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SCI/NASS COMBINATION CASE REPORT

CASE NUMBER - NASS-99-09-071J
LOCATION - Maryland
VEHICLE - 1998 TOYOTA CAMRY
CRASH DATE - June, 1999

Submitted:

April 26, 2000
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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* SCI/NASS combination investigation of a side air bag deployment crash involving a 1998 Toyota Camry with manual safety belts and dual front and side air bags, and a 1995 Freightliner tractor-trailer rig.			
16. *Abstract* This report covers a SCI/NASS combination investigation of a side air bag deployment crash that involved a 1998 Toyota Camry four-door sedan (case vehicle) and a 1995 Freightliner truck tractor with semi-trailer (vehicle #2). This crash is of special interest because the case vehicle was equipped with seat back-mounted side air bags, one of which deployed as a result of the left side impact. The case vehicle's restrained driver (43-year-old female) sustained incapacitating injuries and was hospitalized for one day. The case vehicle was traveling west in the left turn lane of a four-lane, undivided, private roadway, entering a controlled intersection intending to turn left. Vehicle #2 was traveling north in the third lane of a seven-lane, divided U.S. roadway entering the same controlled intersection, intending to continue northbound. The left rear area of the case vehicle was impacted by the front of vehicle #2, causing the case vehicle driver's seat back-mounted side air bag to deploy. The impact caused the case vehicle to rotate counterclockwise an estimated 170 degrees coming to rest heading in a easterly direction. The case vehicle's driver was seated upright with her seat track located in its middle to rear most position, and with the tilt steering wheel located between its middle and upmost position. She was restrained by her available, active, three-point, lap-and-shoulder safety belt and sustained, according to her interview and medical records; a concussion without loss of consciousness, multiple contusions to her left arm, left and right knees, right chest, neck, and abdomen, with abrasions to her neck and abdomen. Both vehicles were towed from the scene due to damage.			
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This combination SCI/NASS investigation concerns a 1998 Toyota Camry (case vehicle) and a 1995 Freightliner truck tractor with semi-trailer (vehicle #2). The crash occurred in June, 1999, at 7:27 p.m., in Maryland and was investigated by the applicable police department. This crash is of special interest because the case vehicle was equipped with redesigned front air bags and seat-mounted side air bags. Both of the front air bags and the left side air bag deployed as a result of a left side impact, and the restrained driver [43-year-old female, White (non-Hispanic)] sustained incapacitating injuries. The NASS investigator inspected the scene and case vehicle in June 1999. This report is based on the Police Crash Report, the NASS investigator's coded forms and scene photgraphs, driver interviews, scene and vehicle inspections, occupant kinematic principles, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling west in the left turn lane of a four-lane, two-way, undivided private roadway and was entering a four-leg, controlled intersection, intending to turn left and travel south (i.e., there was one through lane in both directions and a left and right turn lane for the westbound roadway). Vehicle #2 was traveling north in the third lane of a four-lane, one-way roadway (i.e., two through lanes, a left turn lane and a right turn lane, divided by a grass median) that was part of a divided trafficway and was entering the same controlled intersection, intending to continue traveling northbound. The case vehicle's driver was unable to attempt any avoidance maneuvers and was struck by vehicle #2. The crash occurred in the intersection of the two roadways.

The front of vehicle #2 impacted the left side of the case vehicle, causing the case vehicle's dual front and left side air bags to deploy. The case vehicle continued in a westerly direction rotating counterclockwise approximately 170 degrees. The case vehicle came to rest in the intersection of the two streets, near the edge of the north median, heading in a easterly direction. Both vehicles were towed from the scene due to damage.

Figure 1: Case vehicle's westbound path of travel prior to entering intersection

The drivers of both vehicles were transported by ambulance to a hospital with police-reported incapacitating injuries. The case vehicle driver was hospitalized over night. The driver of vehicle #2 was treated and released.

The bituminous roadway for the case vehicle was straight with a negative slope of over 2% heading into the point of the crash. The bituminous roadway for vehicle #2 was straight and level at the point of the crash. It was daylight at the time of the crash with the roadways being dry and without defects. The posted speed limit is 89 km.p.h. (55 m.p.h.) for both roadways. Both roadways were controlled by an cycled automatic on-colors signal with turn arrow. The case vehicle's east/west roadway was divided by a double white line, with a solid white line dividing the left and right turn lanes and bordered with solid white

fog and raised curbs (**Figure 1**, above). Vehicle #2's north/south trafficway was divided by a raised grassy median, with a painted solid white line on the outside and inside of the left and right turn lanes respectively and a painted dashed white line dividing the two through lanes. The northbound lanes were bordered by a painted solid yellow line along the median and a painted solid white fog line and raised curb along the west edge of the roadway.

CASE VEHICLE

The case vehicle was a front wheel drive 1998 Toyota Camry XLE, five-passenger, four-door sedan (VIN: 4T1BF28KXWU------) equipped with a 3.0 liter V6 engine, power-assisted rack-and-pinion steering, and a 4-speed automatic transmission with console-mounted selector lever. Braking was achieved by a power-assisted, four wheel anti-lock system. The case vehicle had a wheelbase of 267 centimeters (105.2 inches). The case vehicle's recorded mileage is unknown due to an electronic odometer.

Figure 2: Front left oblique view of case vehicle's damaged left side

The front seat of the case vehicle was equipped with adjustable front bucket seats with adjustable head restraints and manual, three-point lap-and-shoulder safety belts. The vehicle was equipped with rigid knee bolsters for the driver and front right passenger seat positions. The back row was a bench seat with manual, three-point lap-and-shoulder safety belts for all three seat positions and adjustable head restraints for the outboard seat positions. The front safety belt systems were equipped with manually operated height adjusters for the D-rings with both in the full-down position. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of front air bags and seat back-mounted side air bags for the driver and front right seat positions.

CASE VEHICLE DAMAGE

The case vehicle's initial contact with vehicle #2 involved the left side from just behind the left B-pillar (**Figures 2-3**). Field L began 156 centimeters (61.4 inches) behind the left front axle and extended rearward 224 centimeters (88.2 inches). Direct damage from the case vehicle's initial impact extended from 178 centimeters (70.1 inches) behind the left front axle and extended rearward 203 centimeters (79.9 inches). The maximum crush to the case vehicle's left side was a measured 53 centimeters (20.1 inches) and was located between C2 and C3 (**Figure 4**). The

Figure 3: Rear left oblique view of deformation to case vehicle's left rear side; NOTE integrity loss

wheelbase on the left side was lengthened 6 centimeters (2.4 inches) with the right side being shortened 6 centimeters (2.4 inches). All of the case vehicle's doors remained closed with the left rear being jammed and inoperable. The glazing was disintegrated to the case vehicle's back light and left rear door. There was 12 centimeters (4.7 inches) of intrusion to the case vehicle's left C-pillar and 9 centimeters (3.5 inches) to the left rear door panel.

Figure 4: Straight on view of deformation to case vehicle's left side with contour gauge set up; NOTE: integrity loss to back light and door window

The CDC was determined to be: **10-LZAW-4 (-70)** for the case vehicle (maximum crush was 53 centimeters [20.1 inches] on the left side). No reconstruction program was used on the case vehicle's left side impact due to one of the collision conditions (i.e., vehicle #2 is a heavy truck) being beyond the scope of the WinSMASH reconstruction program; however, this contractor's visually estimated total Delta V for the left side impact is between 27 km.p.h. (17 m.p.h.) and 34 km.p.h. (21 m.p.h.).

An examination of the case vehicle's interior showed evidence of contact to the case vehicle's left front door panel including the armrest, front left door window sill, driver's front air bag and the driver's left side air bag. Suspected damage from the deploying case vehicle driver's side air bag was found to the left B-pillar (**Figure 5**). Movement of the case vehicle's energy absorbing steering column was not measured for compression. The case vehicle driver's knee bolster showed evidence of scuffing.

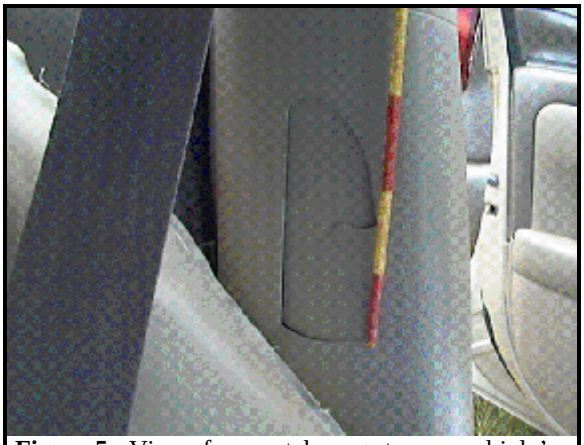

Figure 5: View of suspect damage to case vehicle's left B-pillar from side air bag deployment

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a SRS that consisted of front air bags and seat back-mounted side air bags at the driver and front right passenger seat positions. The dual front air bags and the left side air bag deployed as a result of the case vehicle's left side impact with the front of vehicle #2. The front air bags deployed because of the negative longitudinal force while the left side air bag deployed as a result of the positive lateral force resulting from the angled impact. The driver's air bag deployed from the steering wheel hub were it was mounted. The module cover consisted of H-configuration cover flaps made of thick vinyl with dimensions of 16 centimeters (6.3 inches) laterally at the center horizontal seam, 5 centimeters (2 inches) vertically for the upper flap and 8 centimeters (3.2 inches) vertically for the lower flap. The driver's air bag was round with diameter 69 centimeters (27.2 inches) and was designed with 2 tethers (unknown width) that were sewn interiorly and two vent ports (unknown diameter) located at the eleven and one o'clock positions.

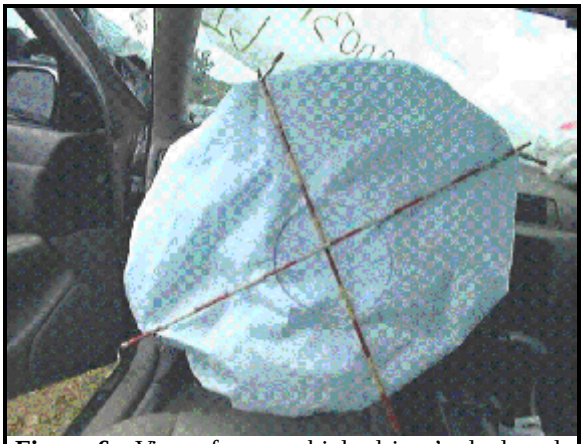

Figure 6: View of case vehicle driver's deployed front air bag

Figure 7: View of case vehicle's deployed front right air bag showing no damage or contact

An inspection of the case vehicle's driver air bag revealed no visible evidence of contact by the case vehicle driver (**Figure 6**). There was, however, an area on the lower half of the air bag that was stained red with translucent flakes which the investigator thought was food since it was also on the front right passenger's air bag cover flaps. An inspection of the driver air bag module's cover flaps showed no visible evidence of direct contact from the driver.

The front right passenger air bag was mounted on the top of the front right instrument panel. The cover flaps appear to be made of a thick vinyl-like substance. The flap's angled dimensions were 21 centimeters (8.3 inches) at the horizontal seam and 3 centimeters (1.2 inches) for the left upper vertical seam and 5 centimeters (2 inches) for the lower right vertical seam The profile of the case vehicle's instrument panel with the leading edge of the cover flap was not measured and is unknown.

Figure 8: View of torn seam in case vehicle driver's seat back and location of deployed side air bag module

The front right passenger air bag module's cover flaps opened properly along the tear points. Inspection of the cover flap revealed no damage other than a red stain with translucent flakes which the investigator thought was food since it was also on the driver's air bag. Examination of the front right passenger air bag showed no evidence of damage or contact (**Figure 7**).

The front right passenger air bag had one wide tether sewn to the center but had no vent ports. The air bag's front surface was 41 centimeters (16.1 inches) wide and 66 centimeters (26 inches) tall.

The driver's seat back-mounted side air bag deployed as a result of the case vehicle's left side impact from vehicle #2. The driver's side air bag deployed through a seam on the outboard side of the driver's seat back. The seam along the seat back side was 23 centimeters (9.1 inches) vertically. The side air bag was 31 centimeters (12.2 inches) longitudinally and 30 centimeters (11.81 inches) vertically (**Figure 9**). The driver's side air bag had no vent ports and was not tethered. Suspected damage due to the deploying case vehicle driver's side air bag was found to the left B-pillar (**Figure 5**, above).

Figure 9: View of case vehicle driver's deployed side air bag

CASE VEHICLE DRIVER KINEMATICS

The case vehicle's [43-year-old, White (non-Hispanic) female) driver was restrained by her available, active, three-point, lap and shoulder belt. Seatbelt usage was based on the police report, seat belt inspection, and the driver's interview.

Figure 10: Vertical view of case vehicle driver's seating area

The case vehicle's driver [165 centimeters and 95 kilograms (65 inches, 209 pounds)] was seated in an upright posture with her back against the seat back, her left foot was on the floor, her right foot on the accelerator, and both hands were on the steering wheel. Her seat track was located between it's middle and rearmost position, the seat back was upright, and the tilt steering wheel was between the full-up and center position.

The case vehicle's driver made no avoidance maneuvers; subsequently her pre-impact posture remained unchanged prior to impact. The case vehicle's impact with vehicle #2 resulted in the case vehicle's driver continuing slightly forward but primarily leftward, contacting the left knee bolster with her left knee, the steering column with her right knee, the side arm rest and door panel with her abdomen and upper torso as the case vehicle rotated counterclockwise. The driver's seat belt usage kept her in her seat during the approximately 170 degree rotation. At final rest the driver remained conscious and in her seat (**Figure 10**).

The case vehicle driver was transported by ambulance to a hospital where she was hospitalized over night and released the following day.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Contusion, left side of neck	390402.1 minor	Seat belt webbing	Certain	Discharge Summary
2.	Contusion, left lower abdomen	590402.1 minor	Seat belt webbing	Certain	Discharge Summary
3.	Abrasion, left lower abdomen	590202.1 minor	Seat belt webbing	Certain	E.R.
4.	Abrasion, left side of neck	390202.1 minor	Seat belt webbing	Certain	E.R.
5.	Contusion, left upper arm	790402.1 minor	Side air bag	Probable	E.R.
6.	Contusion, left hand	790402.1 minor	Left side hardware	Probable	E.R.
7.	Contusion, right chest	490402.1 minor	Seat belt webbing	Certain	Interviewee
8.	Contusion, right knee	890402.1 minor	Steering column	Probable	Interviewee
9.	Contusion, left hip	890402.1 minor	Left side door panel	Probable	Interviewee
10.	Nonanotomic brain injury, awake, NFS	160499.1 minor	Noncontact	Probable	E.R.

VEHICLE #2

Vehicle #2 was a 1995 Freightliner 6X4 truck tractor with semi-trailer (VIN: 1FUYDSEB4SH------) equipped with a 12.7 liter Diesel engine. Braking was achieved using a air brake system. The vehicle was not inspected and no photographs are available.