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REMOTE AIR BAG DEPLOYMENT REPORT

CASE NUMBER - IN99-043
LOCATION - CONNECTICUT
VEHICLE - 1998 SUBARU LEGACY WAGON
CRASH DATE - May 1998

Submitted:

January 20, 2000

Revised:
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Contract Number: DTNH22-94-D-17058

Prepared for:

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National Highway Traffic Safety Administration
National Center for Statistics and Analysis
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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*
Remote air bag deployment investigation involving a 1998 Subaru Legacy Wagon, four-door, with manual safety belts and dual redesigned front air bags, and a 1994 Plymouth Voyager minivan

16. *Abstract*

This report covers a remote investigation of an air bag deployment crash that involved a 1998 Subaru Legacy Wagon (case vehicle) and a 1994 Plymouth Voyager minivan (vehicle #2). 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 case vehicle's restrained driver (77-year-old male) sustained fatal injuries. The case vehicle was traveling south in the southbound lane of a two-way, undivided state highway. Vehicle #2 was traveling north in the northbound lane of the same roadway. For some unknown reason, the case vehicle drifted left-of-center into the northbound lane. The front of the case vehicle impacted the front of vehicle #2 causing the case vehicle's driver and front right passenger air bags to deploy. Investigating officers found no evidence of pre-impact braking by the case vehicle and a witness following the case vehicle saw no brake lights prior to the crash. Although investigating officers did not detect any pre-impact brake marks on the pavement from vehicle #2, its driver stated she "slammed" on the brakes immediately prior to impact and a witness noticed the front of vehicle #2 "dip" just prior to the collision. Investigating officers estimated the travel speed for the case vehicle at 56 km.p.h. (35 m.p.h.) and estimated the travel speed for vehicle #2 at 64 km.p.h. (40 m.p.h.). The case vehicle driver's seated posture, seat track adjustment and steering wheel adjustment are not known. It is possible that the case vehicle driver was asleep at the time of the crash. He was restrained by his available, active, three-point, lap-and-shoulder safety belt system and sustained, according to his death certificate, a fracture-dislocation of the cervical spine and a contusion of the spinal cord that resulted in respirator-dependant quadriplegia. A decision was made to discontinue respirator support and he was pronounced dead five days and 16 hours post-crash. No autopsy was performed.

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Additional photographs are available in SCI EDCS case IN99-043.

BACKGROUND

IN99-043

This case was brought to the NHTSA's attention by a review of the 1998 Fatality Analysis Reporting System (FARS) in February 1999. The crash involved a 1998 Subaru Legacy Wagon (case vehicle) and a 1994 Plymouth Voyager minivan (vehicle #2). The collision occurred in May 1998, at 6:12 p.m., in Connecticut, 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 crash events and the case vehicle's restrained driver (77-year-old male) sustained fatal injuries. The Police Crash Report was received in April 1999, with both the police photographs and the death certificate obtained in November 1999. This report is based on the Police Crash report, the death certificate, police photographs, occupant kinematic principles, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling south in the southbound lane of a two-lane, undivided, state highway **(Figure 1**). Vehicle #2 was traveling north in the northbound lane of the same roadway. It was daylight with clear weather. The roadway was bituminous, dry, straight, level, with no roadway defects and no vision obstructions. The posted speed limit for this roadway was 64 km.p.h. (40 m.p.h.). Traffic control devices present at the crash scene consisted of a double solid yellow (no passing) centerline and single solid white edge lines on the east and west pavement edges. For some unknown reason, the case vehicle drifted left of center into the northbound lane. There was no evidence of pre-impact braking by the case vehicle and a witness following the case vehicle saw no brake lights prior to the crash. Investigating officers did not detect any pre-impact brake marks from vehicle #2, but its driver stated she "slammed" on the brakes immediately prior to impact and a witness noticed the front of vehicle #2 "dip" just prior to the collision.

Figure 1: Southerly view of crash scene; Note: case vehicle at final rest left-of-center (case photo #01)

Figure 2: Southeast view of both vehicles at final rest; Note: case vehicle is at the left (case photo #08)

The collision occurred in the northbound lane. The front of the case vehicle impacted the front of vehicle #2, causing the case vehicle's driver and front right passenger air bags to deploy. Vehicle #2's driver and front right passenger air bags also deployed. Neither vehicle rotated post-crash but they rebounded such that they were separated by a measured distance of 4.3 meters (14 feet), with the case vehicle facing south at final rest and vehicle #2 facing north (**Figure 2**). Investigating officers estimated the travel speed for the case vehicle at 56 km.p.h. (35 m.p.h.) and estimated the travel speed for vehicle #2 at 64 km.p.h. (40 m.p.h.).

The case vehicle was an all-wheel-drive, 1998 Subaru Legacy, four-passenger, five-door station wagon (VIN: 4S3BK4353W7------) equipped with a 2.2 liter gasoline engine and a four-speed automatic transmission with a console-mounted shift lever. It was not equipped with four-wheel anti-lock brakes. The wheelbase for the case vehicle was 263 centimeters (103.5 inches). An odometer reading of 8,819 kilometers (5,480 miles) was reported by investigating officers. The case vehicle was towed from the scene due to disabling damage.

Figure 3: Case vehicle's front damage; Note: corner-to-corner damage (case photo #02)

The case vehicle sustained direct contact across the entire width of its front end (**Figure 3**). All damaged components directly contacted were displaced rearward: the front bumper and fascia, grille, front hood edge, and left and right front fenders. The left headlamp assembly was missing and the right headlamp assembly was smashed but remained in place. Both turn light assemblies were missing. Induced damage included: left front tire and wheel restricted and pushed into left lower A-pillar, windshield splintered, left front door pushed into left lower B-pillar, left roof rail buckled, right front tire and wheel restricted and pushed into right lower A-pillar, right front door pushed into right lower B-pillar, and the right roof rail buckled. Based on police photographs, the CDC for the case vehicle was estimated as: **12-FDEW-2** (principal direction of force 0 degrees). The WinSMASH reconstruction program, with CDC-only estimated crush profile, provided a borderline reconstruction, but the results appear reasonable. The case vehicle's estimated Total, Longitudinal, and Lateral Delta Vs are, respectively: 59.2 km.p.h. (36.8 m.p.h.), -59.2 km.p.h. (-36.8 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.).

Interior damage to the case vehicle was difficult to assess with a single photograph as the sole view inside. There is a slight indication that the driver's foot well might have sustained a modest upward intrusion, but investigating officers stated in the Police Crash Report's narrative, "The interior of the vehicle was mostly undamaged with only the steering wheel and steering column being pushed forward."

Case Vehicle Driver

The case vehicle's driver [77-year-old, White (non-Hispanic) male; unknown height and weight] was reportedly wearing his available, active, three-point, lap-and-shoulder, safety belt system. There was no other occupant in the case vehicle. His pre-crash seat adjustments, steering wheel position, and posture are not known. The driver of vehicle #2 claimed she saw no driver behind the steering wheel of the case vehicle immediately prior to the collision. A witness had been following the case vehicle and observed that the case vehicle's driver appeared to be having trouble staying awake. The case vehicle's driver was transported from the scene by ambulance to a local medical facility and was subsequently transferred to another hospital by a lifeline helicopter. He was pronounced dead approximately five days and 16 hours post-crash. No autopsy was performed.

The following discussion is based on the Police Crash Report's narrative section, the death certificate, police on-scene photographs, and occupant kinematic principles. It is suspected that the case vehicle's driver may have fallen asleep. There were no indications that this driver attempted any avoidance maneuvers prior to the crash. The impact caused the case vehicle's driver and front right passenger air bags to deploy (**Figure 4**). As that impact was a central, head-on collision, the driver moved forward and it is possible that the deploying air bag caught his lower chin and neck with sufficient force to cause a fracture-dislocation of cervical vertebra C2, with associated contusion of the spinal cord. He continued forward a sufficient distance to deflate the air bag and come into contact with the steering wheel, causing fractured ribs (aspect unknown). He then rebounded and was found slumped in his seat to the left at final rest.

Figure 4: Case vehicle driver's seat area; Note: no obvious contact marks on air bag or steering wheel (case photo #12)

The case vehicle driver's injuries resulted in respirator-dependant quadriplegia. A decision was made to discontinue the respirator support and the case vehicle's driver was pronounced dead approximately five days and 16 hours post-crash. No autopsy was performed. Immediate causes of death listed on his death certificate consisted of, "respiratory failure and multiple blunt force injuries with fracture-dislocation of cervical spine, contusion of the spinal cord, and quadriplegia." The fracture-dislocation of the cervical spine and contusion of the spinal cord were likely caused by contact with the driver's air bag. Injuries mentioned in the narrative section of the Police Crash Report consisted of, "several broken ribs and a broken C2 vertebra." The rib fractures likely resulted from steering wheel contact.

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.	Fracture-dislocation of C2 vertebra with cord contusion, resulting in respirator-dependant quadriplegia	640236.6 untreatable	driver's air bag	possible	death certificate
2.	Rib fractures, NFS	450220.2 moderate	steering wheel hub/spokes	possible	police crash report

Vehicle #2 was a front wheel drive, 1994 Plymouth Voyager SE, seven-passenger, three-door minivan (VIN: 2P4GH2534RR------) equipped with a 3.0 liter, V-6 gasoline engine and a three-speed automatic transmission. Four-wheel anti-lock brakes were an option for this vehicle, but it is unknown if it was so equipped. The wheelbase for vehicle #2 was 285 centimeters (112.3 inches). The odometer reading was 131,390 kilometers (81,644 miles). Vehicle #2 was towed from the scene due to disabling damage. It was equipped with driver and front right passenger air bags and the impact with the case vehicle caused both air bags to deploy (**Figure 5**). Direct contact damage to vehicle #2 included: front bumper and fascia displaced rearward, front grille disintegrated, engine compartment front brackets and hood latch shoved rearward, both headlight assemblies displaced, the radiator vanes smashed, front quarter of hood edge bent under and back, the right front fender shoved rearward, and the left front fender buckled (**Figure 6**). Induced damage included: the left front wheel and tire shoved back into the left lower A-pillar, the left front door's forward seam and the beltline at the rear door seam were buckled, the windshield was splintered, the left rear corner of the vehicle was raised up, the right front wheel and tire shoved back into the right lower A-pillar, the right front door was buckled, the right roof rail was buckled, the right upper B-pillar was buckled slightly, and the right lower C-pillar was slightly buckled. Based on police photographs, the CDC for vehicle #2 was estimated as: **12-FDEW-2** (principal direction of force 0 degrees). The WinSMASH reconstruction program, CDC-only algorithm, provided a borderline reconstruction, but the results appear reasonable. Vehicle #2's estimated Total, Longitudinal, and Lateral Delta Vs are, respectively: 50.9 km.p.h. (31.6 m.p.h.), -50.9 km.p.h. (-31.6 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). There were five occupants in vehicle #2, including the driver.

Figure 5: Vehicle #2 driver's seat area; Note: both front air bags deployed (case photo #13)

Vehicle #2's driver (35-year-old female; unknown race/ethnicity, height, and weight) was wearing her available, active, three-point, lap-and-shoulder, safety belt system. Her pre-crash seat adjustments, steering wheel position, and posture are not known. She sustained a police-reported "B" injury (fractured left clavicle) and was transported from the scene by ambulance to a medical facility. Her front right passenger (9-year-old female; unknown race/ethnicity, height, and weight) was wearing her available, active, three-point, lap-and-shoulder, safety belt system. She sustained police-reported "B" injuries (fractured right radius and ulna) and was transported from the scene by ambulance to a medical facility. The second seat left passenger (3-year-old female; unknown race/ethnicity, height, and weight) was wearing her available, active, three-point, lap-and-shoulder, safety belt system. She sustained police-reported "C"

Figure 6: Vehicle #2's front damage; Note: maximum crush just right of the front left corner (case photo #07)

injuries (contusion to forehead and complaint of abdominal and back pain) and was transported from the scene by ambulance to a medical facility. The second seat right passenger (7-year-old male; unknown race/ethnicity, height, and weight) was wearing his available, active, three-point, lap-and-shoulder, safety belt system. He sustained police-reported "B" injuries (a jejunal crush injury, a mesentery hematoma, a retroperitoneal hematoma, and a lumbar region back sprain) and was transported from the scene by ambulance to a medical facility. The third seat right passenger (3-year-old female; unknown race/ethnicity, height, and weight) was wearing her available, active, three-point, lap-and-shoulder, safety belt system. She sustained police-reported "C" injuries (minor head injury and a seat belt-related abdominal injury) and was transported from the scene by ambulance to a medical facility.