

Child air bag fatality Investigation / Vehicle v. Tree
Dynamic Science, Inc. / Case Number: DS03028
1992 Ford Taurus
Ohio
July, 2003

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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 crash-worthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract This single vehicle child driver air bag fatality crash occurred in July, 2003 at 0643 hours. The crash occurred on a two-lane undivided residential roadway. At the time of the crash there was moderate to very heavy rainfall with dark overcast clouds. Street lights were present and were on at the time of the crash. The speed limit is 40 km/h (25 mph). The case vehicle was a 1992 Ford Taurus GL four-door sedan that was being driven by an unrestrained 5-year-old male (112 cm/44 in, 21 kg/47 lbs). The case vehicle was equipped with a steering wheel mounted driver's air bag. The case vehicle was initially parallel parked in front of a residence facing north. The child was able to start the vehicle. The vehicle was taken out of PARK and put into DRIVE. He initially steered to the left to exit the parking space. As he did so, the right side of the case vehicle contacted the left rear bumper corner of a parked 1988 Ford Fiesta. The case vehicle continued northbound for 266 m (874 ft) until veering right and sideswiping a parked 1990 Chevrolet Prism with its front right side. The case vehicle continued going northbound for 79 m (261 ft) until it veered to the left, over-ran the small curb, and struck a 16.0 cm (6.3 in) wide tree with its front end. The tree remained upright. The driver's air bag deployed at this point. A witness to the crash called 911 and waited until EMS personnel arrived. He did not see anyone get out of the vehicle. When EMS personnel arrived the child driver was found on the floor in front of the driver's seat—approximately 15 minutes post-crash. The child was unconscious. He had sustained head injuries, a heart laceration, C3/C4 fractures with displacement, a C2 fracture with anterior displacement of the odontoid, and multiple contusions and abrasions. The child was being ventilated mechanically. After discussions with the family when it was determined that there was no hope of survival, the child was withdrawn from life support. At 2105 hours, 15 hours post-crash, he was pronounced dead.					
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**Dynamic Science, Inc.
Crash Investigation
Case Number: DS03028**

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BACKGROUND:

Description: This Child Air Bag Fatality case was identified by DSI from on-line Internet sources on July 23, 2003. This was an on-scene investigation. The case vehicle and scene were inspected on July 30, 2003. Local crash investigators and a crime scene technician attended various parts of the inspections.

Investigation Type: Child air bag fatality
Crash Location: Ohio
Crash Date: July, 2003
Notification Date: July 23, 2003
Field Work Completed: July 30, 2003

SUMMARY

Crash Site

This single vehicle crash occurred in July, 2003 at 0643 hours. The crash occurred on a two-lane undivided residential roadway. The asphalt roadway was level and wet. The west edge of the roadway is bounded by a 6.0 cm (2.4 in) concrete curb, followed by a grass tree lined easement, and then a sidewalk. Parking is allowed on both sides of the roadway. At the time of the crash there was moderate to very heavy rainfall with dark overcast clouds. Street lights were present and were on at the time of the crash. The speed limit is 40 km/h (25 mph).



Figure 1. Approach to area of tree impact

Pre-Crash

The case vehicle is a 1992 Ford Taurus GL four-door sedan that was being driven by an unrestrained 5-year-old male (112 cm/44 in, 21 kg/47 lbs). The case vehicle was equipped with a steering wheel mounted driver's air bag. The case vehicle was initially parallel parked in front of a residence facing north. The keys to the vehicle were reported to be inside the residence on a kitchen table. The child took the keys while his family was sleeping. He was able to enter the vehicle on his own.

The child appears to have been seated on the fabric covered bucket seat, facing forward, with one foot on the accelerator. The seat was adjusted to the middle track position (three stops from full forward). The child was able to start the vehicle. The vehicle was taken out of PARK and put into DRIVE. This is a multi step process. This first requires that the left side shift lever button on the center console mounted shifter be pressed. It next requires that the brake pedal be depressed before actually shifting. The vehicle was equipped with a Brake Shift Interlock safety feature (See Attachment 1). This feature prevents the shift lever from being moved from the PARK position until the brake pedal is depressed. This feature is only active when the ignition switch is in the RUN position¹. It appears likely that the interlock was working correctly before the crash took place but this could not be verified. The vehicle shifted freely without having to use the brake, but the vehicle was without power.

The distance from the seat cushion edge to the brake was 43.0 cm (16.9 in) and to the accelerator pedal was 50.0 cm (19.7). The mean leg distance (from hip point at the buttocks to the bottom of the foot) for a child of this age² is 50.5 cm (19.9 in). The measured distance from the sole of the foot to the hip for this child was 50.8 cm (20.0 in). Reaching the brake pedal would not seem to be a problem for a child this age. Police investigators conducted an experiment using a similarly sized child. This child did not experience any difficulty reaching the pedals or putting the vehicle into gear.

The headlights were turned on by the child at some point before the final impact. The windshield wipers were off.



Figure 2. Case vehicle at final rest



Figure 3. Front left, case vehicle

¹The interlock system can be bypassed, if necessary, by first turning the ignition off, then moving the shift lever out of PARK.

²Anthropometry of infants, children, and youths to age 18 for product safety design. SAE-SP-450

Crash

The child initially steered the Ford Taurus to the left to exit the parking space. As he did so, the right side of the case vehicle contacted the left rear bumper corner of a parked 1988 Ford Fiesta.

The case vehicle continued northbound for 266 m (874 ft) until veering right and sideswiping a parked 1990 Chevrolet Prizm with its front right side. The case vehicle continued going northbound for 79 m (261 ft) until it veered to the left, over-ran the small curb, and struck a 16.0 cm (6.3 in) wide tree with its front end (12FYEN2). The tree remained upright. The total velocity change for the case vehicle as calculated by the Barrier algorithm of the WinSmash collision model was 29.0 km/h (18.0 mph). The longitudinal and lateral delta V components were -29.0 km/h (-18.0 mph) and 0 km/h (0 mph), respectively. The driver's air bag deployed at this point.



Figure 4. Driver's seated position (air bag had been removed)

Post-Crash

A witness to the crash called 911 and waited until EMS personnel arrived. He did not see anyone get out of the vehicle. When EMS personnel arrived the child driver was found on the floor in front of the driver's seat—approximately 15 minutes post-crash. The child was unconscious. The child was intubated. Breathing was assisted by bagging. He was resuscitated and transport was begun. He was transported by ground ambulance to a local hospital where he was placed in the pediatric intensive care unit. The child arrived with a Glasgow Coma Scale of 3. The child had sustained multiple head injuries, a right atrium laceration, C3/C4 fractures with displacement, a C2 fracture with anterior displacement of the odontoid, facial contusions and abrasions, and abrasions to the right neck, right shoulder, and right upper arm. The child was being ventilated mechanically. After discussions with the family when it was determined that there was no hope of survival, the child was withdrawn from life support. At 2105 hours, 15 hours post-crash, he was pronounced dead.

The vehicle was towed from the scene and placed under a police hold.

SCENE DIAGRAM

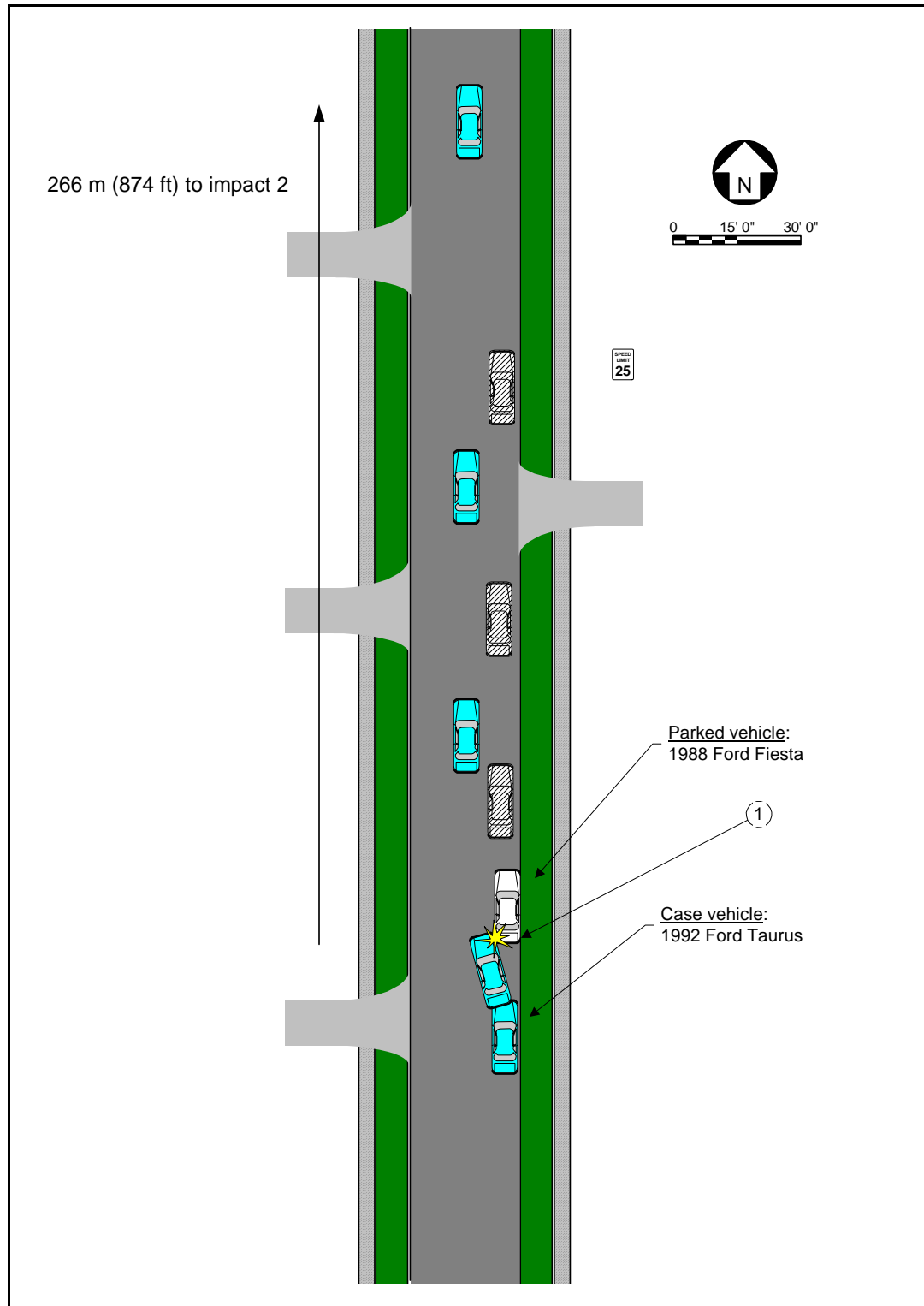


Figure 5. Scene diagram (impact 1)

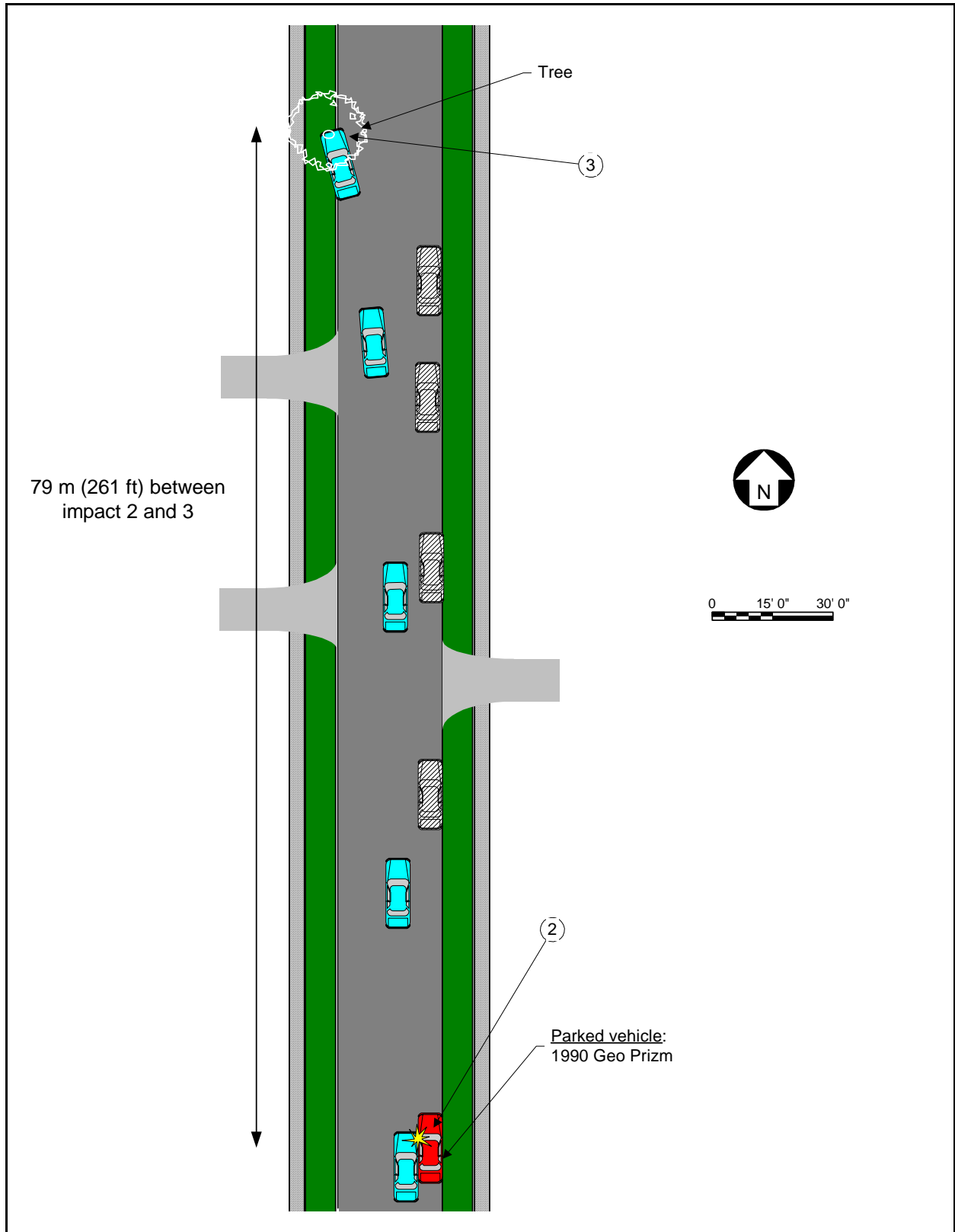


Figure 6. Scene diagram (impacts 2 and 3)

VEHICLE DATA - 1992 Ford Taurus GL four door sedan

VIN: 1FACP52U4NGxxxxxx
 Odometer: 180,222 km (111,988 miles)
 Engine: 3.0L, V6
 Reported Defects: None noted
 Cargo: None

The 1992 Ford Taurus was equipped with All Season Radial P205/70R14 tires. The specific tire data is as follows:

Tire	Tread	Pressure	Recommended pressure
LF	5 mm (0.19 in)	221 kpa (32 psi)	241 kpa (35 psi)
LR	5 mm (0.19 in)	145 kpa (21 psi)	241 kpa (35 psi)
RF	6 mm (0.25 in)	296 kpa (43 psi)	241 kpa (35 psi)
RR	5 mm (0.19 in)	186 kpa (27 psi)	241 kpa (35 psi)

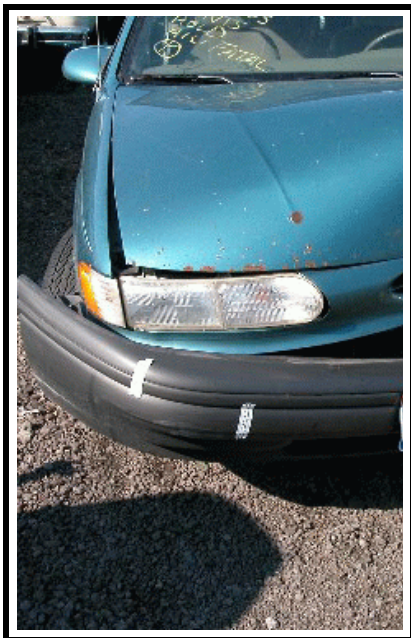


Figure 7. Front, impact with parked vehicle (impact 1)



Figure 8. Right side impact with second parked vehicle (impact 2)

The front seating positions in the 1992 Ford Taurus were configured with bucket seats with adjustable head restraints that were in the down position. Both seat backs were found to be slightly reclined at the time of inspection. The rear seating positions were configured with a bench seat. There were no head restraints for the rear seat.

VEHICLE DAMAGE

Exterior Damage - 1992 Ford Taurus

Damage Description:	Moderate frontal contact damage from tree impact. Light scraping to right front bumper and right fender from impacts to parked vehicles.	
CDC:	Impact 1: 12FREE1 Impact 2: 12RFES1 Impact 3: 12FYEN2	
Delta V (Impact 3):	Total	29.0 km/h (18.0 mph)
	Longitudinal	-29.0 km/h (-18.0 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	47,084 joules (34,727 ft lbs)

This vehicle sustained 22.0 cm (8.6 in) of direct contact to the right front bumper corner from the impact with the first parked vehicle (impact 1). This damage was altered by a subsequent impact. The vehicle sustained 110.0 cm (43.3 in) of direct contact to the right fender from the impact with the second parked vehicle (impact 2). The vehicle sustained 34.0 cm (13.4 in) of direct contact damage to the bumper that began 30.0 cm (11.8 in) from the left front bumper corner from the impact with the tree (impact 3). The residual crush measured along the bumper was as follows: C1=0 cm (0 in), C2=0 cm (0 in), C3=47.0 cm (18.5 in), C4=34.0 cm (13.4 in), C5=0 cm (0 in), C6=0 cm (0 in). The maximum crush was measured at C3. The principle direction of force was within the 12 o'clock sector and was an estimated 0 degrees. The damaged components included the bumper fascia and reinforcement bar, hood, grille, and radiator. Both front and rear doors remained closed and operational. There was no glazing damage.

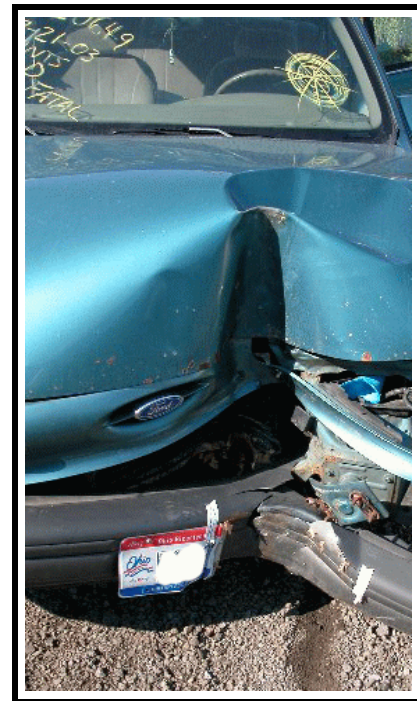


Figure 9. Front, tree impact (impact 3)

Interior Damage - 1992 Ford Taurus

There was minimal interior damage to the Ford Taurus. There was no intrusion and all the glazing remained intact. There was no steering column movement or steering wheel rim deformation. There was a plastic panel beneath the steering column that was missing. The plastic cover near the hinge point on the left side of the driver's seat was cracked. The center console was slightly displaced. This damage appears to be related to vehicle usage.



Figure 10. Cracked plastic on driver's seat

MANUAL RESTRAINT SYSTEMS - 1992 Ford Taurus

The 1992 Ford Taurus was configured with manual 3-point lap and shoulder belts with sliding latch plates and emergency locking retractors for both front positions and the rear outboard positions. There were no anchorage adjustments for the shoulder belts. A 2-point lap belt with a sewn-on latch plate was present for the rear center position. There were no seat belts in use during this crash.

FRONTAL AIR BAG SYSTEM - 1992 Ford Taurus

The case vehicle was equipped with a steering wheel mounted driver's air bag. The deployed air bag was circular with a diameter of 69.0 cm (27.2 in). There were four vertical folds, a single tether, and two vent ports. The module cover had an "H" configuration. The top cover measured 20.5 cm (8.1 in) wide by 12.0 cm (4.7 in) high. The bottom cover measured 20.5 cm (8.1 in) wide by 3.0 cm (1.2 in) high. A blood spot was found by police on the lower right cover (see A in upper figure), but that had been removed by forensic personnel prior to this contractor's inspection. There was a possible skin contact on the right side of the upper module cover (see B in the upper figure). A faint skin contact was found on the back of the air bag, on the left side if facing forward in the vehicle.

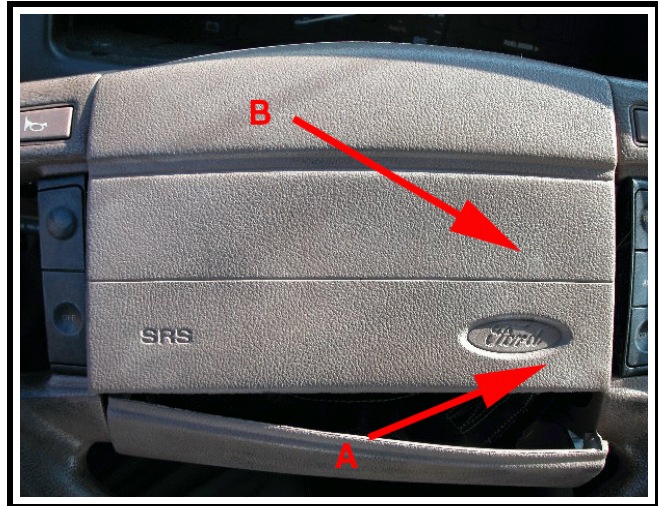


Figure 11. Top of driver's air bag module cover

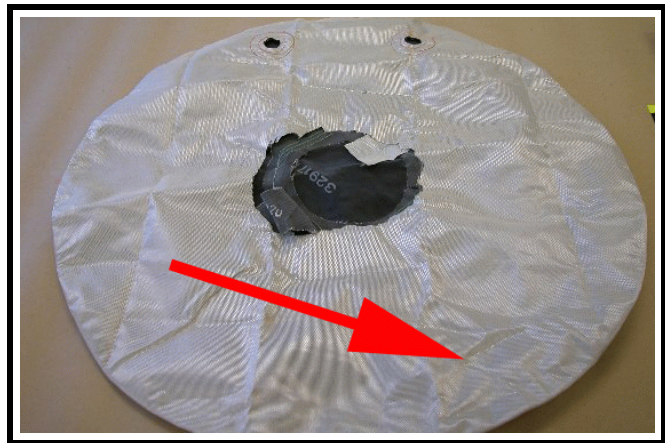


Figure 12. Driver's air bag, back. Probable skin contact to bottom left side (facing forward in vehicle).

OCCUPANT DEMOGRAPHICS - 1992 Ford Taurus

	Driver
Age/Sex:	5/Male
Seated Position:	Front left
Seat Type:	Fabric covered bucket seat, facing forward. Seat was adjusted to the middle track position (three stops from full forward). Seat back inclined at 68.5 degrees from horizontal. Seat bottom at 15.2 degrees from horizontal.
Height:	112 cm (44 inches) ³
Weight:	21 kg (47 lbs)
Occupation:	N/A
Pre-existing Medical Condition:	Asthma, per autopsy report
Alcohol/Drug Involvement:	None
Driving Experience:	None
Body Posture:	Sitting in an upright fashion on the edge of the driver's seat.
Hand Position:	Unknown
Foot Position:	Right foot on accelerator, left unknown
Restraint Usage:	Lap and shoulder belt available, not used
Air bag:	Driver steering wheel mounted air bag, deployed

³Additional measurements: crown rump length 63 cm (25 in), shoulder width 25 cm (10 in), shoulder to index finger tip 43 cm (17 in), great toe to knee 36 cm (14 in), sole of foot to knee 28 cm (11 in), great toe to hip 58 cm (23 in), sole of foot to hip 51 cm (20 in), hip to shoulder 41 cm (16 in), and hip to knee 28 cm (11 in).

OCCUPANT INJURIES - 1992 Ford Taurus

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence</u>
Laceration, right atrium 0.15 cm (0.06 in)	441008.3,4	Air bag	Probable
Right subdural hematoma, 10 mL	140652.4,1	Seat back	Probable
Contusion, right temporal lobe	140602.3,1	Seat back	Probable
Laceration, cerebrum	140474.4,6	Seat back	Possible
Subarachnoid hemorrhage, left lateral parietal lobe (3 cm/ 1.2 in diameter), right cerebellar hemisphere (3 x 2 cm/1.2 x 0.8 in)	140684.3,2 140684.3,1	Seat back	Probable
C4 fracture with displacement, disruption of the intervertebral disc space of the facet	650216.2,6	Air bag, flexion injury	Certain
C2 fracture with anterior displacement of the odontoid	650222.3,6	Air bag, flexion injury	Certain
Bilateral pulmonary contusions, upper lobe, with bilateral hemothoraces	441410.4,3	Air bag	Certain
Contusion, anterior right neck, superior right shoulder 2.6 x 1.9 cm (6.5 x 5.0 in). Part of this lesion has a pattern abrasion of faint parallel lines over an area 1.5 x 1.2 cm (4.0 x 3.0 in).	390402.1,1 390202.1,1 790402.1,1 790202.1,1	Air bag Air bag	Certain Certain
Bilateral periorbital ecchymoses	297402.1,3	Air bag	Certain
Contusion, lateral right cheek, 0.8 x 0.6 cm (2.0 x 1.5 in)	290402.1,1	Air bag	Certain
Contusion, left lower lip	290402.1,8	Air bag	Certain
Fractures, bilateral upper central incisors and left lateral upper incisor	251404.1,8	Air bag	Probable
Partial avulsion, left lateral upper incisor	251406.1,8	Air bag	Probable

Abrasion, right and central chest, 2.8 x 0.09 cm (7 x 0.25 in)	490202.1,1 490202.1,4	Air bag	Certain
Abrasions, right arm	790202.1,1	Air bag	Probable
Abrasion, lateral distal right thigh	890202.1,1	Unknown	Unknown
Abrasion, heel of right foot	890202.1,1	Foot controls	Possible
Right toe avulsion	890800.1,1	Foot controls	Possible
Contusion, left knee	890402.1,2	Unknown	Unknown
Spinal shock (coded as blunt cervical spine injury)	615099.7,6	Air bag, flexion injury	Certain

OCCUPANT KINEMATICS - 1992 Ford Taurus

The 5-year-old male child driver was seated facing forward. He was not wearing the available lap and shoulder belt. It appears likely that he was sitting in an upright fashion on the edge of the driver's seat. The seat was adjusted to the middle track position (three stops from full forward). An average erect sitting height for a child of this age⁴ would be 60.5 cm (23.8 in) from his buttocks to the top of his head. The coroner indicated that the crown to rump measurement for this child was 63.5 cm (25.0 in). The distance from the seat bottom to the top of the steering wheel was 48.0 cm (18.9 in). Both the average and actual seated heights would have put the top of child's head slightly above the top of the steering wheel rim with his face/neck in the general area of the air bag module. The steering



Figure 13. Driver's air bag, front

wheel was at a 51 degree angle from the horizontal. The distance from the seat bottom edge to the face of the brake pedal was 43.0 cm (16.9 in). The distance to the accelerator was 50.0 cm (19.6 in). The distance from the top of the steering wheel to the driver seat back was 70.0 cm (27.5 in). The distance from the bottom of the steering wheel to the seat back was 44.0 cm (17.3 in).

The first two impacts to this vehicle were very minor and did not result in any significant driver kinematic activity.

At impact with the tree, the unrestrained child pitched forward. The air bag began deploying. The driver's right arm may have contacted the upper module cover, causing abrasions to the forearm and elbow. As the air bag continued to deployed, the bottom back side of the air bag engaged the child's face and neck and began forcing his head rearward. The movement likely continued as the bag fully inflated. The driver's neck was hyperextended—causing the C2/C3-C4 fractures and the spinal injury. The driver was likely forced rearward into the seat back—causing the brain/head injuries-- and rebounded into the area below the steering wheel.

⁴See previous footnote

Attachment 1. Excerpt from 1992 Ford Taurus Owner Guide (shift interlock)

Driving Your Taurus

Procedures for driving your car will vary depending on which type of *transaxle* your car has. You may be familiar with the term "transmission." We use *transaxle* because it is a more accurate term for cars that have front-wheel drive.

Your car will have one of the following types of transaxes:

- an automatic overdrive transaxle, or
- a manual transaxle.

If you are not sure which transaxle your car has, talk to your dealer.

Driving with an Automatic Overdrive Transaxle

Your automatic overdrive transaxle provides fully automatic operation in either **D** (Overdrive) or **D** (Drive). Driving with the shift selector in **D** (Overdrive) gives the best fuel economy for normal driving conditions. For manual control, start in **L** (Low) and then shift manually.

Brake Shift Interlock Safety Feature

Your vehicle is equipped with a Brake Shift Interlock safety feature. This feature prevents the shift lever from being moved from the park position until the brake pedal is depressed. This feature is active when the ignition switch is in the RUN position.

NOTE: The interlock system can be bypassed, if necessary, by first turning the ignition off, then moving the shift lever out of PARK.

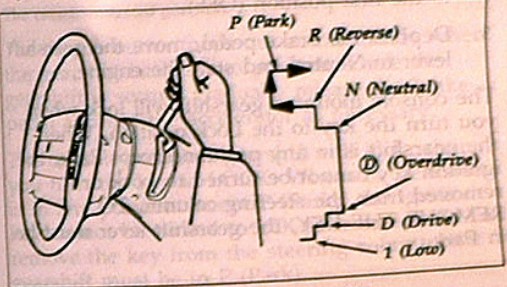
Putting Your Vehicle in Gear

Your car's gearshift can be on the column or on the console.

Warning: Hold the brake pedal down while you move the gearshift from position to position. If you do not hold the brake pedal down, your vehicle may move unexpectedly and injure someone.

Using a column-mounted gearshift

If your gearshift is on the column, you can use any of the following positions:



The positions of the column-mounted gearshift

Once you place the gearshift securely into position, gradually release the brake pedal and use the accelerator as necessary.

Using a console-mounted gearshift (optional)

If your car has a console-mounted gearshift, you must push in the thumb button to move the gearshift to the position you choose.

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