TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER

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ON-SITE ADVANCED OCCUPANT PROTECTION SYSTEM INVESTIGATION

VERIDIAN CASE NO. CA01-011

VEHICLE: 2001 CHRYSLER TOWN & COUNTRY MINIVAN

LOCATION: NEW YORK

CRASH DATE: DECEMBER 2000

Contract No. DTNH22-94-07058

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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 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 of the involved vehicle(s) or their safety systems.

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17. *Abstract*

This on-site investigation focused on the performance of the Advanced Occupant Protection System in a 2001 Chrysler Town & Country minivan. The Chrysler was involved in a frontal crash with a 1985 Ford 2-door Escort. The Chrysler Town & Country was equipped with an Advanced Occupant Protection System (AOPS) that included dual stage inflators for the frontal air bags, side impact air bags for the front seat positions and front seat buckle-pretensioners. The frontal air bags and the left pretensioner fired as a result of the crash. The restrained driver and rear seat passenger (restrained in a child safety seat) were the only occupants in the Chrysler and were not injured in the moderate severity crash. The driver of the 1985 Ford Escort had a police reported complaint of pain and did not require medical attention.

The Special Crash Investigations team at Veridian identified this crash on January 11, 2001 through a local search of the automobile dealers and notified the Crash Investigations Division of the National Highway Traffic Safety Administration (NHTSA). NHTSA subsequently assigned an on-site investigation of the crash to Veridian SCI team the same day, as part of the Advanced Occupant Protection System Study. The vehicle was at a local repair center and was available for inspection.

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BACKGROUND

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SUMMARY

Crash Site

This three-vehicle crash occurred during the afternoon hours of December, 2000. At the time of the crash, it was dusk and the road surfaces were wet. The crash occurred at the four-leg intersection of a two lane north/south road and a two lane east/west road in a suburban setting. A standard (red/amber/green) traffic signal controlled the intersection. The traffic signal was working properly at the time of the crash and was green for traffic in the north/south direction. The speed limit in the area of the crash was 72 km/h (45 mph). No evidence from the crash was found at the scene upon inspection. The lack of scene evidence resulted in part due to the passage of time between the date of the crash and crash notification. **Figure 1** is a view into intersection.

Figure 1: Northbound view of the crash scene.

Pre-crash

The 2001 Chrysler Town & Country minivan was southbound and was stopped behind a non-contact vehicle at the four-leg intersection. A 1996 Ford sedan was stopped behind the Chrysler. These southbound vehicles were waiting for northbound traffic to clear and intended to turn left and travel east on the intersecting road. The Chrysler was driven by a 36 year old restrained female. A 3 year old male child was properly restrained in a booster seat positioned on the left side of the second row of seats.

The 1985 Ford Escort was northbound driven by a 20 year old restrained male. As the Escort approached the intersection, the southbound non-contact vehicle turned left (eastbound) across the path of the Escort. The driver of the Escort reacted to the turning vehicle by steering counterclockwise and braking. The left avoidance maneuver by the driver of the Escort caused the vehicle to traverse laterally across the northbound lane and into the stopped Chrysler.

Crash

The crash occurred when the center and right aspects of the Ford Escort impacted the front of the Chrysler. The force of the crash caused the left buckle pretensioner to fire and the frontal air bags in the Chrysler to deploy. The barrier equivalent delta V experienced by the Chrysler was approximately 19.6 km/h (12.2 mph). The northbound momentum of the Ford displaced the Chrysler rearward and caused it rotate clockwise. The vehicles then contacted again in a minor secondary side slap with the right front side of the Ford contacting the left side of the Chrysler. The rearward displacement of the Chrysler from the initial impact caused a minor secondary contact with the 1996 Ford sedan. The 1985 Ford and the Chrysler Town & Country came to rest adjacent to each other facing westward. A schematic of the crash is depicted in **Figure 2**.

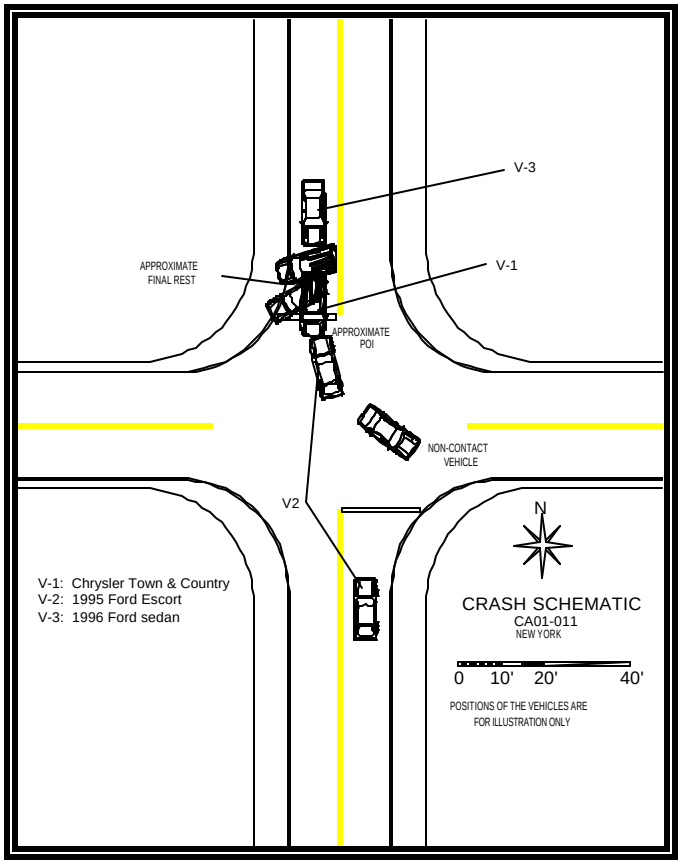

Figure 2: Crash schematic.

Post-crash

The police and ambulance personnel responded to the scene. The Ford Escort and the Chrysler Town & Country sustained disabling damage and were towed. The Ford Escort was considered a total loss by its insurance company. It was not available for inspection. The 1996 Ford sedan drove from the scene under its own power. The two occupants of the Chrysler were not injured. The driver of the 1985 Ford had a police reported complaint of pain, however he did not seek medical attention. He was not transported. The 17 year old female driver in the 1996 Ford was not injured in the secondary impact.

2001 Chrysler Town & Country Minivan

The 2001 Chrysler Town & Country minivan was identified by the Vehicle Identification Number (VIN): 2C8GP64L21R (production sequence deleted). The vehicle's power train consisted of a 3.8 liter, V6 engine linked to a 4-speed automatic transmission. The service brakes were 4-wheel anti- lock system. The leather trimmed seating system in the vehicle was configured for seven passengers and consisted of driver and front right captain's chairs, two second row captain's chairs and a third row bench seat. The manual restraint system consisted of 3-point lap and shoulder belts for the six outboard seat positions and a third row center lap belt. The driver and front right passenger restraints were equipped with buckle-pretensioners. The Supplemental Restraint System (SRS) consisted of front seat belt buckle-pretensioners, frontal air bags with multi-stage inflators and seat-mounted side impact air bags for the driver and front right passenger. The vehicle's date of manufacture was September 2000. The odometer read 3,209 km (1,994 miles) at the time of the inspection.

Exterior Damage

Figures 3 and 4 are the front and left right lateral views of the frontal damaged Chrysler, respectively. The Chrysler sustained 158 cm (62 in) of direct contact damage that extended across the entire frontal end width of the vehicle. The residual crash measured along the bumper reinforcement bar was as follows: C1=2.0 cm (0.8 in), C2=15.0 cm (5.9 in), C3=18.0 cm (7.1 in), C4=11.0 cm (4.3 in), C5=1.0 cm (0.4 in), C6=0. The maximum crush was located 33.5 cm (13.2 in) left of center (between C2 and C3) and measured 24.1 cm (9.5 in). The principle direction of force was within the 12 o'clock sector and was an estimated 350 degrees (-10 degrees). The impact energy was managed by the forward structures of the vehicle. The damaged components included the bumper fascia and reinforcement bar, upper and lower radiator supports and the hood. There was no measured change in the wheelbase dimensions. There were no glazing fractures and all the doors remained operational. The Collision deformation Classification (CDC) was 12-FDEW-1. The total velocity change calculated by the Missing Vehicle algorithm of the WINSMASH collision model was 24.3 km/h (15.1 mph). The longitudinal and lateral delta V components were -24.0 km/h (14.9 mph) and 4.2 km/h (2.6 mph), respectively.

Figure 3: Front view of the Chrysler.

Figure 4: Left lateral view.

The left side of the vehicle sustained minor damage as a result of a secondary side slap, **Figure 5.** This damage pattern was centered on the trailing aspect of the driver's door 152 cm (60 in) forward of the rear axle and measured 23 cm (9 in) in length. The lateral deformation in the area was an estimated 3.8 cm (1.5 in). The CDC of this contact was 09-LPEN-1.

Figure 5: Left side view of the Chrysler.

Interior Damage

The interior damage to the Chrysler consisted of the deployment of the frontal air bag system and minor interior occupant contacts. There was no interior damage or intrusion related to the exterior forces of the crash.

The driver's seat was adjusted to a mid-track position at the time of the inspection and measured 9.7 cm (3.8 in) forward of full rear. The total seat track travel measured 21.6 cm (8.5 in). It was possible this was the at-crash position given the driver's stature. The tilt-steering wheel had a four position adjustment and was located one notch above the lowest position. There was no deformation of the 4-spoke steering wheel rim. The horizontal distance from the driver air bag module to the seat back measured 64 cm (25 in).

The driver's knee bolster exhibited two scuff marks from contact with the driver's lower extremities. The left lower extremity scuff measured 5 cm x 18 cm (2 in x 7 in) and was centered 10 cm (4 in) left of the steering column. A 2 cm x 3.8 cm (1 in x 1.5 in) scuff from right knee contact was located 5.3 cm (2.1 in) right of the steering column. These occupant contacts are depicted in **Figure 6.**

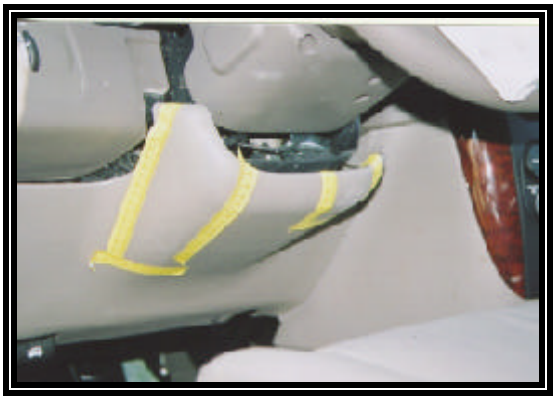

Figure 6: View of the driver's knee bolster.

Manual Restraint System

The driver's manual restraint system consisted of a continuous loop 3-point lap and shoulder belt with a sliding latch plate. The dual mode locking retractor was located in the base of the B-pillar. The seat belt buckle was mounted on a pretensioner attached to the inboard aspect of the seat. The left pretensioner had fired as a result of the impact. Comparable measurements taken from the unfired right pretensioner indicated the left pretensioner stroked approximately 6.9 cm (2.8 in). **Figure 7** is a composite photograph of the front seat pretensioners taken from the second row looking forward. The left upper adjustable D-ring was 2.5 cm (1.0 in) above the lowest adjustment. The total adjustment range was 10 cm (4 in). There was little evidence of historical usage observed on the surface of the latch plate, however, this was consistent with the age of the vehicle. There was no crash-related evidence observed on the webbing.

Figure 7: Composite photograph of the fired driver and unfired front right pretensioners.

A booster seat (make/model unknown) was restrained in the second row left seat. The manual restraint for this position was a continuous loop 3-point lap and shoulder belt with a switchable retractor. The surface of the latch plate exhibited minor abrasions. The adjustable D-ring was in the full down position. The webbing was free of crash related evidence.

Supplemental Restraint System

The Supplemental Restraint System in the 2001 Chrysler Town & Country consisted of driver and front right passenger air bags that deployed as a result of the crash. The driver air bag module was designed in the typical manner and located in the center hub of the steering wheel rim, **Figure 8**. The driver air bag module had a single semi-circular flap that hinged on top. The vinyl cover flap measured 20 cm (8 in) in diameter. There was no contact evidence on the cover flap. The diameter of the deployed driver air bag, **Figure 9**, measured 66 cm (26 in) in its deflated state. It was tethered by four internal straps sewn to the face of the bag and vented internally. There was no contact evidence on the face of the bag. The following nomenclature was affixed to the cover flap:

VT3482
Pt.1=09.2 Pt.2=08.4 Pt.3=06.1 Pt.4=07.6
00908000065754
Breed P/NE54741 Chrysler
E55340 Dodge

Figure 8: Driver air bag module.

Figure 9: Deployed driver air bag.

The front right passenger air bag was a mid-mount design located in the right aspect of the instrument panel. The single cover flap measured 30 cm x 20 cm (12 in x 8 in), width by height, and conformed to the contoured shape of the instrument panel. The passenger air bag was internally vented and was not tethered. The face of the deflated bag measured 18 in x 28 in, width by height. There was no contact evidence on the face of the bag.

OCCUPANT DEMOGRAPHICS

	Driver	**Second Row Left Passenger**
Age/Sex:	36 year old/Female	3year old/Male
Height:	157 cm (62 in)	97 cm (38 in)
Weight:	49 kg (108 lb)	15 kg (34 lb)
Restraint Use:	3-pt. lap and shoulder with pretensioner	Booster seat (make/model unknown)
Usage Source:	SCI inspection	SCI inspection/interview
Medical Treatment:	None	None

OCCUPANT ISSUES

Immediately prior to the crash, the Chrysler Town & Country minivan was stopped at a functioning traffic light intending to turn left. An opposite direction Ford Escort overreacted to a non-contact vehicle resulting in a lane change and subsequent frontal impact with the Chrysler. The two respective occupants in the Chrysler Town & Country minivan were restrained at the time of the crash. Upon impact, the driver's pretensioner fired and the frontal air bags deployed. The driver responded to the 12 o'clock direction of the impact by exhibiting a forward trajectory and loading the pretensioned and locked manual restraint system. Her upper torso contacted the deployed driver air bag and her lower extremities contacted the knee bolster. These contacts did not result in injury.

The 3 year old male restrained in the booster seat initiated a forward trajectory in response to the 12 o'clock direction of the impact and loaded the safety seat harness. The child rode down the forces of the crash and then rebounded back into the seat. He was not injured in the event.