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SCI/NASS COMBINATION CASE REPORT

CASE NUMBER - NASS-98-41-099A
LOCATION - Florida
VEHICLE - 1998 DODGE STRATUS ES
CRASH DATE - July 1998

Submitted:

April 21, 1999
Revised:
May 9, 2000
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Contract Number: DTNH22-94-D-17058

Prepared for:

U.S. Department of Transportation
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.

Special Disclaimer

for SCI/NASS combination case NASS-1998-41-099A

This case was originally completed as a Special Crash Remote Investigation. Later, it was learned that this case had also been selected for NASS/CDS. The NASS researcher was not able to inspect any of the vehicles and there are no inspection data nor vehicle photographs in the NASS coded case.

Police photographs were acquired for the SCI investigation. These photos made it possible for the SCI report to include photo-estimated CDCs, reconstruction calculations and injury mechanism data, none of which were possible for the NASS case.

The police photographs are included in this SCI report as Appendix A.

Technical Report Documentation Page

1. *Report No.* NASS-1998-41-099A	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
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15. *Supplementary Notes*
Combination SCI/NASS investigation involving a 1998 Dodge Stratus ES, a 1998 Toyota Corolla VE (both four-door sedans with manual safety belts and redesigned front air bags) and a 1995 Toyota Tercel.

16. *Abstract*

This report covers a combination SCI/NASS investigation of an air bag deployment crash that involved a 1998 Dodge Stratus (case vehicle, vehicle #2), a 1998 Toyota Corolla (vehicle #1) and a 1995 Toyota Tercel (vehicle #3). This crash is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of the collision events and the unrestrained driver (37-year-old female) suffered fatal brainstem injuries as a result of sustaining hyperflexion of the cervical spine. The case vehicle (vehicle #2) was traveling north in the fourth northbound lane of a five-lane roadway that was part of a divided urban interstate highway. Vehicle #3 was also traveling north, in the third northbound lane of the same roadway. Vehicle #1 was traveling south in the fourth northbound lane. All three vehicles were traveling at or near the 105 km.p.h. [65 m.p.h.] posted speed limit. The front right area of the case vehicle impacted the front right of vehicle #1, causing the case vehicle's driver and front right passenger air bags to deploy. There is no evidence that either driver attempted any avoidance actions. Vehicle #1 was pushed backwards and sideways into the third lane and the front right area of vehicle #3 impacted the right front of vehicle #1. The case vehicle driver's pre-crash seat adjustments and posture are not known. She was extremely obese and was not wearing her available active three-point lap-and-shoulder safety belt. According to the autopsy, she sustained an atlantooccipital dislocation with brainstem lacerations, transverse fractures of the C_2 and C_3 vertebral bodies, bilateral lung contusions and multiple rib fractures. She was declared dead at the scene. The drivers of vehicle #1 and vehicle #3 were restrained by their available active three-point lap-and-shoulder safety belts and survived. There were no other occupants in any of the three vehicles.

17. *Key Words* Redesigned Air Bag Deployment Motor Vehicle Traffic Crash Injury Severity		18. *Distribution Statement* General Public	
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This combination SCI/NASS investigation was brought to the NHTSA's attention by NASS/CDS sampling activities and a review of the 1998 Fatality Analysis Reporting System (FARS) in February 1999. The crash involved a 1998 Toyota Corolla (vehicle #1), a 1998 Dodge Stratus (case vehicle, vehicle #2) and a 1995 Toyota Tercel (vehicle #3). The crash occurred in July 1998 at 4:25 a.m. in Florida and was investigated by the applicable state police. This case is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of the collision events and the case vehicle's unrestrained driver (37-year-old female) suffered fatal brainstem injuries as a result of sustaining hyperflexion of the cervical spine. The Police Crash Report, the autopsy report and police photographs were received in April 1999. A copy of the NASS electronic case was received in May 2000. Because the NASS researcher was not able to inspect any of the vehicles in this case, this report is presented as a remote investigation. This report is based on the Police Crash Report, the autopsy report, police photographs, occupant kinematic principles and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle (vehicle #2) was traveling north in the fourth northbound lane of a five-lane roadway that was part of a divided urban interstate highway. Vehicle #3 was also traveling north, in the third northbound lane of the same roadway. Vehicle #1 was traveling south in the fourth northbound lane. It was dark with no street lights, the weather was clear and there were no roadway defects. The speed limit was 105 km.p.h. [65 m.p.h.]. The crash occurred in the fourth northbound lane. It is not known if the case vehicle driver attempted any avoidance actions, but there are no brake skids cited in the police report and none are visible in the police on-scene photographs. Gouge marks at the initial point of impact are parallel to the lane lines, indicating no steering maneuvers (**Figure 1**). The front right area of the case vehicle impacted the front right of vehicle #1, causing the case vehicle's driver and front right passenger air bags to deploy. Vehicle #1 was also equipped with front air bags and the driver and front right passenger air bags deployed. The case vehicle rotated a few degrees clockwise and slid to rest heading north-northeast, straddling the fourth and fifth lanes. Vehicle #1 was pushed backwards and sideways into the third lane and the front right area of vehicle #3 impacted the right front of vehicle #1. Vehicle #1 rotated approximately 90 degrees counterclockwise and came to rest headed east, straddling the first and second lanes. Vehicle #3 rotated a few degrees counterclockwise and slid to rest heading north-northwest, straddling the fourth and fifth lanes (**Figure 2**). The crash severity for the case vehicle was high (greater than 40 km.p.h [25 m.p.h.]).

Figure 1: Case vehicle's northbound approach and final rest position - note gouges in foreground indicating point of impact

Figure 2: Vehicle #1 (on right) and vehicle #3 at final rest

The case vehicle was a front wheel drive 1998 Dodge Stratus ES five-passenger four-door sedan (VIN: 1B3EJ56H1WN------) equipped with a 2.5 liter V-6 engine and a five-speed manual transmission with floor-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 274 centimeters [108.0 inches]. The odometer reading is not known. The case vehicle was towed due to disabling damage.

The case vehicle sustained direct contact damage across the right half of the front (**Figure 3**). The bumper cover was torn off, the grille and headlights were shattered, the hood was folded and crushed down along the front edge and the windshield was fractured across the entire width. The right front wheel was forced rearward against the right A-pillar, resulting in the right A-pillar being displaced rearward, causing the right side of the roof to buckle upward and the right front door to buckle outward. The left side profile of the passenger area was essentially unchanged, with no movement of the left A-pillar, roof rail or door sill. The left front door remained closed and operational. The CDC for the case vehicle, estimated from police photographs, is **12-FZEW-5**. Delta V was estimated using the case vehicle's CDC with the other vehicle treated as missing (because vehicle #1 sustained two impacts in the same area and a CDC could not be estimated; see discussion of vehicle #1, below). These ROLDMIS CDC-only results provide a borderline reconstruction, but the results appear reasonable. The estimated total, longitudinal and lateral delta Vs are, respectively, 63.0 km.p.h. [39.1 m.p.h.], -63.0 km.p.h [-39.1 m.p.h.] and 0.0 km.p.h.

Figure 3: Case vehicle's front contact damage and induced damage on right side

There was heavy intrusion into the front right area, extending into the center. The driver's seat area sustained only modest intrusion, primarily as a result of the movement by the instrument panel on the right side but also including intrusion on the right side of the toe pan in the driver's foot well and displacement of the clutch, brake and accelerator pedals (**Figure 4**). The steering wheel is not fully visible in the available photographs, but the rim sustained major deformation and was jammed against the intruded instrument panel to the right of the driver's seat area.

Figure 4: Case vehicle's driver seat area - note undeformed door opening and minor intrusion in foot well

CASE VEHICLE DRIVER NASS-1998-41-099A

The case vehicle's driver (37-year-old female, Black, unknown if Hispanic, not pregnant, 163 centimeters, 128 kilograms [64 inches, 282 pounds]) was not restrained by the available manual three-point lap-and-shoulder safety belt system. There was no other occupant. The driver's pre-crash seat adjustments, steering wheel adjustment and posture are not known. Based on the post-crash position of the driver's body, she was probably in a partially reclined driving posture at the moment of impact. Because of her large girth, she was very close to the steering wheel (her abdomen is described as "large and bulging due to obesity" in the autopsy report).

As a result of not being restrained, the driver moved straight forward in response to the head-on impact force and her abdomen engaged the steering wheel rim, causing a contusion in the upper right area of her abdomen. The air bag deployed against her torso. She continued moving forward, compressing the air bag and causing it to deflate, as the vehicle rotated clockwise and the right side of the instrument panel intruded. Her chest engaged the steering wheel as it pivoted toward her relative to her forward motion. The combined effects of the air bag's pressure and the driver's contact with the steering wheel caused a fracture of the right clavicle, fractures of ribs one through seven on the right with vertical fracture lines at the costovertebral junctions and bilateral lung contusions. Her left knee and thigh engaged the lower instrument panel/knee bolster, causing abrasions. Her arms flailed forward and her right upper arm sustained an area of three linear abrasions, possibly from contacting control knobs on the intruding center instrument panel. Her head continued forward as her torso was slowed due to engaging the steering wheel and she sustained hyperflexion of the cervical spine, causing atlantooccipital dislocation, lacerations of the upper medulla and brainstem, and transverse fractures of the C_2 and C_3 vertebral bodies. As she rebounded back into the seat, the movement of her head around the now-disrupted atlantooccipital juncture caused further damage in the lower brain area, with subarachnoid hemorrhage in the left occipital convexity, extensive hemorrhage into the cerebral ventricles and further hemorrhage into the posterior neck muscles, extending downward into the thoracic region. At final rest, she was slumped to the left with her abdomen wedged between the steering wheel rim and the front edge of the seat cushion and her thighs jammed against the under side of the instrument panel.

CASE VEHICLE DRIVER'S INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Atlantooccipital dislocation, almost complete	650208.2	Noncontact -- Collision force (momentum)	Certain	Autopsy
2.	Laceration of the medulla with almost complete disruption of the brainstem at this level	140212.6	Noncontact -- Collision force (momentum)	Certain	Autopsy
3.	Subarachnoid hemorrhage, left occipital convexity	140684.3	Noncontact -- Collision force (momentum)	Certain	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
4.	Intraventricular hemorrhage (cerebral ventricles filled with clotted and liquid blood)	140678.4	Noncontact -- Collision force (momentum)	Certain	Autopsy
5.	Transverse fracture of C_2 vertebral body	650230.2	Noncontact -- Collision force (momentum)	Certain	Autopsy
6.	Transverse fracture of C_3 vertebral body	650230.2	Noncontact -- Collision force (momentum)	Certain	Autopsy
7.	Fracture, right clavicle, vertical fracture line 3 cm lateral of sternoclavicular junction	752200.2	Steering wheel rim	Probable	Autopsy
8.	Fracture of right ribs 1 through 7, vertical fracture lines along costovertebral junctions	450230.3	Steering wheel hub/spokes	Probable	Autopsy
9.	Contusions of both lungs (bilateral)	441410.4	Steering wheel hub/spokes	Probable	Autopsy
10.	Contusion, right upper quadrant of abdomen	590402.1	Steering wheel rim	Certain	Autopsy
11.	Abrasions, left knee and thigh	890202.1	Left instrument panel	Certain	Autopsy
12.	Abrasions, right upper arm	790202.1	Center instrument panel	Possible	Autopsy

VEHICLE #1

Vehicle #1 was a front wheel drive 1998 Toyota Corolla VE four-passenger four-door sedan (VIN: 1NXBR12E3WZ------) with a 1.8 liter I-4 engine, and a five-speed manual transmission with floor-mounted shift lever. Four wheel anti-lock brakes were an option for this model vehicle but it is not known if vehicle #1 was so equipped. Vehicle #1's wheelbase was 246 centimeters [97.0 inches]. The odometer reading is not known. Vehicle #1 was towed from the scene due to disabling damage.

Figure 5: Vehicle #1, front and right side damage

Vehicle #1 sustained direct contact damage across the right two-thirds of the front, with the right front wheel pushed rearward into the right A-pillar, causing the A-pillar to be displaced rearward resulting in extensive intrusion into the right side of the front seat row (**Figure 5**). The left side of the passenger cabin was essentially undamaged, with no disturbance of the left A-pillar, roof rail or door sill (**Figure 6**). Vehicle #1's driver (34-year-old female, height and weight unknown) sustained police-reported incapacitating injuries. There was no other occupant in vehicle #1.

The CDCs for vehicle #1's two impacts cannot be estimated due to overlapping damage. Delta V for vehicle #1's first impact, with the case vehicle, was estimated based on the case vehicle's CDC only. These ROLDMIS CDC-only results provide a borderline reconstruction, but the results appear reasonable. The total, longitudinal and lateral Delta Vs for vehicle #1's first impact are, respectively, 79.1 km.p.h [49.2 m.p.h.], -79.1 km.p.h. [-49.2 m.p.h.] and 0 km.p.h.

Figure 6: Vehicle #1, left side and driver's seat area

VEHICLE #3

Vehicle #3 was a front wheel drive 1995 Toyota Tercel five-passenger two-door sedan (VIN: JT2EL55DXS0------) equipped with a 1.5 liter I-4 engine and a four-speed manual transmission with floor-mounted shift lever. Four wheel anti-lock brakes were an option for this model vehicle, but it is not known if this vehicle was so equipped. Vehicle #3's wheelbase was 238 centimeters [93.7 inches]. The odometer reading is not known. Vehicle #3 was towed from the scene due to disabling damage. Because vehicle #3 was not involved in any impact with the case vehicle, delta V was not calculated and no photographs are presented.

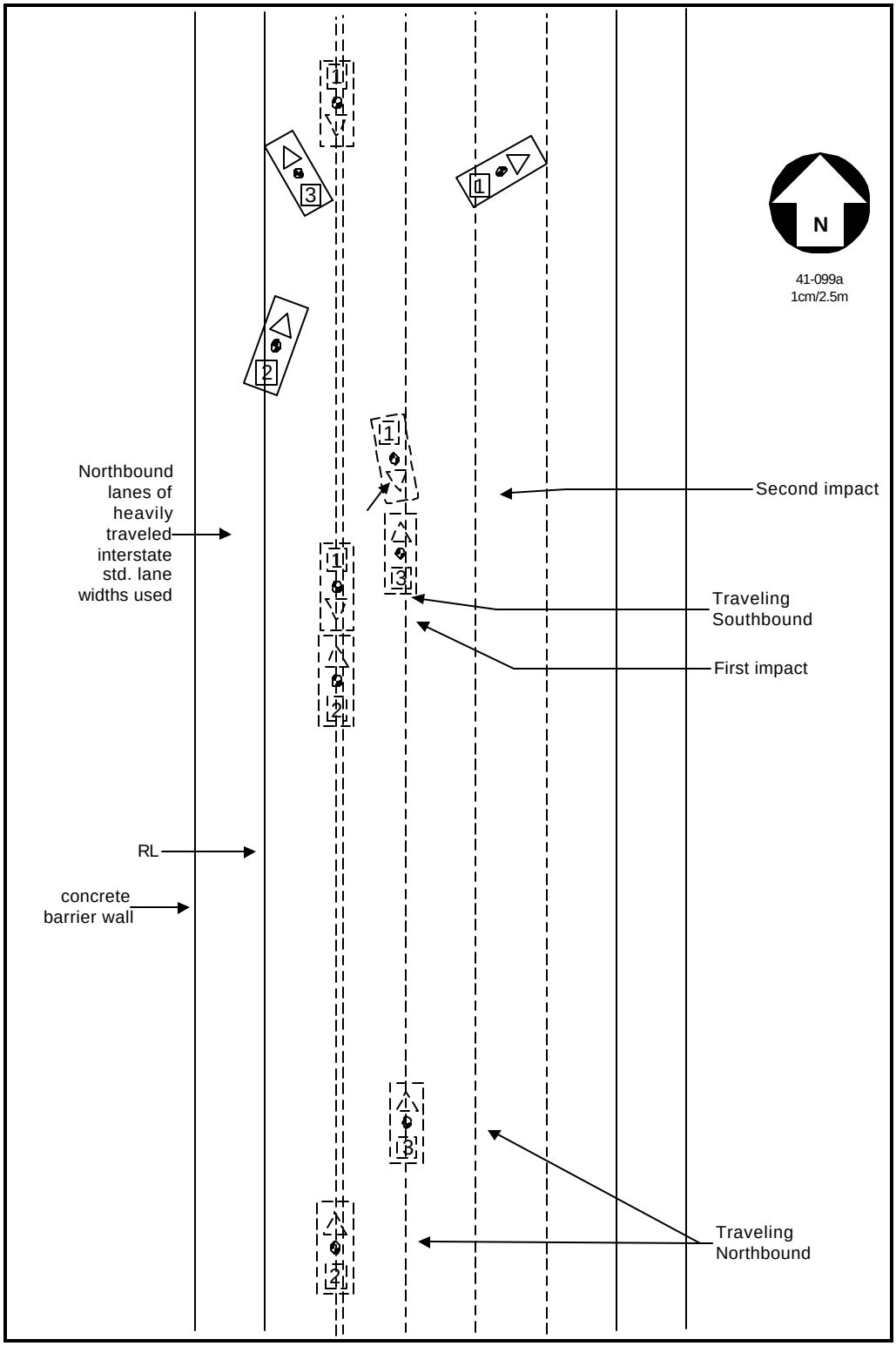
N
41-099a
1cm/2.5m
Northbound lanes of heavily traveled interstate std. lane widths used
Second impact
Traveling Southbound
First impact
RL
concrete barrier wall
Traveling Northbound

Figure A-1: CV's northbound approach, POI and FRP

Figure A-2: V#1 (right) and V#3 at FRP

Figure A-3: Front of case vehicle

Figure A-4: Case vehicle's front and left side

Figure A-5: Case vehicle's left front side

Figure A-6: Case vehicle's back and left side

Figure A-7: Case vehicle's back and right side

Figure A-8: Case vehicle's left side

Figure A-9: Case vehicle's front and left side

Figure A-10: Front of V#1

Figure A-11: V#1's front and left side

Figure A-12: V#1's left side

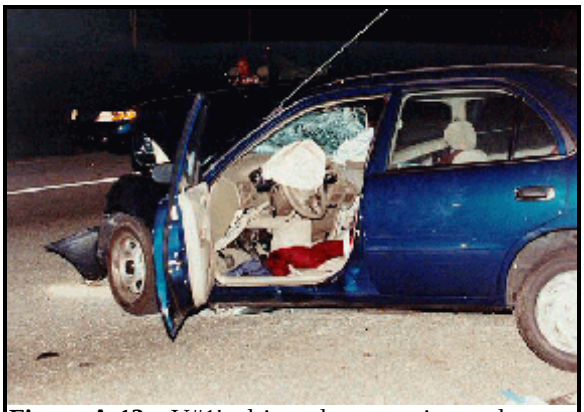

Figure A-13: V#1's driver door opening and seat area

Figure A-14: V#1's back and right side

Figure A-15: V#1's right side

Figure A-16: V#1's front right area

Figure A-17: V#3's front and left side

Figure A-18: V#3's right side