

On-Site Investigation / Vehicle to Animal  
Dynamic Science, Inc. / Case Number: DS98020  
1996 Ford Taurus GL 4-door  
Colorado  
July, 1998

---

*This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.*

*The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.*

*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.*

---

|   |  |                                      |                            |   |           |
|---|--|--------------------------------------|----------------------------|---|-----------|
| 1. Report No.<br>DS98020  |  | 2. Government Accession No.          |                            | 3. Recipient Catalog No.                                      |           |
| 4. Title and Subtitle<br>In-Depth Accident Investigation  |  |                                      |                            | 5. Report Date<br>March 28, 2000                              |           |
|   |  |                                      |                            | 6. Performing Organization Report No.                         |           |
| 7. Author(s)<br>Dynamic Science, Inc.   |  |                                      |                            | 8. Performing Organization Report No.                         |           |
| 9. Performing Organization name and Address<br>Dynamic Science, Inc.<br>530 College Parkway, Ste. K<br>Annapolis, MD 21401  |  |                                      |                            | 10. Work Unit No. (TRAIIS)                                    |           |
|   |  |                                      |                            | 11. Contract or Grant no.<br>DTNH22-94-D-27058                |           |
| 12. Sponsoring Agency Name and Address<br>U.S. Dept. of Transportation (NRD-32)<br>National Highway Traffic Safety Administration<br>400 7th Street, SW<br>Washington, DC 20590   |  |                                      |                            | 13. Type of report and period Covered<br>[Report Month, Year] |           |
|   |  |                                      |                            | 14. Sponsoring Agency Code                                    |           |
| 15. Supplemental Notes  |  |                                      |                            |   |           |
| 16. Abstract<br><p>The collision occurred in Colorado in July, 1998 at 2202 hours. The crash took place on the southbound travel lanes of a seven-lane divided state highway. The highway is a designated east-west highway, but it runs north-south at the area of the collision. There are three southbound travel lanes and three northbound lanes with a left turn lane. The north and southbound lanes are separated by a raised concrete median. There is a left turn lane for northbound traffic. The weather was clear and the roadway was dry and free of defects. There was a negative 3.3% grade at this location. The posted speed limit is 80 km/h (50 mph).</p> <p>Vehicle 1, a 1996 Ford Taurus GL 4-door driven by a 47-year-old female (160cm/50 kg), was traveling southbound in the third lane from the right at a minimum pre-braking travel speed of 58.7 km/h (36.5 mph). The front right seat was occupied by 9-year-old male (137.2 cm/31.8 kg). Vehicle 1 was equipped with dual front air bags. A second vehicle had braked, swerved to the right and struck a 272 kg (600 lb) elk with its left front bumper. The elk was hurled into the path of Vehicle 1. Just prior to striking the elk, the driver probably braked. Vehicle 1 struck the elk with its front left bumper, and the elk went underneath Vehicle 1. On impact, both of the air bags in Vehicle 1 deployed. After impact, the driver of Vehicle 1 continued braking until coming to rest 19.4 m (63.5 ft) south of the point of impact and left 19.4 m (63.5 ft) of front left locked wheel skid mark. Vehicle 1 had no visible damage to the front end, and there was no visible damage to the undercarriage. A CDC of (12FYEN1) was assigned to the damage. The maximum crush was 1 cm (.4 in) to the left front bumper at C<sup>1</sup>. In order to calculate a delta v, the barrier portion of the WinSmash reconstruction algorithm was used even though the collision is beyond its scope. WinSmash calculated a total delta v of 10.4 km/h (6.5 mph), and longitudinal delta v of -10.9 km/h (-6.8 mph). This a borderline reconstruction and the results appear low. It is not clear whether the air bags should have deployed in such a low speed impact collision.</p> <p>It is this investigator's opinion that the front right occupant in Vehicle 1 was seated in an upright position. He was wearing the lap belt, and the shoulder belt was behind him. Just prior to impact, the driver began to brake. At impact with the elk, both of the air bags in Vehicle 1 deployed. Due to the hard braking, the front right occupant was pitched forward to some extent and he slid forward on the seat. The deploying air bag caught him in face and in the anterior throat areas, there was evidence of skin transfers on the air bag. There were also several bluish transfers on the air bag, that probably came from the blue and white striped shirt or blue jeans that he was wearing. As the air bag continued its deployment pattern, the front right occupant's head was accelerated/pushed rearward. He came to rest on the front center seat area with his head against the seat back cushion.</p> <p>The local fire department arrived on the scene at 2208 hours. Paramedics noted that the front right occupant was without vital signs and a cardiac monitor showed asystole. Paramedics called a helicopter to transport the front right occupant to a hospital. The flight nurse assumed care and after examining the front right occupant, contacted the emergency room of the hospital. The front right occupant was then pronounced dead at 2232 hours. The coroner's report indicates that the final cause of death was a closed head injury due to blunt force trauma. It listed significant injuries of bilateral subdural hematomas, cerebral contusions, and cerebral edema.</p> |  |                                      |                            |   |           |
| 17. Key Words<br>Air bag, deployment, injury, accident, fatality, passenger,  |  |                                      | 18. Distribution Statement |   |           |
| 19. Security Classif. (of this report)  |  | 20. Security Classif. (of this page) |                            | 21. No of pages   | 22. Price |

**Dynamic Science, Inc.  
Accident Investigation  
Case Number: DS98020**

**TABLE OF CONTENTS**

|  |    |
|--|----|
| Background . . . . .                     | 1  |
| Description . . . . .                    | 1  |
| Investigation Type . . . . .             | 1  |
| Crash Location . . . . .                 | 1  |
| Crash Date . . . . .                     | 1  |
| Notification Date . . . . .              | 1  |
| Field Work Completed . . . . .           | 1  |
| Summary . . . . .                        | 1  |
| Scene Diagram . . . . .                  | 6  |
| Detailed Information . . . . .           | 7  |
| Vehicles . . . . .                       | 7  |
| Occupants . . . . .                      | 10 |
| Injuries and Injury Mechanisms . . . . . | 11 |
| Occupant Kinematics . . . . .            | 14 |

## BACKGROUND:

**Description:** This case was initiated in response to a report of a low-speed impact involving an air bag deployment and a fatally injured front right passenger, a 9-year-old child. This case was conducted as an on-site investigation. The NHTSA was notified on July 28, 1998, by the NHTSA Region VIII office as a result of several newspaper articles that were written regarding this collision. DSI was notified on July 29, 1998 at 1219 hours via fax. Present at the inspection of Vehicle 1 was the local police Sergeant that was supervising the investigation, and several of the insurance adjusters.

**Investigation Type:** On-Site

**Crash Location:** Colorado

**Crash Date:** July, 1998

**Notification Date:** July, 1998

**Field Work Completed:** July 31, 1998

## SUMMARY:

The collision occurred in Colorado in July, 1998 at 2202 hours. The crash took place on the southbound travel lanes of a seven-lane divided state highway. The highway is a designated east-west highway, but it runs north-south at the area of the collision. There are three southbound travel lanes and three northbound lanes with a left turn lane. The north and southbound lanes are separated by a raised concrete median. The weather was clear and the roadway was dry and free of defects. There was a negative 3.3% grade at this location. The posted speed limit is 80 km/h (50 mph).



**Figure 1.** Area of impact and post-impact skid.

Vehicle 1, a 1996 Ford Taurus GL 4-door driven by a 47-year-old female (160cm/50 kg), was traveling southbound in the third lane from the right at a minimum pre-braking travel speed of 58.7 km/h (36.5 mph)<sup>1</sup>. The front right seat was occupied by 9-year-old male (137.2 cm/31.8 kg). Vehicle 1 was equipped with dual front air bags.

A second vehicle was traveling southbound in the second lane from the right, and ahead of Vehicle 1. This second vehicle was traveling at a driver stated speed of 72 km/h (45 mph). The driver of Vehicle 1 saw the second vehicle make a swerving motion to the right. The second vehicle had braked, swerved to the right and struck a 272 kg (600 lb) elk with its left front

<sup>1</sup> See Attachment 1

bumper. The elk was hurled into the path of Vehicle 1. The driver of Vehicle 1 remembers seeing the neck and shoulder of the elk. Just prior to striking the elk, the driver probably braked. Vehicle 1 struck the elk with its front left bumper, and the elk went underneath Vehicle 1. On impact, both of the air bags in Vehicle 1 deployed. After impact, the driver of Vehicle 1 continued braking until coming to rest 19.4 m (63.5 ft) south of the point of impact and left 19.4 m (63.5 ft) of front left locked wheel skid mark. Vehicle 1 came to final rest facing south.

Vehicle 1 had minor damage to the front end. A CDC of 12FYEN1 was assigned to the damage, with a direct damage width of 13 cm (5.1 in). The maximum crush was 1 cm (.4 in) to the left front bumper at C<sup>1</sup>. In order to calculate a delta v, the barrier portion of the WinSmash reconstruction algorithm was used even though the collision is beyond its scope. WinSmash calculated a total delta v of 10.4 km/h (6.5 mph), and longitudinal delta v of -10.9 km/h (-6.8 mph). This a borderline reconstruction and the results appear low given that the air bags in Vehicle 1 deployed. Since the collision condition is beyond the scope of WinSmash, the elk was a yielding object, the results were not coded in the EDCS.



**Figure 2.** Exterior damage to Vehicle 1.

The driver of Vehicle 1 did not claim any injuries. She did receive treatment at the scene by fire paramedics; this was primarily due to shock.

The driver of Vehicle 1 indicated that the front right occupant was seated in a normal upright position, and that he was tall enough so that his feet were able to touch the floor board with his back in contact with the seat back cushion. They were engaged in an active conversation. At the inspection of Vehicle 1, the cloth covered front right bucket seat was adjusted to the rear most track position and the seat back was slightly reclined. There is a question as to how the front right occupant in Vehicle 1 was wearing the three-point manual lap and shoulder belts. The driver of Vehicle 1 indicated that the front right occupant was wearing the lap portion of the belt, but was unsure if the shoulder belt was behind him. The front right



**Figure 3.** Blood spots on front right seat.

occupant had commented to the driver on prior occasions that the shoulder belt was uncomfortable to wear because it came across his face. The inspection of the vehicle revealed curling and fraying of the seat belts. There were also blood spots on the shoulder belt. These blood spots matched up with the blood spots on the seat back cushion, around the area where the front right occupant's head came to rest after the collision (see Figure 3). It is thought that the shoulder belt was behind the front right occupant and the shoulder belt was stained in this position.

Two bystanders arrived at the scene after the collision occurred, and they were both interviewed. The first bystander indicated that when he got there the driver of Vehicle 1 was out of the vehicle and hysterical. The bystander got into Vehicle 1 and sat in the driver's seat. He had a hard time breathing due to all the smoke in the vehicle. He began to push the air bag away from around the front right occupant. The bystander exited the vehicle and went around to the front right door to get better access to the front right occupant. He indicated that he thought that the front right occupant had submarined underneath the lap belt, and that both of his feet and knees were well beneath the dashboard. His buttocks were at the leading edge of the bottom seat cushion. The shoulder belt was behind the front right occupant, and the lap belt was at mid-chest level. His head was facing upward and against the seat back. The bystander stated that the seat back was inclined as if the front right occupant was sleeping; this observation is contrary to what the driver indicated. At the time of the vehicle inspection, the seat back was only slightly reclined. The second bystander, a nurse, arrived at the scene after the first bystander and she started mouth to mouth resuscitation on the front right occupant until the emergency rescue personnel arrived. One of the paramedics noted that the front right occupant was scooted down low in the front right passenger seat, with the lap belt placed across the hips and the shoulder strap behind the body.

It is this investigator's opinion that the front right occupant in Vehicle 1 was seated in an upright position. He was wearing the lap belt, and the shoulder belt was behind him. Just prior to impact, the driver began to brake. At impact with the elk, both of the air bags in Vehicle 1 deployed. Due to the hard braking, the front right occupant was pitched forward to some extent and he slid forward on the seat. He may have contacted the instrument panel with both his hands. The deploying air bag caught him in face and in the anterior throat areas, there was evidence of skin transfers on the air bag. There were also several bluish transfers on the air bag, that probably came from the blue and white striped shirt or blue jeans that he was wearing. As the air bag continued its deployment pattern, the front right occupant's head was accelerated/pushed rearward. The right hand was pushed laterally—likely into the A-pillar and windshield, and the left hand was also pushed laterally into the windshield. He came to rest on the front center seat area with his head against the seat back cushion.

There was no evidence of the front right occupant contacting the windshield. There were air bag fibers all about the windshield, and there was no evidence of occupant contact to the front right module cover. The module cover was cut and deformed when it struck, starred and shattered the windshield. The plastic molding around the front right A-pillar was cracked more than likely by contact with the right hand of the front right occupant.

Injury data was obtained from the investigator's report from the coroner's office and the coroner's report of the autopsy. The front right occupant sustained a small laceration to the brain stem (AIS 6) involving the junction between the pons and medulla; the C1 and C2 vertebrae were

intact. There was bilateral subdural hemorrhaging (AIS 5) involving both cerebral hemispheres. Bilateral subdural hematomas (AIS 5) and cerebral contusions (AIS 3) under the surfaces of the frontal, temporal, and occipital areas of both cerebral hemispheres. Cerebral edema (AIS 3) is prominent. There was a 2.5 cm (1 in) laceration (AIS 1) to the right upper eyelid surrounded by an abrasion and contusion (AIS 1). There was a semi circular contusion (AIS 1) and abrasion (AIS 1) just below the right eye. There were two linear, horizontal contusions (AIS 1) mid-aspect of nose that measured 2.5 cm (1 in) and 3.8 cm (1.5 in) respectively. There was a neck abrasion (AIS 1) from ear to ear that measured 5.0 cm (2 in) wide. The right side of the face had a large area of abrasion (AIS 1) from adjacent to the right eye and extending to the right chin. There was an abrasion (AIS 1) and contusion (AIS 1) to the lateral aspect of the right ear. On the left side of the face was a circumscribed area of abrasion (AIS 1) and on the midline and lower aspect of the chin is a circumscribed area of abrasion (AIS 1). There was a lower lip laceration (AIS 1). There was a small area of contusion (AIS 1) on the anterior surface of the left shoulder. A road rash type abrasion (AIS 1) to the inner right arm—above and below the elbow. Abrasions (AIS 1) and contusions (AIS 1) of the anterior aspect of the left forearm. Abrasions (AIS 1) to the medial aspects of the right forearm and large areas of abrasion (AIS 1) on the anterior-medial aspect of the left upper arm. All of the above injuries were as a result of interaction with the front right passenger's air bag.

The front right occupant also sustained a scalp contusion (AIS 1) and a diagonal curvilinear scalp laceration (AIS 1) to the top of the head a measuring 2.5 cm (1 in). There were two linear, vertical superficial lacerations (AIS 1) that measure 1.9 cm (.75 in) and 2.5 cm (1 in) to the anterior right ear. The source of these injuries is not known.

The front right occupant also sustained injuries to his upper and lower extremities. There were minor lacerations (AIS 1) and abrasions (AIS 1) to the four minor digits of the right arm, and the lateral aspect of the right hand and wrist had a large contusion (AIS 1). Multiple lacerations (AIS 1) involving the lateral aspect of the ring and little finger of the left hand, and also punctate lacerations (AIS 1) of the index finger of left hand. These injuries were “fling” type injuries from the air bag into the A-pillar and windshield areas. There was an abrasion (AIS 1) on the anterior medial aspect of the left knee and scattered contusions (AIS) on the anterior aspect of the left lower leg that were caused by contact with the right lower instrument panel.

In a newspaper article the coroner's office stated the air bag had been cleared in the front right occupant's death.

*“...boy who died when his head hit the windshield. He was not killed by the car's air bag, which deployed in the collision.”*

As indicated above, there is no evidence of contact to the windshield by the front right occupant. One of the photographs taken at the coroner's autopsy also notes *“scalp laceration...No glass indications.”*

The local fire department was notified at 2205 hours and arrived on the scene at 2208 hours. Paramedics noted that the front right occupant was without vital signs and a cardiac monitor showed asystole. After administering advanced trauma life support which included intubation and large bore IV line, paramedics called a helicopter to transport the front right occupant to a



hospital. Paramedics then transported the front right occupant back to their fire station to await the helicopter. The helicopter arrived at the fire station at 2226 hours. The flight nurse assumed care and after examining the front right occupant, contacted the emergency room of the hospital. The front right occupant was then pronounced dead at 2232 hours.

The coroner's report indicates that the final cause of death was a closed head injury due to blunt force trauma. It listed significant injuries of bilateral subdural hematomas, cerebral contusions, and cerebral edema.

Vehicle 1 was towed from the scene, but due to the circumstances of the collision and not due to damage sustained by the vehicle. The insurance company later declared the vehicle a total loss.

Scene Diagram

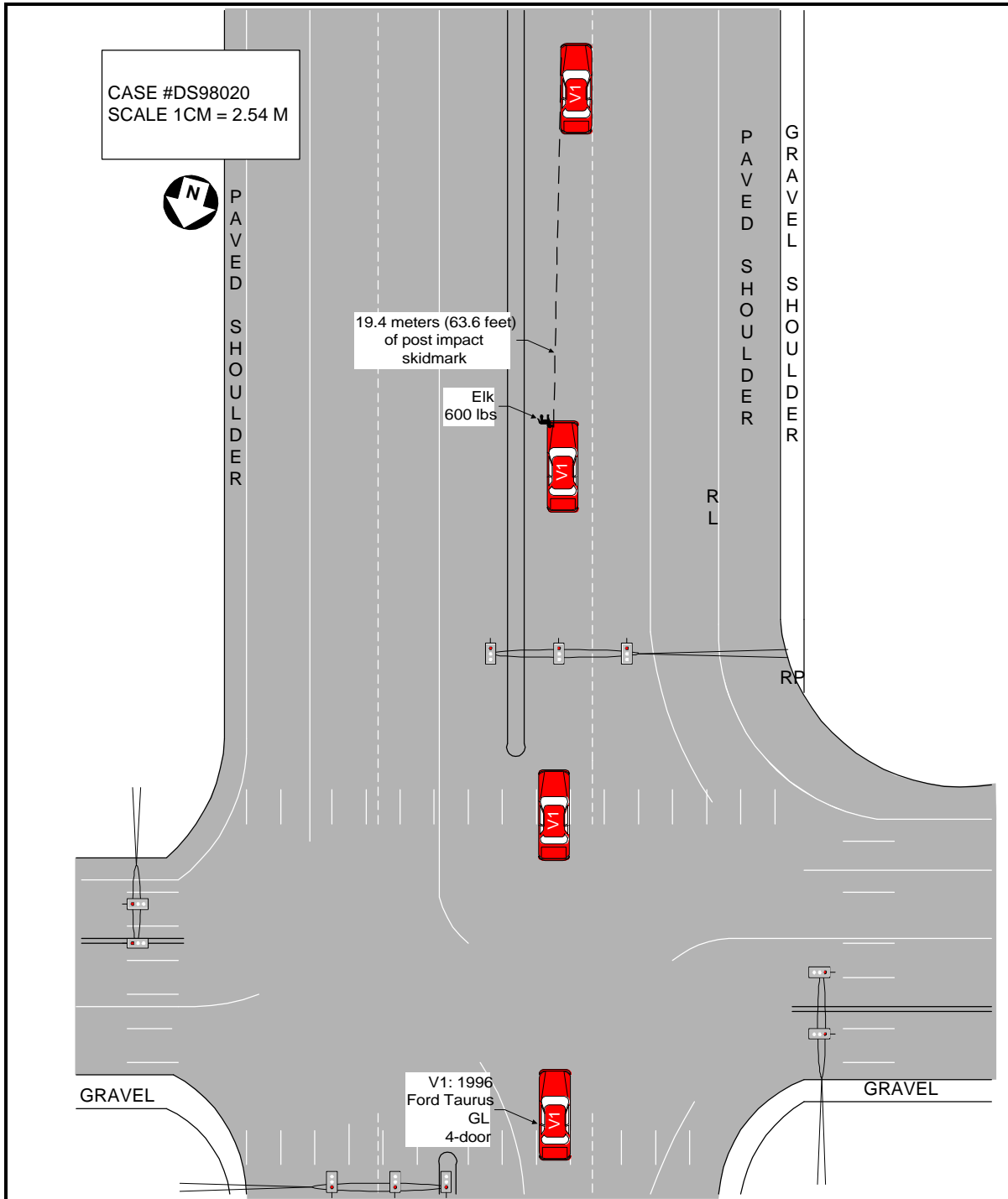


Figure 4. Scene diagram

## DETAILED INFORMATION

### Vehicles

#### Vehicle 1

|                        |   |                             |
|------------------------|---|-----------------------------|
| Description:           | 1996 Ford Taurus GL 4-door sedan                          |                             |
| VIN:                   | 1FALP52U2TAXXXXXX   |                             |
| Odometer:              | 54,359 km (33,000 miles)                                  |                             |
| Engine:                | 3.0 L, 6 cylinder   |                             |
| Reported Defects:      | None  |                             |
| Cargo:                 | Back pack, two jackets. Approximately 3-3.6 kg (7-8 lbs). |                             |
| Damage Description:    | Minor contact damage to front bumper—minimal crush.       |                             |
| CDC:                   | 12FYEN1   |                             |
| Delta V <sup>2</sup> : | Total   | 10.4 km/h (6.5 mph)         |
|                        | Longitudinal  | -10.4 km/h (6.5 mph)        |
|                        | Latitudinal   | 0                           |
|                        | Energy  | 6,692 joules (4,938 ft-lbs) |



**Figure 5.** Exterior damage to Vehicle 1.

---

<sup>2</sup> In order to calculate a Delta-V, the barrier portion of the WinSmash reconstruction algorithm was used even though the collision is beyond its scope. This a borderline reconstruction and the results appear low given that the air bags in Vehicle 1 deployed. Since the collision condition is beyond the scope of WinSmash, the elk was a yielding object, the results were not coded in the EDCS. It is not clear whether the air bags should have deployed in such a low speed impact collision.

Vehicle 1 was equipped with dual front air bags. The driver's air bag was housed in the steering wheel hub and was concealed by symmetrical double horizontal module cover flaps. The circular air bag had two tether straps and no exhaust vent port holes. It measured 52 cm (20.5 in) in diameter. The lower instrument panel is equipped with a rigid plastic knee bolster. There were bluish streaks on the air bags that had been caused by rain.



**Figure 6.** Right front passenger air bag.

The front right passenger's air bag was located on the instrument panel, top surface plane, and incorporated a single air bag module cover with two nylon tethers (25.5 cm/10 in long) attached to it. The tethers allow the entire module cover to separate during deployment. The module cover flap is symmetrical and oblong with rounded flap corners. The front right passenger's module cover and air bag starred and cracked the laminated windshield glazing upon impact. The front right passenger's air bag measured 61 cm (24 in) x 59 cm (23.2 in). It was not tethered and had no exhaust vent port holes, and a maximum bag excursion of 67 cm (26.4 in). There was evidence of skin transfers on the air bag (see Figure 9). There were also several bluish transfers on the air bag (see Figure 10), that probably came from contact with the blue and white striped shirt or blue jeans that he was wearing.



**Figure 7.** Front right air bag module cover.



**Figure 9.** Skin transfer on front right air bag.



**Figure 8.** Bluish transfer on front right air bag.

**Occupants**

| <u>Vehicle 1</u>                | Occupant 1  | Occupant 2  |
|---------------------------------|---|---|
| Age/Sex:                        | 47/Female   | 9/Male  |
| Seated Position:                | Front left  | Front right   |
| Seat Type:                      | Bucket-cloth covered                                  | Bucket-cloth covered  |
| Height:                         | 160 cm (63 in)  | 137.2 cm (54 in)  |
| Weight:                         | 50 kg (110 lbs)                                       | 31.8 kg (70 lbs)  |
| Occupation:                     | Unknown   | Student   |
| Pre-existing Medical Condition: | None noted  | None noted  |
| Alcohol/Drug Involvement:       | None  | NA  |
| Driving Experience:             | Presumed . 31 years                                   | NA  |
| Body Posture:                   | Normal, upright                                       | Normal, upright   |
| Hand Position:                  | Both hands on wheel @ the 10 and 3 o'clock positions  | Unknown   |
| Foot Position:                  | Right foot depressing brake pedal, left foot on floor | Unknown   |
| Restraint Usage:                | Lap and shoulder belt used properly                   | Lap and shoulder belts, with shoulder belt worn behind back |
| Air bag:                        | Deployed at impact                                    | Deployed at impact  |

**Injuries and Injury Mechanisms**

## Vehicle 1

|              | <u>INJURY</u>   | <u>OIC CODE</u>           | <u>ICD-9</u> | <u>SOURCE</u>                       |
|--------------|---|---------------------------|--------------|-------------------------------------|
| Driver:      | Not injured   |                           |              |                                     |
| RF Occupant: | Small laceration to the brain stem involving the junction between pons and medulla. C1 and C2 are intact.                 | 140212.6, 8               | 851.6        | Air bag                             |
|              | Bilateral subdural hematomas  | 140654.5, 3               | 432.1        | Air bag                             |
|              | Cerebral contusions under surfaces of frontal, temporal, and occipital areas of both cerebral hemispheres                 | 140620.3, 3               | 851.4        | Air bag                             |
|              | Cerebral edema is prominent. The brain bulges from cranial vault and shows prominent flattening of external convolutions. | 140660.3, 3               | 348.5        | Air bag                             |
|              | Scalp contusion   | 190402.1, 5               | 920          | Unknown / possibly center seat area |
|              | Top of the head a diagonal curvilinear scalp laceration measuring 2.5 cm (1 in)   | 190602.1, 5               | 873.0        | Unknown / possibly center seat area |
|              | 2.5 cm (1 in) laceration to right upper eyelid surrounded by abrasion and contusion                                       | 297602.1,1                | 870.0        | Air bag                             |
|              | Semi circular contusion and abrasion just below the right eye   | 297402.1,1<br>297202.1, 1 | 920<br>910.0 | Air bag                             |

|   |                            |                |  |
|---|----------------------------|----------------|--|
| Mid-aspect of nose are two linear, horizontal contusions separated by a distance of .6 cm (.25 in). The contusions measure 2.5 cm (1 in) and 3.8 cm (1.5 in) respectively | 290402.1, 4                | 920            | Air bag  |
| Neck abrasion-ear to ear 5.0 cm (2 in) wide   | 390202.1, 5                | 910.0          | Air bag  |
| Abrasion and contusion to lateral aspect of right ear   | 290202.1, 1<br>290402.1, 1 | 910.0<br>920   | Air bag  |
| Anterior right ear are two linear, vertical superficial lacerations that measure 1.9 cm (.75 in) and 2.5 cm (1 in) that are separated by .6 cm (.25 in)                   | 290602.1, 1                | 872.0          | Unknown  |
| Right side of face is a large area of abrasion extending from adjacent to the right eye to the right chin   | 290202.1, 1                | 910.0          | Air bag  |
| Left side of face is a circumscribed area of abrasion   | 290202.1, 2                | 910.0          | Air bag  |
| Midline and lower aspect of chin is a circumscribed area of abrasion  | 290202.1, 8                | 910.0          | Air bag  |
| Lower lip laceration  | 290602.1,8                 | 873.43         | Air bag  |
| Small area of contusion on anterior surface of the left shoulder  | 790402.1, 2                | 923.00         | Air bag  |
| Road rash type abrasion to inner right arm—above and below elbow  | 790202.1,1                 | 913.0          | Air bag  |
| Minor lacerations and abrasions to the four minor digits of right arm   | 790602.1,1<br>790202.1,1   | 915.0<br>882.0 | Fling from air bag injury into A-pillar and windshield |



|   |                            |                 |  |
|---|----------------------------|-----------------|--|
| Lateral aspect of right hand and wrist is a large contusion   | 790402.1, 1                | 923.20          | Fling from air bag injury into A-pillar and windshield |
| Multiple lacerations involving the lateral aspect of ring and little finger of left hand. Also punctate lacerations of index finger of left hand. | 790602.1, 2                | 883.0           | Fling from air bag injury into windshield              |
| Abrasions and contusions of anterior aspect of left forearm   | 790202.1, 2<br>790402.1, 2 | 913.0<br>923.10 | Air bag  |
| Abrasions on medial aspects of right forearm  | 790202.1,1                 | 913.0           | Air bag  |
| Large areas of abrasion on anterior-medial aspect of left upper arm   | 790202.1, 2                | 912.0           | Air bag  |
| Abrasion on the anterior medial aspect of left knee   | 890202.1, 2                | 916.0           | Right lower instrument panel                           |
| Scattered contusions on anterior aspect of left lower leg   | 890402.1, 2                | 924.10          | Right lower instrument panel                           |

## Occupant Kinematics

The front right occupant was seated in a cloth covered bucket seat which had been adjusted to the rear most track position. The front seats are equipped with active three-point lap and shoulder restraints with adjustable height anchorage adjustments. The anchorage was set to the mid position for the front right occupant position. According to a variety of sources, this occupant was wearing the lap belt but had the shoulder portion of the belt behind him.

Just prior to impact, the driver had begun to brake. The front right occupant was pitched forward to some extent and may have contacted the instrument panel with his hands. At impact, both air bags in Vehicle 1 deployed. The deploying front right passenger air bag caught him in the anterior face and throat, and the upper arms; there was evidence of skin transfer found on the air bag, as well as several bluish transfers that probably came from the blue and white striped shirt or blue jeans that he was wearing. As the air bag continued its deployment pattern, the head was accelerated/pushed rearward. The right hand was flung laterally—into the A-pillar, cracking the plastic molding (see Figure 11), and into the windshield. The left hand was flung laterally and up into the windshield. He came to rest with both of his feet and knees well beneath the dashboard. His buttocks were at the leading edge of the bottom seat cushion. The shoulder belt was behind the front right occupant, and the lap belt was at mid-chest level. His head was facing upward and against the seat back.



**Figure 10.** Right A pillar—possible right hand contact.

The front right occupant sustained a small laceration to the brain stem involving the junction between the pons and medulla; the C1 and C2 vertebrae were intact. Bilateral subdural hemorrhage involving both cerebral hemispheres. There were bilateral subdural hematomas and cerebral contusions under the surfaces of the frontal, temporal, and occipital areas of both of the cerebral hemispheres. Cerebral edema is prominent. There was a 2.5 cm (1 in) laceration to the right upper eyelid that was surrounded by an abrasion and contusion. There was a semi circular contusion and abrasion just below the right eye. There were two linear, horizontal contusions to the mid-aspect of the nose that measured 2.5 cm (1 in) and 3.8 cm (1.5 in) respectively. There was a neck abrasion from ear to ear that measured 5.0 cm (2 in) wide. The right side of the face had a large area of abrasion extending from the right eye and extending to the right chin. There was an abrasion and contusion to the lateral aspect of the right ear. On the left side of the face was a circumscribed area of abrasion and the midline and lower aspect of the chin there was a circumscribed area of abrasion. There was a lower lip laceration. There was a small area of contusion on the anterior surface of the left shoulder. A road rash type abrasion to the inner right arm—above and below the elbow. Abrasions and contusions of the anterior aspect of the left forearm. Abrasions to medial aspects of the right forearm and large areas of abrasion on the anterior-medial aspect of the left upper arm. All of the above injuries were as a result of interaction with the front right passenger's air bag (see Figure 12).

The front right occupant also sustained a scalp contusion and a diagonal curvilinear scalp laceration to the top of the head a measuring 2.5 cm (1 in). There were two linear, vertical superficial lacerations that measure 1.9 cm (.75 in) and 2.5 cm (1 in) to the anterior right ear. The source of these injuries is not known.

The front right occupant sustained injuries to his upper and lower extremities. Minor lacerations and abrasions to the four minor digits of the right arm, and the lateral aspect of the right hand and wrist had a large contusion. Multiple lacerations involving the lateral aspect of the ring and little finger of the left hand, and also punctate lacerations of index finger of the left hand. These injuries were “fling” type injuries from the air bag pushing the hands into the A-pillar and windshield areas. There was an abrasion on the anterior medial aspect of the left knee and scattered contusions on the anterior aspect of the left lower leg that were caused by contact with the right lower instrument panel.

The coroner’s report indicates that the final cause of death was a closed head injury due to blunt force trauma. It listed significant injuries of bilateral subdural hematomas, cerebral contusions, and cerebral edema.

**Attachment 1.**

**CASE NUMBER: DS9820**

**\* \* MINIMUM SPEED W/ KNOWN DRAG FACTOR \* \***

$$S = \sqrt{30 \times D \times f}$$

$$S = \sqrt{30 \times 63.50 \times 0.70}$$

$$S = \sqrt{1333.50}$$

$$S = 36.51$$

S = The Speed in MPH.

30 = A Constant.

D = The Distance in Feet.

f = The Adjusted Accel/Drag Factor.

| INPUTS:                          |       |
|----------------------------------|-------|
| The Acceleration/Drag Factor is: | 0.70  |
| The Distance in Feet is:         | 63.50 |

| RESULTS:                |       |
|-------------------------|-------|
| The Speed in MPH is:    | 36.51 |
| The Velocity in FPS is: | 53.52 |

Printed: 05/08/00