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REMOTE AIR BAG DEPLOYMENT REPORT

CASE NUMBER - IN99-093
LOCATION - Texas
VEHICLE - 1998 CHEVROLET CORVETTE
CRASH DATE - October 1998

Submitted:

December 29, 2000

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Contract Number: DTNH22-94-D-17058

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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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Remote air bag report involving a 1998 Chevrolet Corvette, equipped with manual safety belts and dual redesigned front air bags, and two not in-transport vehicles (both with attached, empty boat trailers).

16. *Abstract*

This report covers a remote investigation of an air bag deployment crash that involved a 1998 Chevrolet Corvette (case vehicle) and two not in-transport vehicles (both with attached, empty boat trailers). This crash is of special interest because the Corvette was equipped with redesigned air bags that deployed as a result of the collision events. The restrained driver (20-year-old male) was killed and his restrained front right passenger (19-year-old male) sustained police-reported “B” (non-incapacitating) injuries. The Corvette was traveling south in the southbound lane of a two-lane, undivided county roadway. The two not in-transport vehicles were unoccupied and illegally parked on the east shoulder of the county roadway. The Corvette crossed the center line, the northbound travel lane, and entered the dirt and gravel east shoulder. The Corvette’s front impacted the back of an empty boat trailer attached to a not in-transport van and, continuing on, the Corvette’s front left impacted the back right of the van, causing the Corvette's driver and front right passenger air bags to deploy. The Corvette also collided with a second empty boat trailer attached to a not in-transport pickup truck. The Corvette struck the not in-transport van a second time and descended an embankment into a canal. No avoidance maneuvers by the Corvette were reported by police. The Corvette's driver was restrained by his available, manual, three-point, lap-and-shoulder safety belt system. The autopsy listed his cause of death as exsanguination from multiple skull fractures. Specific injuries included: multiple comminuted basilar skull fractures; multiple comminuted facial bone fractures; a laceration of the cerebrum; contusions and lacerations of the lungs; lacerations of the liver and spleen; comminuted fractures of the left femur, tibia and fibula; and multiple lacerations, contusions, and abrasions over his entire body. The driver was declared dead at the scene. The front right passenger was transported to a hospital where he was treated and released. His specific injuries are not known. The Corvette was towed due to disabling damage.

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Additional photographs are available in SCI EDCS case IN99-093

BACKGROUND

IN99-093

This case was brought to the NHTSA's attention by a review of the 1998 Fatality Analysis Reporting System (FARS) in June 1999. The crash involved a 1998 Chevrolet Corvette (case vehicle) and two not in-transport vehicles (both with attached, empty boat trailers). The crash occurred in October 1998, at 6:30 a.m., in Texas, and was investigated by the applicable state police agency. This case is of special interest because the Corvette was equipped with redesigned air bags that deployed as a result of collision events. The restrained driver (20-year-old male) was killed and his restrained front right passenger (19-year-old male) sustained police-reported "B" (non-incapacitating) injuries. The Police Crash Report was received in December 1999, while the police photographs, autopsy, and the Certificate of Death were obtained in February 2000. This report is based on the Police Crash Report, the Certificate of Death, autopsy, police photographs, occupant kinematic principles, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The Corvette was traveling south in the southbound lane of a two-lane, undivided county roadway. It was dark with no street lights, clear weather, and no vision obstructions noted. The roadway was bituminous, dry, straight, level, and without defects. The posted speed limit was 80 km.p.h. [50 m.p.h.]. No pre-impact skidmarks were visible in police photographs and no avoidance maneuvers by the Corvette were mentioned by the investigating police officer. The Corvette crossed the center line, went off the left (east) edge of the roadway, and entered the dirt and gravel east shoulder.

Figure 1: Southbound approach for Corvette along east shoulder; Note: Corvette's final rest position just beyond white van (case photo #01)

The crash occurred on the east shoulder (**Figure 1**). The front of the Corvette impacted the back of an empty boat trailer attached to a not in-transport cargo van. The front left of the Corvette then struck the back right of the van, causing the Corvette's driver and front right passenger air bags to deploy. The front of the Corvette also collided with a second empty boat trailer attached to a not in-transport pickup truck. The left side of the Corvette struck the right front wheel area of the not in-transport van and then descended an embankment into a canal. It is not known how much of the Corvette was in the canal water at final rest (**Figure 2**).

Figure 2: Southeast view of Corvette's final rest position; Note: second boat trailer atop Corvette's hood (case photo #03)

The case vehicle was a rear wheel drive 1998 Chevrolet Corvette, two-passenger, two-door convertible (VIN: 1G1YY32GXW5------) equipped with a 5.7 liter, V-8 gasoline engine and unknown transmission type with the shift lever mounted on a center console. It was equipped with four-wheel anti-lock brakes. The Corvette's wheelbase was 265 centimeters [104.5 inches]. No odometer reading was reported. The Corvette was towed from the crash scene due to disabling damage.

The Corvette sustained five impacts and several of the fiberglass body panels shattered and flew apart. Because of the hood's position in police on-scene photographs, much of the front left damage is hidden (**Figure 3**); note that the Corvette had been hauled up out of the canal to the position where it is seen in these photos. The front bumper fascia was pushed rearward and downward. The hood had scrapes, a long gouge, and a hole (probably from the second trailer overriding the front of the Corvette). The bottom left corner of the windshield frame was separated from the cowl's top and moved rearward and inward; the left front fender disintegrated; the left front tire and wheel was knocked askew (top in, bottom out); the left front door is missing; and the front portion of the left rear quarterpanel was holed (**Figure 4**). The right front fender was disintegrated; the right front door was ajar (unknown if crash-induced or due to extrication) and the door panel showed a streak of rubber transfer; the right upper A-pillar was bent rearward and the lower right corner of the windshield was holed; there was a horizontal crease indentation approximately a third of the way up the windshield that extended from the right upper A-pillar to just short of the left upper A-pillar (**Figure 5**). Induced damage included the left lower A-pillar rearward movement and the dangling/separated interior rearview mirror.

Figure 3: Corvette's front damage; Note: hood position may be from removal operations (case photo #05)

Figure 4: Corvette's left side damage; Note: missing left front door (case photo #07)

Figure 5: Corvette's right side damage; Note: missing right front fender and angle of right A pillar (case photo #09)

The Corvette sustained major intrusion into the passenger compartment, including the left lower and upper A-pillar, the left side of the instrument panel, the steering wheel and column, and the right upper A-pillar. Floorboard and toe pan intrusion seem likely but cannot be verified.

The Corvette's most severe impact (which caused the air bags to deploy) was event #2. The front of the Corvette underrode the back of the parked van (Corvette front underride, van back override; see **Figure 7**, below). Because of the multiple overlapping impacts, it was not possible to estimate any CDCs for the Corvette and no WinSMASH reconstruction run was attempted. The crash severity for the Corvette's most severe impact was moderate (24 to 40 km.p.h. [15 to 25 m.p.h.]).

Figure 6: Corvette's interior from right side; Note: arrow locating blood stain and positioning of left instrument panel and steering wheel (case photo #14)

The available photographs do not permit a thorough evaluation of the Corvette's automatic restraint system, but they do verify that both driver and front right passenger air bags deployed (**Figure 6**). The driver's air bag module was located in the steering wheel hub. It is not known if the driver air bag was equipped with tethers or vent ports. The shape of the driver's air bag is also unknown. One small blood stain was detected on the air bag fabric but the deflated fabric positioning is such that the stain's location cannot be described (**Figure 6**). The front right passenger air bag module was located in the top of the instrument panel's right side. Its cover flap configuation is unknown, as is its shape. No vent ports are discernible but the air bag fabric stitching indicates the likelihood of at least one tether strap being present. No definitive occupant contact marks were identified on the passenger's air bag fabric.

CASE VEHICLE DRIVER

The Corvette's driver (20-year-old male, White, non-Hispanic, height and weight unknown) was reportedly wearing his available, manual, three-point, lap-and-shoulder safety belt system. His pre-crash seat adjustments, steering wheel position, and posture are not known. He was declared dead at the scene and was transported directly to a funeral home. His cause of death was listed as exsanguination from multiple skull fractures. The following discussion of the Corvette's driver is based on his autopsy, on-scene photographs, and occupant kinematic principles.

The driver was probably seated in a normal driving posture, with his back against the seat back, one foot on the floorboard, and the other on one of the foot controls. At least one of his hands would have been on the steering wheel. No reference to an avoidance maneuver of any type was contained in the Police Crash Report. All indications are that the Corvette traveled from its southbound travel lane, over the center line, across the northbound travel lane, and entered the east shoulder at a shallow angle. This vehicular movement would not have affected the driver's pre-impact posture. The front of the Corvette struck the back of an empty boat trailer attached to a full-size van that was parked on the shoulder. This first of five impacts was of modest severity, and probably had little effect on the driver's posture.

The second impact consisted of the Corvette's front left underriding the parked van's back right corner. This second impact caused the Corvette's driver to move forward, loading his safety belt. This impact also deployed the Corvette's dual front air bags, with the driver likely impacting his air bag with his chest and face. The Corvette's driver moved to his left as the contact with the Chevrolet van moved along the Corvette's left side, with the driver sustaining comminuted fractures to his left femur, left fibula, and left tibia as the floor and left side components intruded. With his left shoulder held by the safety belt, the driver pivoted such that his right side was leading as he continued forward relative to the decelerating vehicle. The intruding left upper A-pillar, windshield and/or the windshield header struck the driver's head and face, causing numerous comminuted fractures on the right side, including: the anterior frontal bone and orbital surface; the nasal bone; the right zygomatic bone; the right maxilla and lacrimal bones; the right orbital plate, cribriform plate, crista galli, and the perpendicular plate of the ethmoid bone; the greater wing of the sphenoid bone; and the petrous portion of the temporal bone. He also sustained a traumatic laceration to the right frontal lobe of the cerebrum, diffuse subarachnoid hemorrhage over the right and left hemispheres and a laceration of the right eyeball. As the left instrument panel and steering assembly intruded, the driver deflated the air bag, contacted the steering wheel and sustained: contusions to the right side of the anterior mediastinum and thymus; a laceration to the middle lobe of the right lung and multiple bilateral contusions to the lungs with bilateral hemothorax; a contusion to the right dome of the diaphragm; focal lacerations to the right lobe of the liver and the anterior surface of spleen; and contusions to the right and left adrenal glands. The other impacts (with the second empty boat trailer, the second impact with the van and the final descent down the embankment into the canal) were relatively minor. The driver also sustained multiple superficial lacerations, contusions, and abrasions.

CASE VEHICLE DRIVER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Comminuted basilar skull fractures, right side, involving: orbital plate; ethmoid; sphenoid; petrous portion of the temporal	150206.4 severe	Windshield and/or A-pillar, header, driver's side	Probable	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
2.	Comminuted fracture, right anterior frontal bone (glabella, between the eyebrows)	150404.3 serious	Windshield and/or A-pillar, header	Probable	Autopsy
3.	Comminuted fracture, right zygomatic bone	251800.2 moderate	Windshield and/or A-pillar, header	Probable	Autopsy
4.	Comminuted fracture, right maxilla and lacrimal bones	250800.2 moderate	Windshield and/or A-pillar, header	Probable	Autopsy
5.	Comminuted fracture, nasal bone	251004.2 moderate	Windshield and/or A-pillar, header	Probable	Autopsy
6.	Laceration, right frontal lobe (cerebrum)	140688.4 severe	Windshield and/or A-pillar, header	Probable	Autopsy
7.	Diffuse subarachnoid hemorrhage, bilateral cerebrum	140684.3 serious	Windshield and/or A-pillar, header	Probable	Autopsy
8.	Laceration, right eyeball, NFS	241200.1 minor	Windshield and/or A-pillar, header	Probable	Autopsy
9.	Intraparenchymal laceration, middle lobe, right lung	441418.4 severe	Steering wheel rim/hub/spoke	Probable	Autopsy
10.	Multiple contusions, bilateral lungs	441410.4 severe	Steering wheel rim/hub/spoke	Probable	Autopsy
11.	Contusion, diaphragm, right dome	440602.2 moderate	Steering wheel rim/hub/spoke	Probable	Autopsy
12.	Lacerations, liver, right lobe, NFS	541820.2 moderate	Steering wheel rim/hub/spoke	Probable	Autopsy
13.	Lacerations, anterior surface, spleen, NFS	544220.2 moderate	Steering wheel rim/hub/spoke	Probable	Autopsy
14.	Contusions, right adrenal gland, NFS	540210.1 minor	Steering wheel rim/hub/spoke	Probable	Autopsy
15.	Contusion, left adrenal gland, NFS	540210.1 minor	Steering wheel rim/hub/spoke	Probable	Autopsy
16.	Hemorrhage and hematoma, right anterior mediastinum and thymus	442206.4 severe	Steering wheel rim/hub/spoke	Probable	Autopsy
17.	Comminuted fracture, mid-shaft, left femur	851814.3 serious	Left instrument panel	Probable	Autopsy
18.	Comminuted fracture, proximal left fibula	851606.2 moderate	Floor, toe pan	Possible	Autopsy
19.	Comminuted fracture, distal left tibia	853422.3 serious	Floor, toe pan	Possible	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
20.	Contusion, right anterior neck	390402.1 minor	Unknown	Unknown	Autopsy
21.	Multiple skin lacerations, NFS	990600.1 minor	Unknown	Unknown	Autopsy
22.	Multiple skin contusions, NFS	990400.1 minor	Unknown	Unknown	Autopsy
23.	Multiple skin abrasions, NFS	990200.1 minor	Unknown	Unknown	Autopsy

CASE VEHICLE FRONT RIGHT PASSENGER

The Corvette's front right passenger (19-year-old male, unknown race/ethnicity, height and weight unknown) was reportedly wearing his available, manual, three-point, lap-and-shoulder, safety belt system. His pre-crash seat adjustments and posture are not known. He was transported from the crash scene by ambulance to a medical facility. An addendum to the Police Crash Report indicated this occupant sustained abrasions and contusions and was treated and released. His specific injuries are not known.

OTHER VEHICLES

The first other vehicle was a not in-transport rear wheel drive 1995 Chevrolet G-20, 3/4-ton cargo van (VIN: 1GCEG25K0SF------). Attached to the van was an empty, homemade boat trailer of unknown length. The van had a wheelbase of 318 centimeters (125 inches). No odometer reading was reported. This vehicle was unoccupied and illegally parked on the east shoulder. The van sustained induced damage to the trailer hitch and back bumper as a result of the impact to its trailer. The front of the Corvette went under the back of the van, causing direct damage to the back right bumper corner, the back right corner of the back right quarterpanel, the back right undercarriage and the back right wheel and suspension. The rear axle and right rear wheel were displaced forward (**Figure 7**). A CDC for the van's first impact with the Corvette was estimated from photographs as **06-BREE-4 (180)**. The van also sustained a second, relatively minor impact with the Corvette, at the right front corner area. The right front fender was creased, trim pieces around right headlight assembly were broken, the right turn signal lens was shattered and the right corner of the front bumper was displaced

Figure 7: Back right damage to the first not in-transport vehicle; Note: right rear wheel shoved to front of right rear wheel well (case photo #11)

forward. The available photographs are not sufficient to estimate a CDC for this impact.

The second other vehicle was a not in-transport 1997 Chevrolet S10, 4x2, extended cab pickup truck (VIN: 1GCCS19X6V8------). Attached to the pickup truck was an empty boat trailer of unknown manufacture and unknown size. The wheelbase for the pickup truck is unknown. No odometer reading was reported. This vehicle was unoccupied and illegally parked on the east shoulder of the county roadway. The available photos are not sufficient to describe damage to the trailer or the pickup, except to note that this second trailer was apparently atop the Corvette at final rest in the canal.