On-scene Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS00-002
2000 Ford Taurus
California
February, 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. Supplemental Notes

16. Abstract

This three vehicle crash occurred in California in February, 2000 at 1340 hours. The crash took place on the four northbound travel lanes of an interstate highway. The posted speed limit is 89 km/h (55 mph). There was heavy traffic on this roadway.

The case vehicle, a 2000 Ford Taurus 4-door driven by an unrestrained 70-year-old female , was traveling northbound in the second lane from the right. The front right seat was occupied by an unrestrained 69-year-old male. The second vehicle in the crash, a 1993 Nissan Sentra driven by a 26-year-old female, was traveling northbound in the fourth lane from the right. The third vehicle in this crash, a 1997 Cadillac DeVille driven by a 70-year-old female, was traveling northbound in the first lane from the right. The front right seat was occupied by a 78-year-old male. The right rear seat was occupied by an 80-year-old female. As the driver of the Nissan Sentra approached slowing traffic in front of her, the traffic apparently abruptly stopped. The driver of the Sentra braked and swerved to the right. She crossed the adjacent travel lane and then entered the lane being used by the case vehicle. The Nissan Sentra struck the left front of the case vehicle. The case vehicle went out of control to the right. The vehicle entered the next lane to the right and was struck by the Cadillac DeVille in the right side. The Cadillac veered to the right and struck a sound wall. The case vehicle also continued to the right and struck the sound wall. The case vehicle then rolled backwards across the travel lanes and struck the center median barrier with its rear end.

The driver of the case vehicle sustained facial fractures, dislocated teeth, soft tissue injuries, a neck strain, a 4 in. laceration to the forehead above the left eye, a broken nose, an unknown type injury to her right heel, and a contusion to the left knee. The front right occupant of the case vehicle sustained contusions to both knees. The driver and front right occupant of the case vehicle were transported to a local hospital. The driver was hospitalized. The front right occupant was treated and released after 9 hours. The driver of the Sentra complained of pain to her neck, back, and legs. She indicated that she would seek her own aid. The driver and front right occupant of the Cadillac were not injured. The rear right occupant complained of pain to both legs, but indicated that she would seek her own aid.

| 17. Key Words | 18. Distribution Statement |
|---|---|
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|---|---|---|---|
| | | | |

**Dynamic Science, Inc.**
**Accident Investigation**
**Case Number: DS00-002**

**TABLE OF CONTENTS**

**BACKGROUND:**

| | |
|---|---|
| Description: | This Advanced Occupant Protection Systems (AOPS) case was generated by DSI through existing insurance contacts. NHTSA was notified of the case on June 21, 2000. DSI was assigned the case on June 22, 2000. Field work was completed on June 24, 2000. |
| Investigation Type: | On scene |
| Crash Location: | California |
| Crash Date: | February, 2000 |
| Notification Date: | June 21, 2000 |
| Field Work Completed: | June 24, 2000 |

**SUMMARY:**

This three vehicle crash occurred in California in February, 2000 at 1340 hours. The crash took place on the four northbound travel lanes of an interstate highway. There is an uphill grade and a slight left hand curve at the crash location. The weather was relatively clear and there were no roadway defects indicated. The posted speed limit is 89 km/h (55 mph). There was heavy traffic on this roadway.

The case vehicle, a 2000 Ford Taurus 4-door driven by an unrestrained 70-year-old female (163 cm/64 in., 59 kg/130 lbs) , was traveling northbound in the second lane from the right. The front right seat was occupied by an unrestrained 69-year-old male (188 cm/74 in., 125 kg/275 lbs). The Ford Taurus was equipped with front left and front right frontal air bags, front left and front right side air bags, seat belt pretensioners at the front left and front right seating positions, and adjustable foot controls. While this vehicle had been driven 13,101 km (8,141 miles), the dealer sticker was still in the left rear window and the plastic protective covers on the floorboard had not been removed.

**Figure 1**. Overview of vehicle paths. Crash occurred 640 m (2100 ft) north. Arrow shows approximate area of impact.

**Figure 2**. Front view of case vehicle (2000 Ford Taurus)

The second vehicle in the crash, a 1993 Nissan Sentra driven by a 26-year-old female, was traveling northbound in the fourth lane from the right.

The third vehicle in this crash, a 1997 Cadillac DeVille driven by a 70-year-old female, was traveling northbound in the first lane from the right. The front right seat was occupied by a 78-year-old male. The right rear seat was occupied by an 80-year-old female.

**Figure 3**. Exterior, case vehicle. Shows impact #1.

**Figure 4**. Exterior, case vehicle. Shows impact #2.

As the driver of the Nissan Sentra approached slowing traffic in front of her, the traffic apparently abruptly stopped. The driver of the Sentra braked and swerved to the right. She crossed the adjacent travel lane and then entered the lane being used by the case vehicle. The Nissan Sentra struck the left front of the case vehicle (12LYES1). The case vehicle went out of control to the right. The vehicle entered the next lane to the right and was struck by the Cadillac DeVille in the right side (04RPEW3). The case vehicle sustained a longitudinal delta v of 6.2 km/h (3.9 mph) and a latitudinal delta v of (-10.8 km/h (-6.7 mph)[1]. The passenger side air bag deployed at this point. The Cadillac veered to the right and struck a sound wall. The case vehicle also continued to the right and struck the sound wall (12FDEW1). The case vehicle sustained a longitudinal delta v of -18.7 km/h (-11.6 mph) and a latitudinal delta v of 1.6 km/h (1.0 mph)[2]. Both front air bags deployed at this point. An Electronic Data Recorder report was generated for this vehicle. The results indicate that the vehicle had a longitudinal cumulative delta v of -14.0 mph at the 78 millisecond mark. The case vehicle then rolled backwards across the travel lanes and struck the center median barrier with its rear end.

The driver of the case vehicle sustained facial fractures, dislocated teeth, soft tissue injuries, a neck strain, a 4 in. laceration to the forehead above the left eye, a broken nose, an unknown type injury to her right heel, and a contusion to the left knee.

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[1]Calculated using WinSmash missing vehicle program

[2]Calculated using barrier option and using stiffness values from NCAP test

The front right occupant of the case vehicle sustained contusions to both knees. He also complained of pain to his chest, rib cage, neck, and shoulders.

The driver and front right occupant of the case vehicle were transported to a local hospital. The driver was hospitalized. The front right occupant was treated and released after 9 hours.

The driver of the Sentra complained of pain to her neck, back, and legs (muscle spasms). She indicated that she would seek her own aid.

**Figure 5**. Driver's frontal air bag

The driver and front right occupant of the Cadillac were not injured. The rear right occupant complained of pain to both legs, but indicated that she would seek her own aid.

The Ford Taurus and the Cadillac DeVille were towed from the scene. The Nissan Sentra was driven from the scene.

The case vehicle was equipped with front left and front right frontal air bags, front left and front right side air bags, seat belt pretensioners at the front left and front right seating positions, and adjustable foot controls.

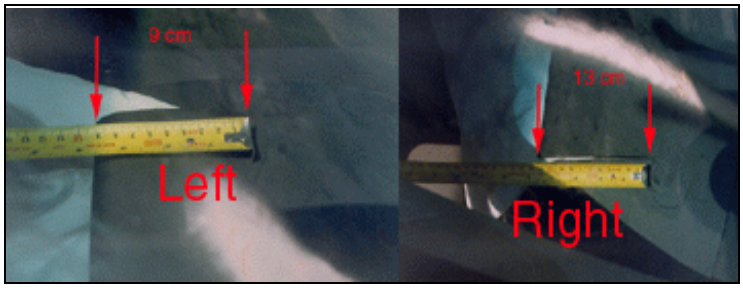



**Figure 6**. Front passenger air bag module cover

The driver's air bag was circular and measured 54 cm (21.2 in.) in diameter. It was equipped with two tethers and two vent holes. There appeared to be eight horizontal folds. Blood was found on the top right quadrant. On the bottom of the rear portion of the air bag there was lipstick and makeup transfers that measured 15 cm (5.9 in.) wide by 11 cm (4.3 in.) high. The module cover opened in an "H" configuration. There were no indications of any damage to the cover.

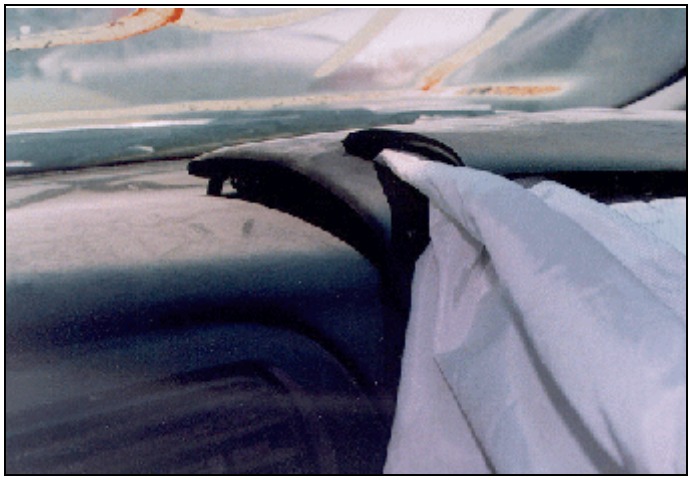


**Figure 7**. Passenger module cover displacement

The front right occupant's frontal air bag was rectangular and measured 60 cm (23.6) laterally. It was equipped with two vent ports and did not have any tethers. On the face of the air bag there was a diagonal plastic transfer that began at the bottom of the air bag, extended for 26 cm (10.2) up and to the right and ended up being 11 cm (4.3) across. The right hand longitudinal seam was measured at 13 cm (5.1 in), while the left hand side measured 9 cm (3.5 in.). The module itself was displaced vertically on the left side.

The front right seat position was equipped with a seat-mounted side air bag. The air bag was equipped with a single tether and no vent ports. The bag is vaguely rectangular and measures 64 cm (25 in.) high by 29 cm (11.4 in.) wide at its base. There was no indication of a contact to the air bag nor any damage.

Both front seat positions were equipped with seat belt pretensioners. The pretensioner barrels were checked and measured 11 cm (4.3 in.), indicating that they had not deployed.

The data from the RCM module was downloaded. It indicated that neither front seat buckles were engaged and that a first stage deployment had occurred.


**Figure 8**. Right front side air bag

**Scene Diagram**

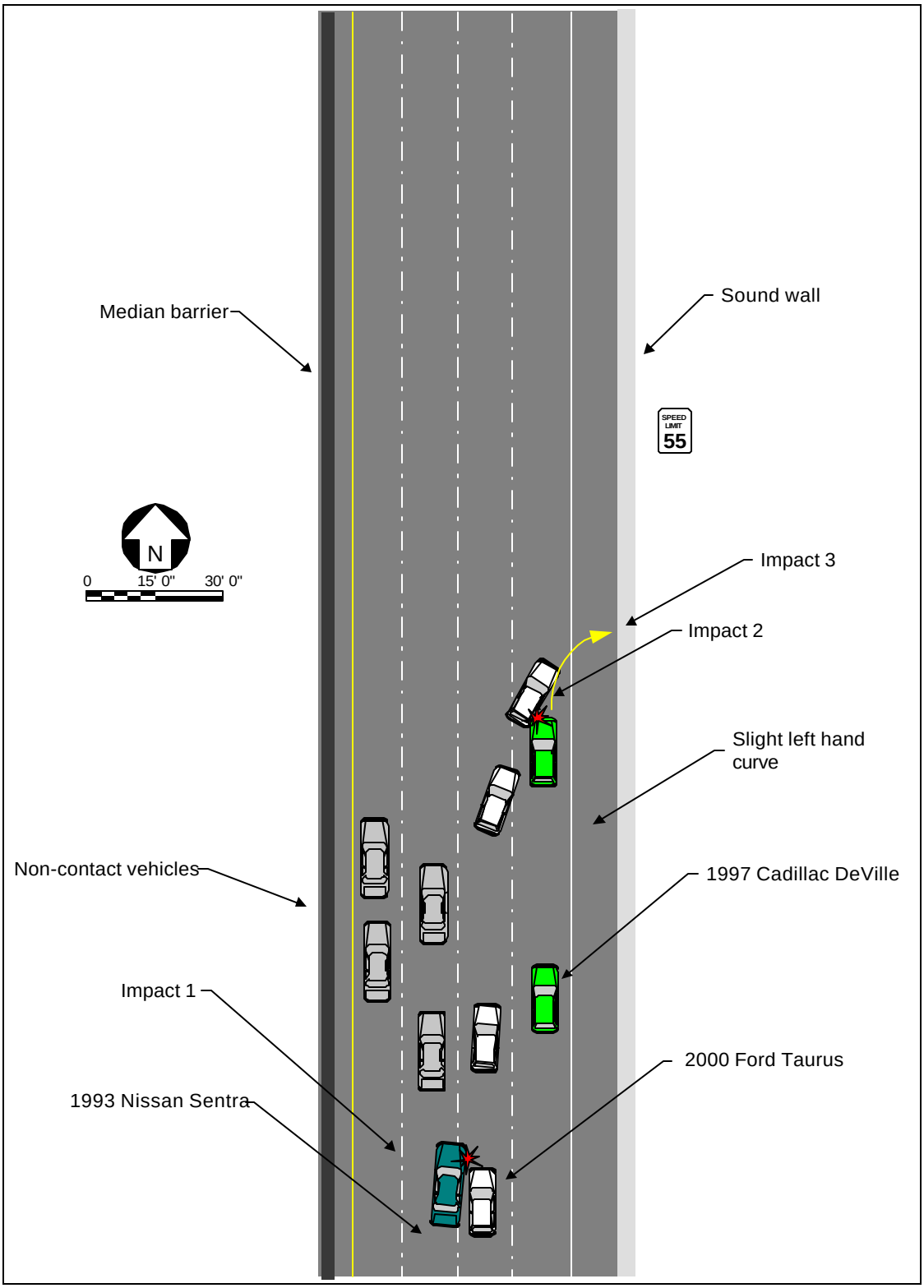



**Figure 9**. Scene diagram (1 of 2)

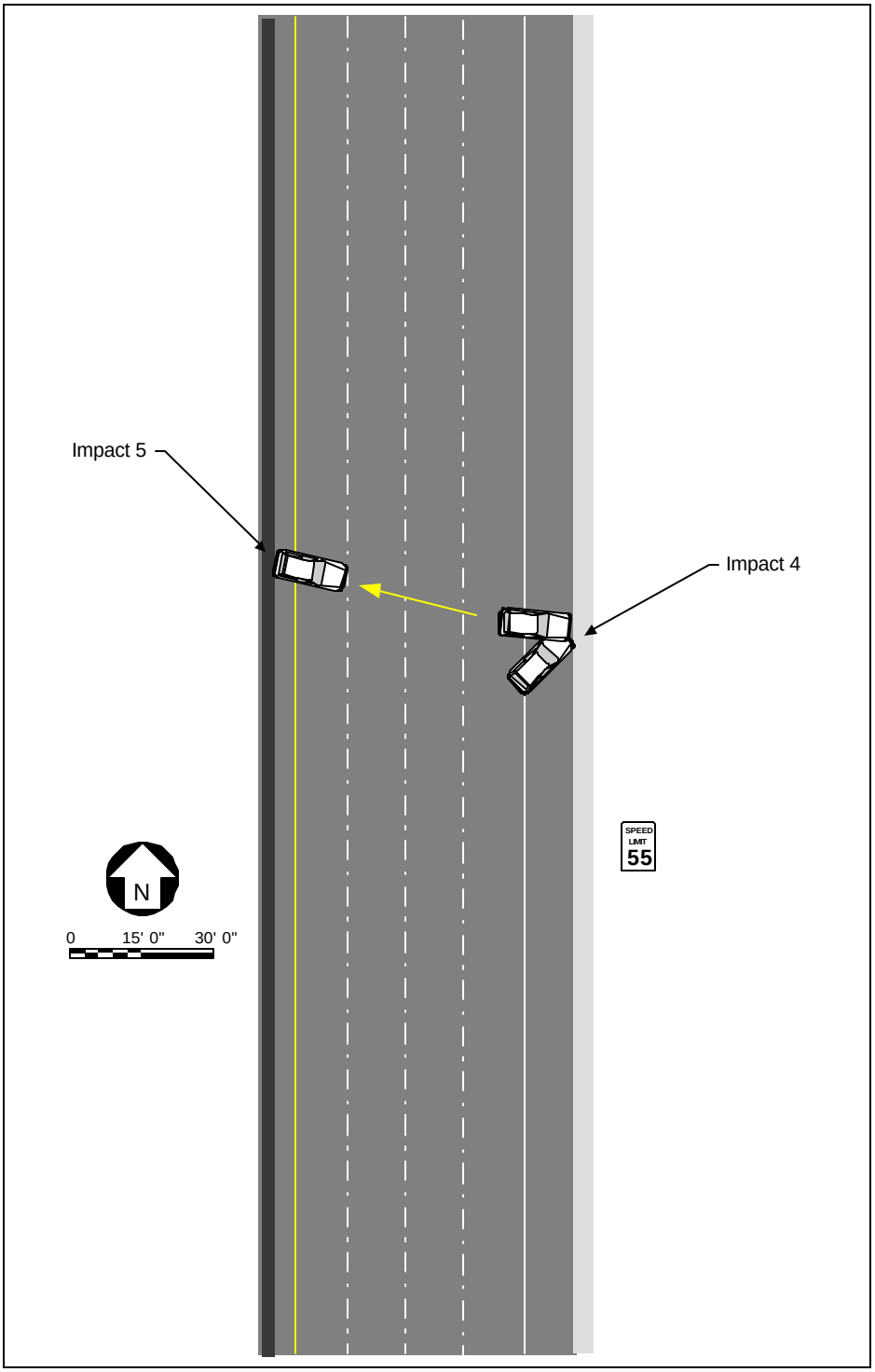



**Figure 10**. Scene diagram (2 of 2)

## DETAILED INFORMATION

### Vehicles

2000 Ford Taurus

| | | |
|---|---|---|
| Description: | 2000 Ford Taurus four-door | |
| VIN: | 1FAFP56S0YGxxxxxx | |
| Odometer: | 13,101 km (8,141 miles) | |
| Engine: | 6 cyl / 182 CID | |
| Reported Defects: | None | |
| Cargo: | None | |
| Damage Description: | Moderate rearward crush to front bumper. Rubber transfer to left front quarter panel. Lateral crush to right rear door; side glass broken out. | |
| CDC: | Impact #1: 12LYES01<br>Impact #2: 04RPEW03<br>Impact #3: 12FDEW01<br>Impact #4: 06BRLN01 | |
| Delta V (Impact #3): | Total | 18.7 km/h (11.6 mph) |
| | Longitudinal | -18.7 km/h (-11.6 mph) |
| | Latitudinal | 1.6 km/h (1.0 mph) |
| | Energy | 23,170 joules (17,088 ft-lbs) |
| Delta V (Impact #2) | Total | 12.4 km/h (7.7 mph) |
| | Longitudinal | 6.2 km/h (3.3 mph) |
| | Latitudinal | -10.8 km/h (-6.7 mph) |
| | Energy | 11,840 joules (8,732 ft–lbs) |

1993 Nissan Sentra

| | | |
|---|---|---|
| Description: | 1993 Nissan Sentra | |
| VIN: | Unknown | |
| Odometer: | Unknown | |
| Engine: | Unknown | |
| Reported Defects: | None noted | |
| Cargo: | Unknown | |
| Damage Description: | Unknown | |
| CDC: | Unknown | |
| Delta V: | Total | Unknown |
| | Longitudinal | Unknown |
| | Latitudinal | Unknown |
| | Energy | Unknown |

1997 Cadillac DeVille

| | | |
|---|---|---|
| Description: | 1997 Cadillac DeVille | |
| VIN: | Unknown | |
| Odometer: | Unknown | |
| Engine: | Unknown | |
| Reported Defects: | None | |
| Cargo: | Unknown | |
| Damage Description: | Unknown | |
| CDC: | Unknown | |
| Delta V (Impact #2 - case vehicle): | Total | 12.0 km/h (7.5 mph) |
| | Longitudinal | -12.0 km/h (-7.5 mph) |
| | Latitudinal | 0 km/h (0 mph) |
| | Energy | 7,582 joules<br>(5,592 ft-lbs) |

**Occupants**

| Ford Taurus | Occupant 1 | Occupant 2 |
|---|---|---|
| Age/Sex: | 70/Female | 69/Male |
| Seated Position: | Front left | Front right |
| Seat Type: | Cloth-covered bucket seat | Cloth-covered bucket seat |
| Height: | 163 cm (64 in) | 188 cm (74 in.) |
| Weight: | 59 kg (130 lbs) | 125 kg (275 lbs) |
| Occupation: | Presumed to be retired | Presumed to be retired |
| Pre-existing Medical Condition: | None noted | None noted |
| Alcohol/Drug Involvement: | None | NA |
| Driving Experience: | > 30 years | NA |
| Body Posture: | Normal, upright | Possibly out of position. Prior to impact was trying to reach something in rear seat. |
| Hand Position: | Both hands on wheel, unknown position | NA |
| Foot Position: | Right foot on brake, left on floor | Unknown–presumed to be on floor |
| Restraint Usage: | Lap and shoulder belts available–not used | Lap and shoulder belts available–not used |
| Air bag: | Left steering wheel mounted front air bag deployed. | Right mid instrument panel mounted air bag deployed.<br><br>Right seat mounted side air bag deployed. |

Nissan Sentra

| | |
|---|---|
| Age/Sex: | 26/Female |
| Seated Position: | Front left |
| Seat Type: | Unknown |
| Height: | 165 cm (65 in) |
| Weight: | 91 (200 lbs) |
| Occupation: | Unknown |
| Pre-existing Medical Condition: | Unknown |
| Alcohol/Drug Involvement: | None |
| Driving Experience: | Unknown, presumed to be around 10 years |
| Body Posture: | Unknown |
| Hand Position: | Unknown |
| Foot Position: | Unknown |
| Restraint Usage: | Lap and shoulder belt used |

Cadillac DeVille

| | | | |
|---|---|---|---|
| Age/Sex: | 70/Female | 79/male | 80/Female |
| Seated Position: | Front left | Front right | Rear right |
| Seat Type: | Unknown | Unknown | Unknown |
| Height: | 165 cm (65 in) | Unknown | Unknown |
| Weight: | 82 kg (180 lbs) | Unknown | Unknown |
| Occupation: | Presumed to be retired | Presumed to be retired | Presumed to be retired |
| Pre-existing Medical Condition: | Unknown | Unknown | Unknown |
| Alcohol/Drug Involvement: | None | NA | NA |
| Driving Experience: | Unknown | NA | NA |
| Body Posture: | Unknown | Unknown | Unknown |
| Hand Position: | Unknown | Unknown | Unknown |
| Foot Position: | Unknown | Unknown | Unknown |
| Restraint Usage: | Lap and shoulder belt used | Lap and shoulder belt used | Lap and shoulder belt used |

**Injuries and Injury Mechanisms**

Ford Taurus

| | INJURY | OIC CODE | ICD-9 | SOURCE |
|---|---|---|---|---|
| Driver: | Blowout fracture, left orbit | 251204.3,2 | 802.8 | Air bag |
| | Dislocated teeth | 251402.1,8 | 873.69 | Air bag |
| | Forehead laceration, left side, 4 inches | 290804.2,7 | 873.42 | Air bag |
| | Nose fracture | 251000.1,4 | 959.0 | Air bag |
| | Contusion, left knee | 890402.1,2 | 924.11 | Lower instrument panel |
| | Heel injury, right foot | 815099.7,1 | 917.8 | Floor board |
| FR Occupant: | Bilateral knee contusions | 890402.1,1<br>890402.1,2 | 924.11<br>924.11 | Lower instrument panel |
| | Complaint of pain to chest, rib cage, neck, and shoulders. | Not codeable | | |

1993 Nissan Sentra

| | INJURY | OIC CODE | ICD-9 | SOURCE |
|---|---|---|---|---|
| Driver: | Complaint of pain to neck, back, and legs. | | | |

1997 Cadillac DeVille

| | INJURY | OIC CODE | ICD-9 | SOURCE |
|---|---|---|---|---|
| Driver: | Not injured | | | |
| Front right occupant: | Not injured | | | |
| Rear right occupant | Not injured | | | |

**Occupant Kinematics**

The driver of the case vehicle was seated in a normal, upright position. She does not appear to have been wearing the available lap and shoulder belt. There were indications of usage, but nothing related to this crash. The pretensioner barrels were checked and measured 11 cm (4.3 in.), indicating that they had not deployed. The data from the RCM module was downloaded and it indicated that neither front seat buckle was engaged. There was negligible driver movement during the initial sideswiping type impact on the left side of the vehicle. The driver steered to the right in response to the impact. The rear right side of the vehicle was struck by the Cadillac and the driver would have moved slightly to the right side. As the case vehicle struck the concrete wall, the driver responded to the 355 degree principal direction of force by moving essentially straight forward. Both of the driver's knees struck the lower instrument panel–causing the contusion to the left knee. The driver's face was close to the steering wheel and as the air bag deployed she engaged the back side of the air bag. This contact likely caused the facial injuries, including the blow-out fracture, the broken nose, and the forehead laceration.

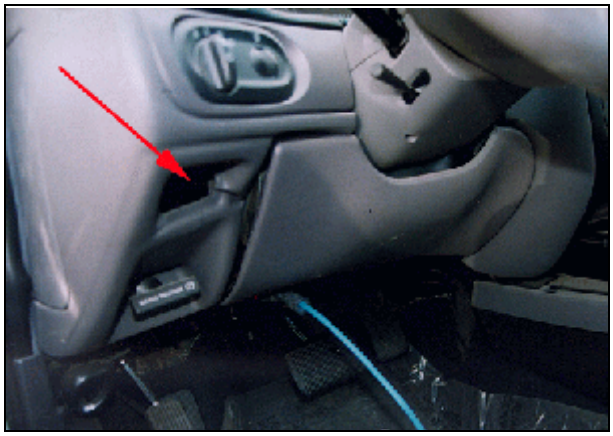


**Figure 11**. Left knee contact to lower instrument panel.

The front right occupant was originally seated in a normal, upright position. According to the interviewee, prior to the impact he had removed his seat belt and was reaching for something in the rear seat. He was not using the available lap and shoulder belt. His movement during the first minor impact would have been similar to that of the driver's. During the second impact, the side air bag deployed and this occupant likely contacted it to some degree, though there was no evidence of any specific contact. As the case vehicle continued on and struck the concrete wall, this occupant responded to the 355 degree principal direction of force by moving essentially straight forward. Both of this occupant's knees struck the glove compartment. This occupant sustained contusions to both knees. He also complained of pain to his chest, rib cage, neck, and shoulders.

**Figure 12**. Driver's air bag. Contact points to back side of air bag.

**EDR Report**

## 2000 Taurus/Sable EDR Report - Summary Page

### Investigation Data

| | | | |
|---|---|---|---|
| File Name: | ds00-002.hex | File Save Date: | 29-Jun-2000 |
| File Read-out Date: | N/A | Report Date: | 20-Oct-2000 |
| Report Version: | 1.4 | | |

### EDR Control Module Data

| | | | |
|---|---|---|---|
| Data Validity Check: | Valid | EDR Model Version: | 141 |
| | | | |
| Time From Side Safing Decision to Left (Driver) Side Bag Deployment: | | | Not Deployed |
| Time From Side Safing Decision to Right (Passenger) Side Bag Deployment: | | | 96 |
| Passenger Airbag Switch Position During Event: | | | N/A |
| Diagnostic Codes Active When Event Occurred: | | | 0 |

| Algorithm Times (Actual initiation depends on restraint system status (below)) | ms |
|---|---|
| Time From Algorithm Wakeup to Pretensioner: | 26 |
| Time From Algorithm Wakeup to First Stage - Unbelted: | 26 |
| Time From Algorithm Wakeup to First Stage - Belted: | 26 |
| Time From Algorithm Wakeup to Second Stage: | 0 |

### Restraint System Status

| | |
|---|---|
| Driver Seat Belt Buckle: | Not Engaged |
| Passenger Seat Belt Buckle: | Not Engaged |
| Driver Seat Track In Forward Position: | No |
| Passenger Seat Weight Switch Position: | N/A |

| Deployment Initiation Attempt Times | Driver | Passenger |
|---|---|---|
| Time From Algorithm Wakeup to Pretensioner Deployment Attempt: | Unbelted | Unbelted |
| Time From Algorithm Wakeup to First Stage Deployment Attempt: | 26 | 26 |
| Time From Algorithm Wakeup to Second Stage Deployment Attempt: | Disposal | Disposal |

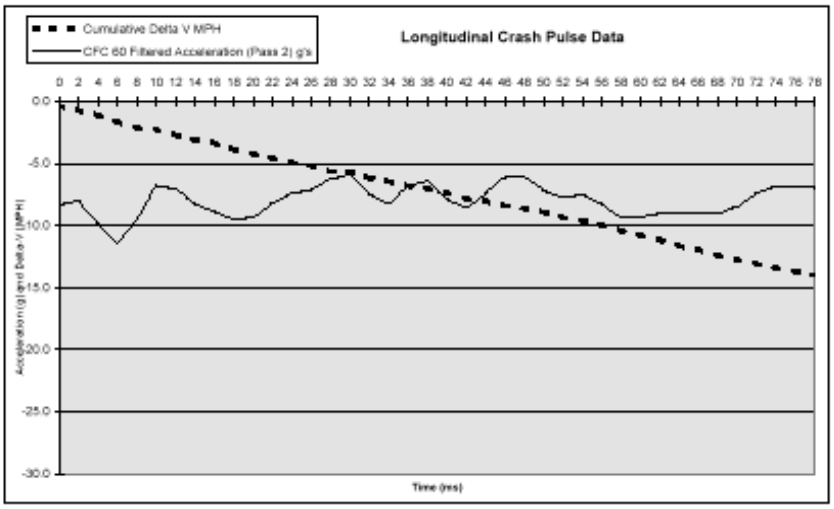
**Notes**

1. Read-out date is set by the PC interface tool.
2. Features and data parameters which are not available on the module are marked "N/A".
3. CFC 60 is a Butterworth 4-pole phaseless digital filter. (See SAE J211 Part 1 Appendix C dated March 1995.)
4. Total and maximum Delta-V results are not available from truncated/incomplete crash pulses.
5. Algorithm wakeup (0 ms) is not the first moment of vehicle contact or impact.
6. The Excel "Analysis ToolPak" Add-in must be enabled for this spreadsheet to operate properly.

## 2000 Taurus/Sable EDR Report - Charts

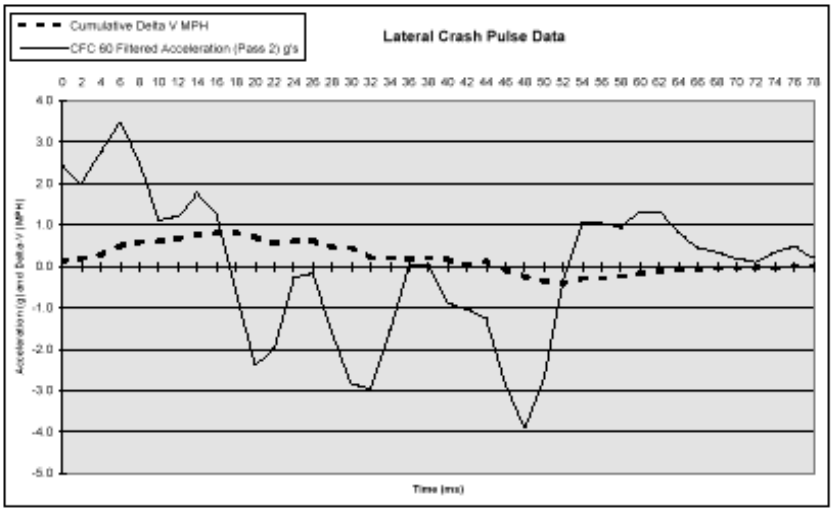
**Longitudinal Cumulative Delta-V**

| Time (ms) | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 78 |
|---|---|---|---|---|---|---|---|---|---|
| Delta-V (MPH) | -0.4 | -2.3 | -4.2 | -5.6 | -7.4 | -8.8 | -10.6 | -12.8 | -14.0 |




**Lateral Cumulative Delta-V**

| Time (ms) | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 78 |
|---|---|---|---|---|---|---|---|---|---|
| Delta-V (MPH) | 0.1 | 0.6 | 0.7 | 0.5 | 0.2 | -0.4 | -0.2 | 0.0 | 0.0 |




**File Name:** ds00-002.hex