

Special Crash Investigation Air Bag Investigation
On-scene Investigation / Vehicle vs Tree
Dynamic Science, Inc. / Case Number: DS98002
1994 Ford Taurus GL 4-door Station Wagon
Washington
December, 1997

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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 <p>The collision took place on a residential, north/south oriented, two lane undivided, level, asphalt roadway. Just prior to the area of the collision, the roadway begins to curve slightly to the left. Vehicle 1, a 1994 Ford Taurus GL 4-door station wagon driven by an 86-year-old male (178 cm / 70 in, 73 kg / 160 lb), was traveling southbound at a police reported speed of 64-81 km/h (40-50 mph). For an unknown reason, the driver of Vehicle 1 failed to negotiate the left curve and drove off the right roadway edge. Vehicle 1 traveled approximately 15.2 m (50 ft) off the road and into a vacant lot before colliding head on into a 34 cm (13.4 in) diameter fir tree. The police noted that no skid marks were present on the roadway, but there was 15.2 m (50 ft) of tire impression left on the hard packed dirt shoulder. On impact with the tree, the driver's and front right passenger's air bags deployed. Vehicle 1 came to final rest heading south-west in contact with the tree. The driver was conscious at the scene, and when he was interviewed by the investigating police officer, the driver stated that he did not know why he left the roadway.</p> <p>Vehicle 1 sustained severe damage to the entire front end (see Figure 4). A CDC of 12FYEN2 with a 0 degree PDOF was assigned to the damage. Maximum crush was measured at C³ and equalled 43.5 cm (17.1 in). The barrier portion of the WinSmash algorithm computed a total Delta-V of 29.1 km/h (18.1 mph), a longitudinal Delta-V of -29.1 km/h (-18.1 mph), and a lateral Delta V of 0. The results fit the collision model and appear reasonable. Vehicle 1 was towed from the scene due to damage.</p> <p>Paramedics arrived on the scene and transported the driver to a local hospital where he arrived at the emergency room at 1830 hours. He was treated for neck injuries, and was then transported via airlift to a trauma center the following day. The driver's health continued to deteriorate and he expired ten days after the date of the collision at 1320 hours. The Certificate of Death attributes the death to pneumonia due to, or as a consequence of, fracture of the C1-C2 vertebra and blunt impact to the head and chest.</p> <p>It is the opinion of this investigator that driver of Vehicle 1 was fully conscious prior to the crash. For an unknown reason he veered off the right side of the road. There was no indication that he took any evasive maneuvers. Contrary to the police report, he was not wearing the available lap and shoulder belts. Based on the uniformity of the leg contacts with the left instrument panel and below, it appears that the driver remained in the seat in an upright, forward facing position. At impact with the tree, the driver went forward and up, wrapping himself up and over the top half of the steering wheel with both legs striking the instrument panel and below. It appears that the driver engaged the air bag prior to it fully deploying. The left side of his head appears to have struck the windshield. The windshield had a spider web crack slightly to left and above the steering wheel. The neck injury was attributed to the striking of the windshield rather than the deploying air bag.</p> | | | | | |
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Dynamic Science, Inc.
Accident Investigation
Case Number: DS98002

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BACKGROUND:

Description: This case was initially investigated as a driver fatality that resulted from an air bag deployment, but it was determined not to be air bag related. This case was conducted as an on-scene investigation. The NHTSA was notified by the investigating police department on January 13, 1998. DSI was notified on January 15, 1998. All field work was completed on January 23, 1998.

Investigation Type: On-scene

Crash Location: Washington

Crash Date: December 1997 at 1700 hours

Notification Date: January 15, 1998

Field Work Completed: January 23, 1998

SUMMARY:

The collision took place on a residential, north/south oriented, two lane undivided, level, asphalt roadway (see Figure 1). Just prior to the area of the collision, the roadway begins to curve slightly to the left. Both sides of the roadway are bordered by dirt and gravel shoulders. It was dusk and there were no street lights. There were no traffic controls present, and the posted speed limit was 81 km/h (50 mph).

Vehicle 1, a 1994 Ford Taurus GL 4-door station wagon driven by an 86-year-old male (178 cm / 70 in, 73 kg / 160 lb¹), was traveling southbound at a police reported speed of 64-81 km/h (40-50 mph). For an unknown reason, the driver of Vehicle 1 failed to negotiate the left curve and drove off the right roadway edge. Vehicle 1 traveled approximately 15.2 m (50 ft) off the road and into a vacant lot before colliding head on into a 34 cm (13.4 in) diameter fir tree (see Figures 1-3). The police



Figure 1. Police photograph of scene.



Figure 2. Police photograph of scene towards impact.

¹ As indicated by Coroner, DMV records indicate 182.9 cm (72 in) / 82.1 kg (181 lb).

noted that no skid marks were present on the roadway, but there was 15.2 m (50 ft) of tire impression left on the hard packed dirt shoulder. On impact with the tree, the driver's and front right passenger's air bags deployed. Vehicle 1 came to final rest heading south-west in contact with the tree. The driver was conscious at the scene, and when he was interviewed by the investigating police officer, the driver stated that he did not know why he left the roadway.



Figure 3. Police photo of tree.

Paramedics arrived on the scene and transported the driver to a local hospital where he arrived at the emergency room at 1830 hours. He was treated for neck injuries, and was then transported via airlift to a trauma center the following day.

Vehicle 1 sustained severe damage to the entire front end (see Figure 4). A CDC of 12FYEN2 with a 0 degree PDOF was assigned to the damage. Maximum crush was measured at C³ and equaled 43.5 cm (17.1 in). The barrier portion of the WinSmash² algorithm computed a total Delta-V of 29.1 km/h (18.1 mph), a longitudinal Delta-V of -29.1 km/h (-18.1 mph), and a lateral Delta V of 0. The results fit the collision model and appear reasonable. Vehicle 1 was towed from the scene due to damage.



Figure 4. Frontal damage to vehicle.

The interior inspection revealed that the driver's seat was adjusted to the rearward most seat position. The fabric covered seat back was reclined approximately 19 degrees rearward. The police report indicates that the driver was wearing the available lap and shoulder belts. The inspection of Vehicle 1 revealed normal wear and tear on the driver's lap and shoulder belts. There were no significant loading marks on the belts or D-ring that could be attributed to this collision. The rigid plastic covers of the knee bolster over the left instrument panel areas, were dented/deformed by the loading of the driver's legs. The upper half of the steering wheel was bent forward approximately 3 cm (1.2 in). The steering wheel hub mounted driver's air bag measured 51 cm (20 in) in diameter. It had two tethers and two rear vent ports at the 11 and 01 o'clock positions, and there were seven vertical folds. The driver's air bag had a maximum excursion of 37 cm (14.6 in), and the distance from the steering wheel hub to the driver's seat back was 81 cm (31.9 in). There were blood spots splattered about the face of the air bag. There were no visible driver contact points, and the air bag was burned near the left vent port by

² WinSmash 1.2.1 using the size and stiffness values in the NASS Coding Manual.

the exhaust gases. The dual module covers opened in a typical “H” pattern, and there were no visible driver contact points or damage to the upper or lower module covers.

The autopsy report was the source for injuries of the driver. The driver sustained blunt impact (AIS 7) to the head and chest. There was a fracture (AIS 1) of the right 5th rib, and fracture (AIS 2) of C1-C2 cervical vertebra. The left forehead shows a diffuse contusion (AIS 1), discoloration of the entire forehead. There was a laceration (AIS 1) to the head. The left lower eye shows a crescent shaped contusion (AIS 1). The chest trauma is attributed to the steering wheel and the head injuries, including the cervical fracture, are attributed to the windshield; there was a spider web crack to the windshield directly above the steering wheel.

In addition, the entire right shoulder shows a mottled purple-green discoloration (contusion, AIS 1). To a similar extent, changes are present beneath the left clavicle with a green-purple speckled discoloration (contusion, AIS 1). These injuries are attributed to the driver’s air bag.

There were scattered cutaneous contusions and lacerations (both AIS 1) of the dorsum of the right hand. Injuries to the right hand were possibly the result of “flinging” by the air bag and the hand then striking the rear view mirror which was cracked. There were also scattered interrupted cutaneous contusions (AIS 1) with the right more severely involved than the left, and these changes occurred below the knee and were the result of contacting the left instrument panel and below.

The autopsy was not an invasive examination, and the cause of death evaluation was based on the hospital record. As a result of no internal examination, the cervical fracture and the 5th rib fracture were based on the hospital record. The autopsy report stated the following:

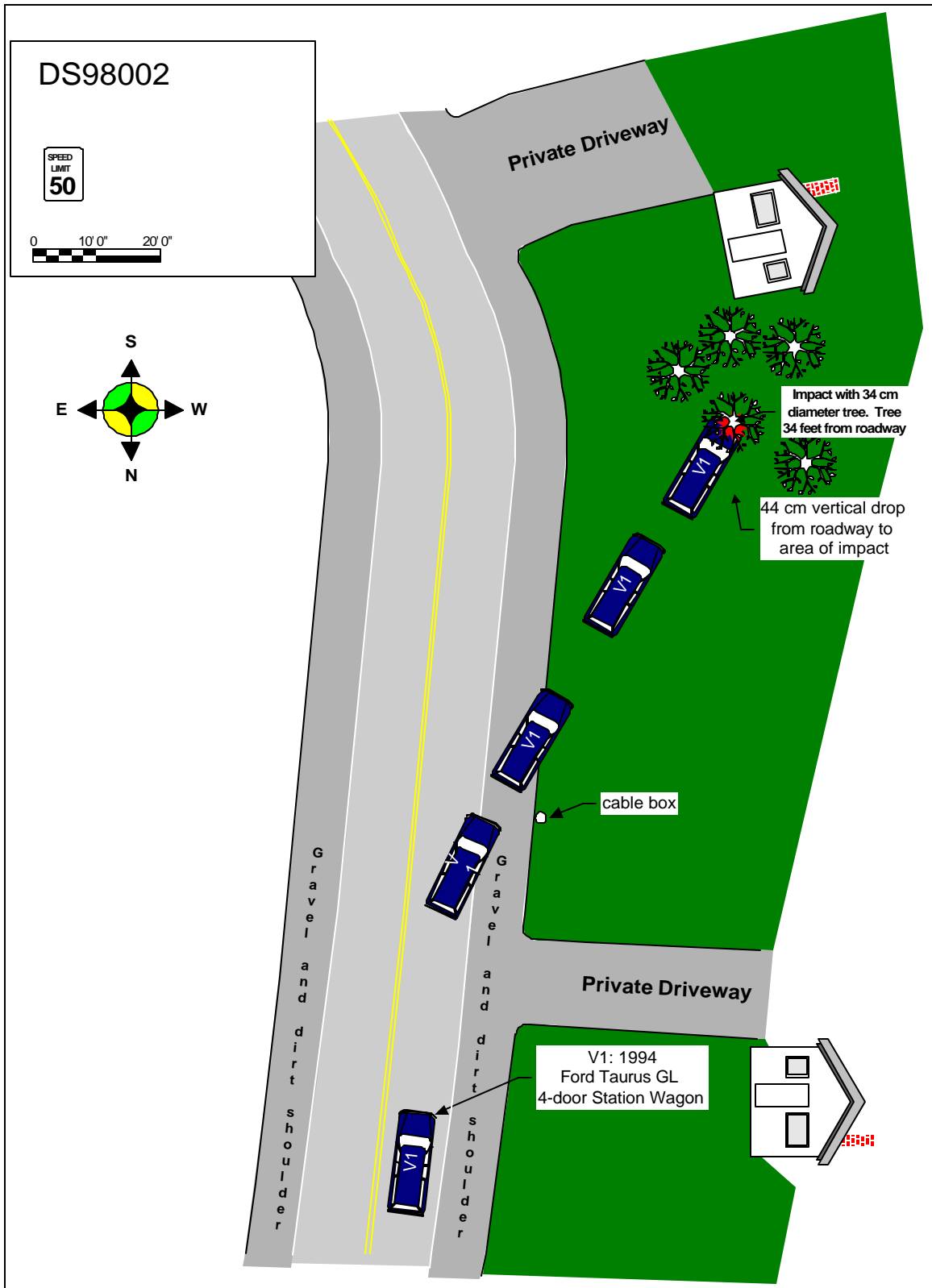
“on the basis of the hospital record, there appears to be no significant cervical spinal cord injury. Although the patient did not show significant neurological deficits, he continued to have respiratory problem which was attributed to some degree of aspiration which resulted ultimately in degradation of his respiratory function and subsequent respiratory arrest.”

The driver’s health continued to deteriorate and he expired ten days after the date of the collision at 1320 hours. The Certificate of Death attributes the death to pneumonia due to, or as a consequence of, fracture of C1-C2 vertebra and blunt impact to the head and chest.

It is the opinion of this investigator that driver of Vehicle 1 was fully conscious prior to the crash. For an unknown reason he veered off the right side of the road. There was no indication that he took any evasive maneuvers. Contrary to the police report, he was not wearing the available lap and shoulder belts. Based on the uniformity of the leg contacts with the left instrument panel and below, it appears that the driver remained in the seat in an upright, forward facing position. At impact with the tree, the driver went forward and up, wrapping himself up and over the top half of the steering wheel with both legs striking the instrument panel and below. It appears that the driver engaged the air bag prior to it fully deploying. The left side of his head appears to have struck the windshield. The windshield had a spider web crack slightly to left and above the steering wheel. The neck injury was attributed to the

striking of the windshield rather than the deploying air bag.

Scene Diagram



DETAILED INFORMATION

Vehicles

Vehicle 1

| | | |
|------------------------|--|------------------------------|
| Description: | 1994 Ford Taurus GL 4-door Station Wagon | |
| VIN: | 1FALP57U0RGXXXXXX | |
| Odometer: | 83,771 km (52,054 miles) | |
| Engine: | 3.0L V6 | |
| Reported Defects: | None reported | |
| Cargo: | None | |
| Damage Description: | Major-total front end damage, hood, grille area, front right fender, and windshield. The roof top buckled. The left front tire was flat and restricted. The front axle was damaged, and the steering linkage broke free. | |
| CDC: | 12FYEN2 | |
| Crush Measurements: | C ¹ =0.6 cm (0.24 in), C ² =28.5 cm (11.2 in), C ³ =43.5 cm (17.1 in), C ⁴ =18.5 cm (7.3 in), C ⁵ =7 cm (2.8 in), C ⁶ =7.6 cm (3 in) | |
| Delta V ³ : | Total | 29.1 km/h (18.1 mph) |
| | Longitudinal | -29.1 km/h (-18.1 mph) |
| | Latitudinal | 0 km/h (0 mph) |
| | Energy | 52,559 joules (38,795 ft-lb) |



Figure 6. Exterior damage.

³ Calculated using the barrier options of WinSmash

Supplemental Restraint System (Air Bags):

Vehicle 1 was equipped with a driver's air bag and top-mounted front right passenger's air bag. The steering wheel hub mounted driver's air bag was circular and measured 51 cm (20 in) in diameter. It had two tethers and two rear vent ports at the 11 and 01 o'clock positions, and there were seven vertical folds. The air bag had a maximum excursion of 30 cm (11.8 in). There were black linear smudges along the back top part of the air bag near the left vent port, these linear smudges are consistent with contact with the module covers as the air bag unfolds. There driver's air bag was burned near the left vent port by the exhaust gases. The dual module covers opened in a typical "H" configuration, and the upper and lower module covers were not deformed nor damaged. There was blood splattered about the lower left face of the driver's air bag as well as the back top and lower right areas. These blood spots are attributed to the lacerations to the head and right hand of the driver.

The passenger side air bag is rectangular in shape and measures 63 cm (24.8 in) by 88 cm (34.6 in); it was not tethered and had two vent holes at the rear and left outboard part of the air bag. The passenger's air bag was not damaged. The dual module covers were symmetrical and rectangular in shape and were not damaged.



Figure 7. Driver's air bag.

Occupants

| | |
|---------------------------------|---|
| <u>Vehicle 1</u> | Occupant 1 |
| Age/Sex: | 86/Male |
| Seated Position: | Front left |
| Seat Type: | Bucket, fabric covered, forward facing |
| Height: | 178 cm (70 in) |
| Weight: | 73 kg (160 lb) |
| Occupation: | Retired |
| Pre-existing Medical Condition: | Unknown |
| Alcohol/Drug Involvement: | None |
| Driving Experience: | Presumed . 70 years |
| Body Posture: | Unknown, but given the uniform damage to instrument panel he was probably seated upright |
| Hand Position: | Unknown, both probably on steering wheel |
| Foot Position: | Right foot probably on accelerator pedal, and left foot on toe pan. |
| Restraint Usage: | Lap and shoulder belts not used (inspection revealed no loading evidence) |
| Air bag: | Driver's and front right passenger's air bag deployed |

Injuries and Injury Mechanisms

Vehicle 1

| | <u>INJURY</u> | <u>OIC CODE</u> | <u>ICD-9</u> | <u>SOURCE</u> |
|---------|---|----------------------------|------------------|---------------------------------|
| Driver: | Fractured cervical vertebra at C1-C2 | 650216.2, 6 | 805.01 | Windshield |
| | Fracture of right 5 th rib | 450212.1, 1 | 807.00 | Steering wheel |
| | Contusion to entire forehead | 290402.1, 7 | 920 | Windshield |
| | Lacerations to head | 190600.1, 9 | 873.0 | Windshield |
| | Crest shaped contusion to left lower eye along the zygomatic arch | 290402.1, 2 | 920 | Windshield |
| | Contusion to entire right shoulder | 790402.1, 1 | 923.00 | Air bag |
| | Contusion beneath left clavicle area | 790402.1, 2 | 923.00 | Air bag |
| | Lacerations to dorsum of right hand | 790600.1, 1 | 882.0 | Rear view mirror |
| | Contusions to dorsum of right hand | 790402.1, 1 | 923.20 | Rear view mirror |
| | Scattered interrupted contusions with the right more severely involved than the left, and these changes occur below the knee. | 890402.1, 1 890402.1, 2 | 924.10 924.10 | Left instrument panel and below |

Occupant Kinematics

The posture of the driver of Vehicle 1 is not known but based on the uniformity of the leg contacts with the left instrument panel and below, it appears that the driver remained in the seat in an upright, forward facing position. Contrary to the police report, he was not wearing the available 3-point manual lap and shoulder belts. His right hand was probably on the steering wheel. He was seated in a fabric covered bucket seat with a folding back. The seat was reclined at a 19E rearward angle and adjusted to rear most track position. For an unknown reason, the driver of Vehicle 1 failed to negotiate the curve on the roadway, and drove off the right side of the roadway edge into a vacant lot. Vehicle 1 continued moving forward in the empty lot until it struck a 34 cm (13.4 in) diameter fir tree head-on. Vehicle 1 experienced a rapid deceleration, and the driver went forward and up, both knees struck the lower instrument panel causing contusions to both of his legs. The driver overloaded the air bag and the wrapping motion loaded the upper and lower steering wheel rim, deforming the upper portion of the rim; basically wrapping himself over the top of the steering wheel. The driver struck the windshield with his head (see Figure 8). He sustained a cervical vertebral fracture at C1-C2. The neck injury was more likely the result of his head striking the windshield and as his body continued moving forward, loading on his cervical spine. The windshield was also the cause of blunt head trauma, causing a contusion to his forehead, and a laceration to his head. The steering wheel and driver's air bag also caused blunt trauma to his chest, contusions to his right shoulder and the area beneath his left clavicle. The driver's air bag also appears to have "flung" the driver's right hand into the rear view mirror causing a contusions and lacerations to the right hand. There was blood about the driver's air bag that was due to the lacerations to his head and right hand (see Figure 9). The driver was conscious at the scene and spoke to the investigating police officer. He died ten days later as a result of pulmonary complications which resulted from hospitalization for a C1-C2 cervical vertebral fracture, and blunt impact to his head and chest.



Figure 8. Spider web to windshield from driver's head, and cracked rear view mirror from his right hand.



Figure 9. Blood on driver's air bag from lacerations to driver.