odometer had recorded 797 km (495 miles). The seating was configured with front bucket seats and a removable rear split bench (with folding backs). The owner reported no previous crashes or maintenance on the Chrysler's frontal air bag system. A cellular phone was present but not in use at the time of the collision.

VEHICLE DAMAGE

Exterior

The Chrysler PT Cruiser sustained moderate frontal damage as a result of the impact with the Ford van **(Figures 3 & 4)**. The direct contact damage encompassed the entire frontal width resulting in a combined direct and induced damage length (Field L) of 108.0 cm (42.5 in). Six crush measurements were documented at the level of the reinforcement bar *(bumper fascia separation)*: C1= 0 cm, C2= 3.0 cm (1.2 in), C3= 9.0 cm (3.5 in), C4= 13.0 cm (5.1 in), C5= 8.0 cm (3.1 in), C6= 4.0 cm (1.6 in). The Collision Deformation Classification (CDC) for this impact to the Chrysler was 11-FDEW-1 with a principal direction of force of (-) 20 degrees. The hood was deformed up and rearward from engagement against the side surface of the Ford van. Direct contact damage was also documented on both fenders which extended rearward to the wheel openings. Reduction in the right side wheelbase measured 3.0 cm (1.2 in). The windshield fractured at the lower left A-pillar area from exterior impact forces (only).

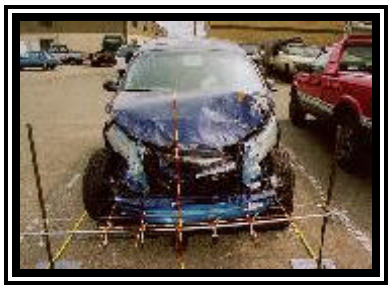

Figure 3. Frontal damage to the 2001 Chrysler PT Cruiser.

Figure 4. Oblique view.

The Ford Econoline 150 cargo van sustained moderate right side surface damage as a result of the impact with the Chrysler PT Cruiser **(Figure 5)**. The direct contact damage began 78.0 cm (30.7 in) aft of the right front axle and extended 234.0 cm (92.1 in) rearward. The combined direct and induced damage length (Field L) began 53.0 cm (20.9 in) aft of the right front axle and extended 259.0 cm (102.0 in) rearward. Six crush measurements were documented at the level of the lower door: C1= 0 cm, C2= 23.0 cm (9.1 in), C3= 32.0 cm (12.6 in), C4= 27.0 cm (10.6 in), C5= 18.0 cm (7.1 in), C6= 0 cm. The Collision Deformation Classification (CDC) for this impact to the Ford was 01-RYEW-3 with a principal direction of force of (+) 40 degrees. The right side doors were jammed. The windshield and right front tempered glazing were undamaged.

Figure 5. Right side damage to the 1996 Ford E-150 cargo van.

Interior

There was no damage to the interior surfaces of the Chrysler PT Cruiser from occupant contact or component intrusion.

MANUAL RESTRAINT SYSTEMS

The interior of the Chrysler PT Cruiser consisted of a five passenger seating configuration with front bucket and a removable rear split bench seat (with folding backs) which accommodates three individual seating positions. The driver 3-point manual lap and shoulder belt system consisted of a continuous loop belt webbing with a sliding latchplate and dual mode retractors (inertial lock/belt sensitive). Minor abrasions were documented to the D-ring of the front left manual restraint **(Figure 6)** along with loading marks to the shoulder webbing **(Figure 7)**. The front right 3-point manual lap and shoulder belt system consisted of a continuous loop belt webbing with a sliding latchplate. The rear seating positions were equipped with 3-point manual lap and shoulder belt systems which consisted of continuous loop belt webbings with sliding latchplates.

Figure 6. Abrasions to the front left restraint D-ring.

Figure 7. Loading marks to the front left shoulder belt webbing.

SUPPLEMENTAL RESTRAINT SYSTEMS

The Chrysler PT Cruiser was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags deployed as a result of the crash **(Figure 8)**. The driver air bag was housed in the center of the steering wheel with a circular flap tear seam. The flap measured 11.6 cm (4.6 in) in diameter. Although no contact evidence was identified on the module cover flap, makeup transfers were documented on the lower (center) section and left mid-section of the air bag face. Light blood spattering was also noted on the upper right quadrant of the air bag face and rear. The diameter of the driver air bag measured 59.0 cm (23.2 in) in its deflated state **(Figure 9)**. The bag was tethered by two internal straps and vented by two ports located at the 10 o'clock and 2 o'clock sectors on the rear aspect of the air bag.

Figure 8. 2001 Chrysler PT Cruiser deployed redesigned frontal air bags.

The front right passenger air bag deployed from the right mid-instrument panel area with a single cover flap design hinged at the top aspect. The cover flap was rectangular in shape and measured 48.1 cm (18.9 in) in width and 17.6 cm (6.9 in) in height. No contact evidence was identified on the air bag or

exterior surface of the module cover flap. The passenger air bag measured 44.5 cm (17.5 in) in width and 58.5 cm (23.0 in) in height in its deflated state **(Figure 10)**. The bag was tethered by two internal straps and vented by two ports located at the 11 o'clock and 1 o'clock sectors on the side aspect of the air bag.

In addition to the frontal air bag system, the Chrysler PT Cruiser was equipped with pyrotechnic pretensioners integrated into the retractor assembly in the B-pillars. All pretensioners apparently fired in the crash but the retractors did not lock. The owner and body shop would not allow disassembly of the cover panels to further evaluate pretensioner design and deployment.

The Chrysler was also equipped with a side impact air bags for the front seated positions. The air bag modules were housed in the outboard side aspect of the front seat backs, and did not deploy as a result of the impact.

Figure 9. 2001 Chrysler PT Cruiser redesigned driver air bag.

Figure 10. 2001 Chrysler PT Cruiser redesigned passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex:	47 year old female
Height:	170 cm (67 in)
Weight:	86 kg (190 lb)
Seat Track Position:	Middle position
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	Vehicle inspection, driver interview, police report
Eyeware:	Prescription glasses
Type of Medical Treatment:	Transported to a local hospital and released

Driver Injuries

Injury	***Severity (AIS 90)***	***Injury Mechanism***
*Bilateral anterior upper arm abrasions	Minor (790202.1,3)	Expanding driver air bag
*Bilateral anterior upper arm contusions	Minor (790402.1,3)	Expanding driver air bag

+Chest contusions (left upper to right lower)	Minor (490402.1,0)	Shoulder belt webbing
+Posterior right hand contusion (between thumb and index finger)	Minor (790402.1,1)	Driver air bag module cover flap
*Left lower abdominal contusion	Minor (590402.1,2)	Lap belt webbing
+Bilateral knee contusions	Minor (890402.1,3)	Left knee bolster
*Right knee abrasion	Minor (890202.1,1)	Left knee bolster

*Sources: *-medical report, +-driver*

Driver Kinematics

The 47 year old female driver of the 2001 Chrysler PT Cruiser was restrained by the available 3-point manual lap and shoulder belt system, seated in an upright posture with the seat track adjusted to the middle position. Her hands were placed *(braced)* at the 10 o'clock and 2 o'clock positions on the steering wheel rim. Belt use was confirmed by the type of injuries sustained in conjunction with the loading evidence identified on the webbing and D-ring of the front left manual restraint.

At impact, the driver initiated a forward trajectory in response to the 11 o'clock impact force as the expanding air bag contacted the anterior aspect of her upper arms resulting in bilateral abrasions and contusions. This injury mechanism was evidenced by the anterior location of the injury relative to the rearward excursion of the driver air bag membrane during deployment. She also sustained a contusion to the posterior aspect of the right hand (between the thumb and index finger) from contact to the air bag module cover flap, evidenced by the size and location of the injury relative to the driver's stated pre-crash placement of the right hand on the steering wheel rim and associated blood spattering noted on the right upper quadrant of the air bag. The driver loaded the manual restraint which resulted in contusions diagonally across the chest and left lower abdominal area. This injury pattern to the abdominal region suggests improper pre-crash placement of the lap harness over the stomach. Subsequent contact to the deployed redesigned driver air bag was confirmed by the makeup transfers documented to the lower (centered) portion and left mid-section of the air bag face. Loading of the knee bolster resulted in bilateral abrasions and contusions. The driver was transported by ambulance to a local hospital for treatment and released. The deployed redesigned driver air bag provided additional protection against further contact to the steering wheel hub/rim, and potential serious injury.

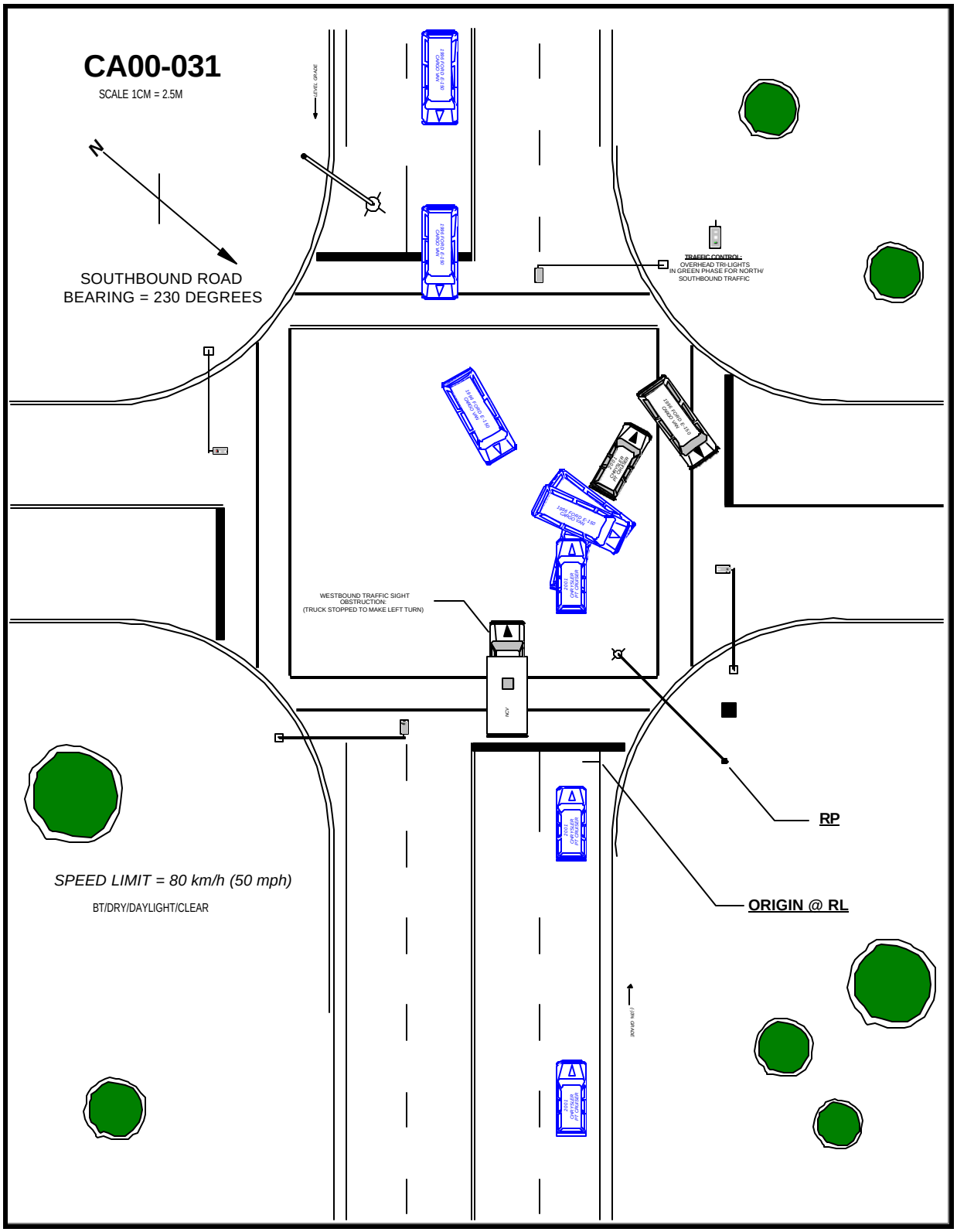

Figure 11. Scene Diagram.