On-site Air Bag Fatality Investigation / Vehicle to Object
Dynamic Science, Inc. / Case Number: DS03018
1992 Ford Taurus L four-door sedan
Colorado
May, 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 crashworthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract

This on-site investigation focused on the injury mechanisms that caused the death of a 16-year-old female driver of a 1992 Ford Taurus. The case vehicle was equipped with a frontal air bag for the driver position which deployed as a result of a frontal collision with a wooden pole. This single vehicle crash occurred in a rural area of Colorado in May, 2003 sometime after 0300 hours. The crash occurred at the intersection of a southbound driveway and an east/west roadway. It was dark and there were no street lights. The east/west roadway is comprised of two lanes. The roadway was gravel covered and was level. The speed limit for the roadway is 89 km/h (55 mph). There is a 4% down grade for the driveway. On either side of the roadway there are 26 cm (10 in) diameter, 102 cm (40 in) high, wooden posts that are used to support a fence and gate for the residence.

The case vehicle was traveling east at a police reported speed of 24-32 km/h (15-20 mph). The driver attempted to turn right in order to enter the driveway. The driver took the turn too wide and struck the wooden gate post with its front end. The driver's air bag deployed at this point. The air bag struck the driver's chin, neck, and upper chest. The air bag expansion hyper-extended the driver's head resulting in a basilar hinge fracture, an atlanto-occipital separation, and scattered subarachnoid hemorrhage along the base of the brain. The driver was fatally injured. She also sustained abrasions under the chin, on the right side of the neck, and on the upper chest. She was found at approximately 0730 hours by her grandmother. When the police arrived they found the driver partially outside the driver's door, her left side on the ground with her face looking towards the left front tire. The grandmother may have opened the door and the driver fell out. The case vehicle was towed from the scene and placed on a police hold.

17. Key Words	18. Distribution Statement
Air bag, deployment, injury, crash, fatality, short stature, female, driver	

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Dynamic Science, Inc.
Accident Investigation
Case Number: DS03018

TABLE OF CONTENTS

BACKGROUND:

Description:	This on-site investigation focused on the injury mechanisms that caused the death of a 16-year-old female driver of a 1992 Ford Taurus. The case vehicle was equipped with a frontal air bag for the driver position which deployed as a result of a frontal collision with a wooden pole. This driver air bag fatality case was identified by a local state patrol investigator. The National Highway Traffic Safety Administration (NHTSA) was notified on May 25, 2003. DSI was notified on May 28, 2003. This was an on-site investigation. The vehicle and scene inspections took place on May 30, 2003.
Investigation Type:	On-site
Crash Location:	Colorado
Crash Date:	May, 2003
Notification Date:	May 28, 2003
Field Work Completed:	May 30, 2003

SUMMARY:

This single vehicle crash occurred in a rural area of Colorado in May, 2003 sometime after 0300 hours. The crash occurred at the intersection of a southbound driveway and an east/west roadway. It was dark and there were no street lights. The east/west roadway is comprised of two lanes. The roadway was gravel covered and was level. The speed limit for the roadway is 89 km/h (55 mph). There is a 4% down grade for the driveway. On either side of the roadway there are 26 cm (10 in) diameter, 102 cm (40 in) high, wooden posts that are used to support a fence and gate for the residence.

Figure 1. Path to impact (east). Arrow points to struck pole.

The case vehicle is a 1992 Ford Taurus L four-door sedan driven by an unrestrained[1] 16-year-old female (157 cm/62 in, 48 kg/105 lbs). The case vehicle was equipped with a driver's steering wheel mounted air bag. According to police investigators, the driver's seat track was in the forward most position. She was seated on a pillow. The seat back was inclined at a 24 degree angle from vertical. The seat bottom was at a 13 degree angle from horizontal. The case vehicle was traveling east at a police reported speed of 24-32 km/h (15-20 mph). The driver attempted to turn right in order enter the driveway. The driver took the turn too wide and struck the wooden gate post with its front end (12FLLN1). The post shifted slightly due to the impact. The driver's air bag deployed at this point. At impact, the driver responded to the 0 degree principle direction of force by moving straight forward. The deploying air bag engaged her upper chest and chin area. The driver was fatally injured. The air bag expansion hyper-extended the driver's head resulting in a basilar hinge fracture, an atlanto-occipital separation, and scattered subarachnoid hemorrhage along the base of the brain. She also sustained abrasions under the chin, on the right side of the neck, and on the upper chest. There was a substantial amount of blood found on the air bag, the driver's seat, the floorboard, and side rail. The driver had bled from both the nose and ears.

Figure 2. Struck pole

Figure 3. Case vehicle at final rest

The total velocity change calculated by the barrier algorithm of the WinSmash collision model was 12.0 km/h (7.5 mph)[2]. The longitudinal and lateral delta V components were -12.0 km/h (-7.5 mph) and 0 km/h (0 mph), respectively. This was a borderline reconstruction due to the yielding wooden post.

[1]No indications of loading or of blood on seat belt

[2]Calculated using stiffness values derived from NCAP test 1177

The last time anyone saw the driver was between 0300 and 0330 hours. She was found at approximately 0730 hours by her grandmother. There is a discrepancy as to whether or not the door was open when she was initially found by the grandmother. When the police arrived they found the driver partially outside the driver's door, her left side on the ground with her face pointing towards the left front tire. The grandmother may have opened the door and the driver fell out.

The case vehicle was towed from the scene, not due to damage, and placed under a police hold.

Figure 4. Close up of frontal damage

Scene Diagram

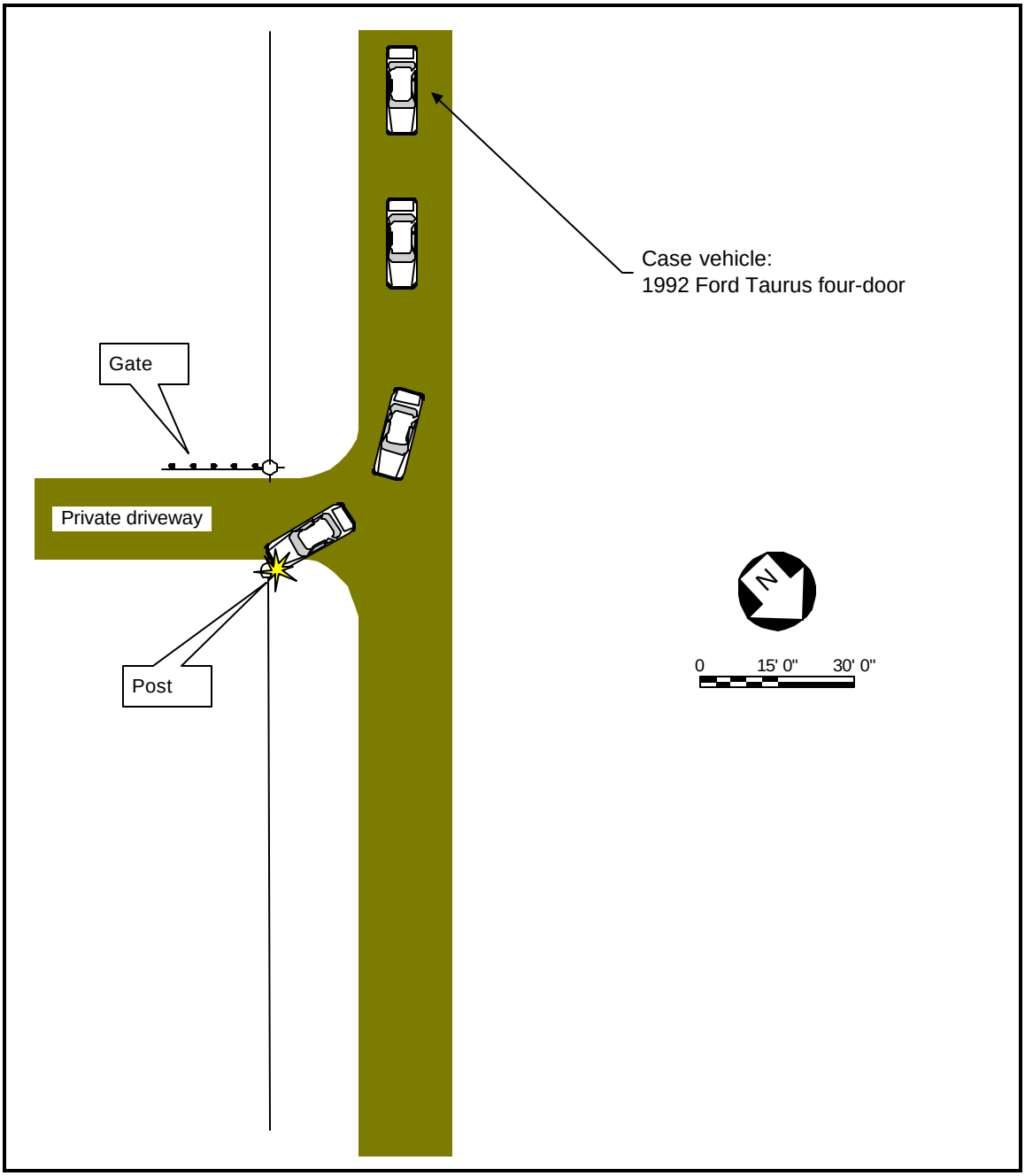

Figure 5. Scene diagram

DETAILED INFORMATION

Vehicles

Case vehicle

Description:	1992 Ford Taurus L four-door, manufactured in 02/1992.	
VIN:	1FACP50U8NGxxxxxx	
Odometer:	Unknown	
Engine:	3.0 L, V6	
Reported Defects:	None related to this crash	
Cargo:	Wheel chair in trunk, plaster figurine in rear seat	
Damage Description:	Minor contact damage to left side of bumper. There was 3.0 cm (1.2 in) of energy absorber compression that was fully restituted at the time of inspection.	
CDC:	12FLLN1	
Delta V:	Total	12.0 km/h (7.5 mph)
	Longitudinal	-12.0 km/h (7.5 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	9,385 joules (6,922 ft-lbs)

Figure 6. Front left, case vehicle

The case vehicle sustained direct contact damage that began 17.0 cm (6.7 in) right of the left bumper corner and measured 20.0 cm (7.9 in) wide. The residual crush as measured along the bumper was as follows: C1=1.0 cm (0.4 in), C2=7.0 cm (2.8 in), C3=3.0 cm (1.2 in), C4=3.0 cm (1.2 in), C5=1.0 cm (0.4 in), and C6=0 cm (0 in). The maximum crush was at C2. The principle direction of force was within the 12 o'clock sector.

Figure 7. Close up of minor damage to bumper

Safety systems discussion

The driver's air bag module had an "H" configuration and was located in the center hub of the steering wheel rim. The single top flap measured 21.0 cm (8.3 in) wide and 13.0 cm (5.1 in) high. The bottom flap measured 21.0 cm (8.3 in) wide and 2 cm (0.8 in) high. There was no contact evidence on the cover flaps. The diameter of the air bag measured 72.0 cm (28.3 in) in its deflated state. There was a single tether and two vent ports. The ports were at the 11 and 1 o'clock positions. The air bag had a maximum excursion of 26.0 cm (10.2 in).

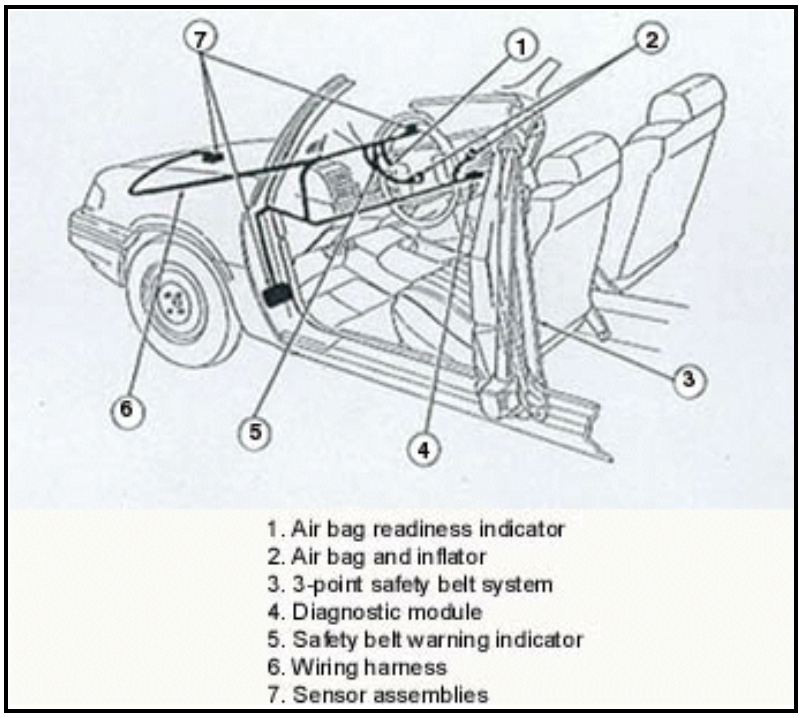

Figure 8. Air bag systems component locations

There was pooled blood on the bottom and bottom right of the air bag face. There was a single 15.0 cm (5.9 in) high by 1-2 cm (0.4-0.8 in) wide vertical scuff on the upper left of the air bag face.

Figure 9. Driver's air bag

Figure 10. Driver's air bag

Occupants

Case vehicle	Occupant 1
Age/Sex:	16/Female
Seated Position:	Front left
Seat Type:	Cloth covered split bench. Seat track was in the forward most position. The seat back was inclined at a 24 degree angle from vertical. The seat bottom was at a 13 degree angle from horizontal. Driver seated on a pillow.
Height:	157 cm (62 in)
Weight:	48 kg (105 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None
Alcohol/Drug Involvement:	THC-COOH (confirmed by gas chromatography-mass spectrometry, 58 ng/ml)[3], Nicotine, Cotinine[4]
Driving Experience:	Unknown, likely less than one year
Body Posture:	Upright, looking to right
Hand Position:	Unknown
Foot Position:	Right foot presumed to be on brake.
Restraint Usage:	Lap and shoulder belt available, not used
Air bag:	Driver's steering wheel mounted air bag available, deployed

[3]Tested positive for cannabinoids

[4]Cotinine is a chemical that is made by the body from nicotine, which is found in cigarette smoke. Since cotinine can only be made from nicotine, and since nicotine enters the body with cigarette smoke, cotinine measurements can show how much cigarette smoke enters your body.

Injuries and Injury Mechanisms

The injuries listed below for the case vehicle were obtained from the autopsy report.

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	"Hinge" fracture, basilar skull	150206.4,8	801.26	Air bag
	Occipital-atlantal separation	650208.2,6	Unknown	Air bag
	Scattered subarachnoid hemorrhage along base of brain	140466.3,2	800.26	Air bag
	Abrasion right anterolateral neck, triangle shape, measuring 6.0 x 2.5 cm (2.3 x 0.98 in) in greatest dimension	390202.1,2	910.0	Air bag
	Abrasion/contusion, lower lip, near midline 0.6 cm (0.23 in) in diameter	290202.1,8 290402.1,8	910.0 920.0	Air bag
	Abrasion, left side of neck, 0.5 cm (0.2 in)	390202.1,2	910.0	Air bag
	Abrasion, right lateral neck extending to the right anterior neck measuring 17.0 x 6.5 cm (6.7 x 2.6 in)	390202.1,1	910.0	Air bag
	Contusion, left upper chest, 5.0 x 3.0 cm (1.9 x 1.2 in)	490402.1,2	922.1	Air bag
	Abrasion, right axilla, 4.0 x 1.0 cm (1.6 x 0.4 in)[5]	490202.1,1	911.0	Air bag
	Contusion, right axilla, 6.0 x 5.0 cm (2.4 x 1.9 in)	490402.1,1	911.0	Air bag
	Abrasions, right lower inner quadrant of breast	490202.1,1	911.0	Air bag
	Abrasions, right medial chest, 20.0 x 6.0 cm (7.9 x 2.4 in)	490202.1.1	911.0	Air bag

[5]Axilla is a pyramidal space, situated between the upper lateral part of the chest and the medial side of the arm.

Occupant Kinematics

The 16-year-old driver (157 cm/62 in, 48 kg/105 lbs) of the case vehicle was unrestrained (3-point manual lap and shoulder safety belt available) and seated in a forward facing fashion on the cloth covered split bench seat. The driver was sitting on a pillow. The seat was adjusted to the forward most track position. This seat track position was determined by the blood pooling to the floor area and further verified by the police interview. Lack of restraint usage was determined by lack of blood stains on the seat belt and the position of the driver when found. In addition, there was no loading evidence on the belt system and the usage indicators were commensurate for a vehicle of this age. There was no steering wheel rim deformation or any steering column compression. There were no contacts to the instrument panel. The seat back was inclined at a 24 degree angle from vertical. The seat bottom was at a 13 degree angle from horizontal. The driver was wearing a blue windbreaker jacket and blue jeans. She was engaged in a right hand turning maneuver and probably looking to the right. Presumably her right foot was on the brake and was slowing the vehicle for the turn. Her left hand was possibly above the right on the steering wheel as she made the turn.

Figure 11. Cloth pillow on seat–color of pillow has been enhanced

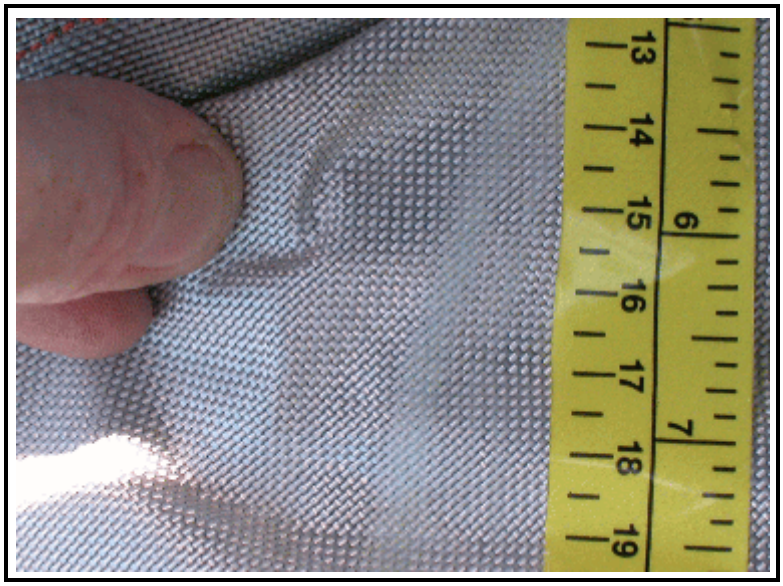

Figure 12. Skin transfer, upper left quadrant of driver's air bag

The driver took the turn too wide and the case vehicle struck the wooden gate post with its front end. The driver's air bag deployed at this point. At impact, the driver responded to the 0 degree direction of force by moving straight forward. This movement may have been exacerbated because she was seated on a pillow. The deploying air bag engaged her upper chest and right side neck area. She sustained abrasions under the chin, on the right side of the neck, and on the upper chest. The air bag expansion hyper-extended the driver's head resulting in a basilar hinge fracture, an atlanto-occipital separation, and scattered subarachnoid hemorrhages along the base of the brain. The driver was displaced both up and rearward by the expanding air bag. It appears that some portion of her face–probably the upper left part of her forehead–contacted the left side visor. There was a small skin transfer and what appeared to be make-up found on the visor. The driver rebounded forward and came to rest slumped over the deflated driver's air bag–leaning to her left based on the blood drip pattern.

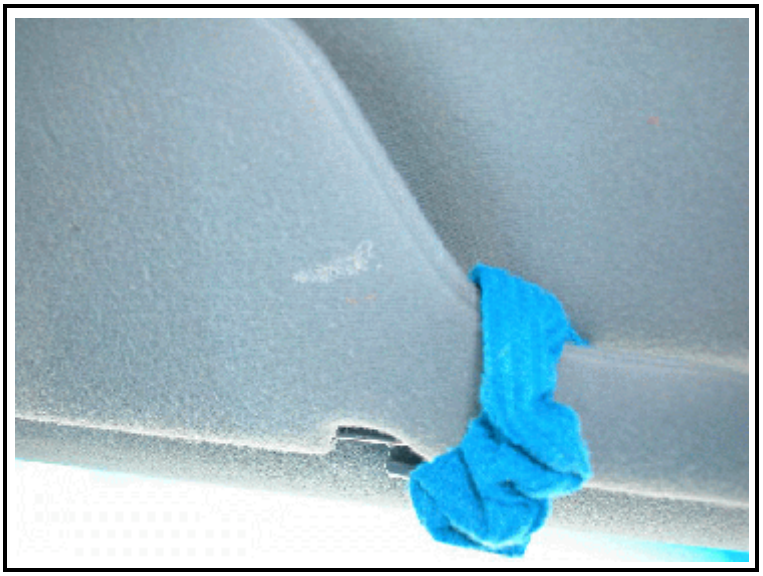

Figure 13. Close up of contact to left side visor

Figure 14. Side view of driver's seated position