

Passenger Air Bag Child Fatality Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS04006
1995 Ford Windstar
Idaho
April, 2004

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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.

1. Report No. DS04006	2. Government Accession No.	3. Recipient Catalog No.	
4. Title and Subtitle Passenger Air Bag Child Fatality Investigation		5. Report Date March 14, 2006	
		6. Performing Organization Report No.	
7. Author(s) Dynamic Science, Inc.		8. Performing Organization Report No.	
9. Performing Organization name and Address Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401		10. Work Unit No. (TRAVIS)	
		11. Contract or Grant no. DTNH22-01-C-27002	
12. Sponsoring Agency Name and Address U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590		13. Type of report and period Covered [Report Month, Year]	
		14. Sponsoring Agency Code	
15. Supplemental Notes			
16. Abstract This on-site passenger air bag child fatality investigation focused on the performance of the front air bags that were installed in a 1995 Ford Windstar minivan. The 1995 Ford Windstar was occupied by a restrained 42-year-old male driver, an unrestrained 3-year-old front right seat occupant, and a restrained 7-year-old rear seat occupant. The Windstar struck the right side of a 1993 Chevrolet Corsica in an intersection crash. Both front air bags in the Windstar deployed. The Windstar was deflected slightly to the right and came to rest facing north in the intersection. The Corsica was pushed in a clockwise rotation and came to rest facing generally west in the western leg of the intersection. The driver of the Windstar was not injured. The front right seat child occupant sustained a complete atlanto-occipital disarticulation of the spine with a fracture to the odontoid and a laceration to the underlying spinal cord. She also sustained a variety of contusions and abrasions to the face. She was transported by ambulance first to a local hospital and then to an area trauma center where she expired two days after the crash. The 7-year-old rear seat occupant was not injured. The Windstar was impounded by the police.			
17. Key Words Air bag, deployment, injury, crash, passenger air bag, 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.
Crash Investigation
Case Number: DS04006

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BACKGROUND:

Description:

This on-site investigation focused on the performance of the front air bags that were installed in a 1995 Ford Windstar minivan. The 1995 Ford Windstar was occupied by a 42-year-old male driver, a 3-year-old front right seat occupant, and 7-year-old rear seat occupant. The Windstar struck the right side of a 1993 Chevrolet Corsica in an intersection crash. The impact resulted in sufficient longitudinal deceleration of the Windstar to command the deployment of the frontal air bags. The Windstar was deflected slightly to the right and came to rest facing north in the intersection. The Corsica was pushed in a clockwise rotation and came to rest facing generally west in the western leg of the intersection. The driver of the Windstar was not injured. The front right seat child occupant sustained a complete atlanto-occipital disarticulation of the spine with a fracture to the odontoid and a laceration to the underlying spinal cord. She also sustained a variety of contusions and abrasions to the face. She was transported by ambulance first to a local hospital and then to an area trauma center where she expired two days after the crash. The 7-year-old rear seat occupant was not injured. The Windstar was impounded by the police.



Figure 1. Front left, 1995 Ford Windstar van

This Passenger Air Bag Related Child Serious Injury case was identified by the local contracts officer in the Idaho Transportation Department. DSI was notified on April 7, 2004. DSI inspected the case vehicle on April 13, 2004.

SUMMARY

Crash Site

This two-vehicle crash occurred at a four-leg intersection of two local roadways in April 2004 at 0850 hours. At the time of the crash, there were no adverse weather conditions and the asphalt roadway surface was dry. Both roadways are two-way and are undivided. There are no traffic controls. The speed limit in both directions is 32 km/h (20 mph).



Figure 2. Approach to point of impact, north

Pre Crash

The 1995 Ford Windstar was traveling northbound at a driver reported speed of 16 km/h (10 mph). The driver was taking the children to a nearby school. The 42-year-old driver was wearing the manual 3-point lap and shoulder belt. The 3-year-old front right occupant was unbelted. The 7-year-old second row right occupant was wearing the manual 3-point lap and shoulder belt.

The 1993 Chevrolet Corsica was traveling eastbound at an unknown speed. The 30-year-old female driver of the Corsica did not slow down and proceeded into the intersection. When the driver of the Windstar detected the approaching vehicle, he applied the brakes.

Crash

The front of the Windstar struck the right side of the Corsica near the right rear tire. The impact severity was minor and resulted in the deployment of the frontal air bag system in the Windstar. The missing vehicle routine of the WinSmash program computed a total delta V of 9.0 km/h (5.6 mph) based on the Windstar's front crush profile. The longitudinal and lateral components were -8.9 km/h (-5.5 mph) and 1.6 km/h (1.0 mph), respectively. The barrier equivalent speed was 12.5 km/h (7.8 mph). The Windstar was deflected slightly to the right and came to rest facing north in the intersection. The Corsica was pushed in a clockwise rotation and came to rest facing generally west in the western leg of the intersection. After coming to rest, the Corsica rolled backwards slightly.



Figure 3. Final rest, viewed to the northeast

Post Crash

The driver of the Windstar and 7-year-old rear seat occupant were not injured.

The front right seat child occupant sustained a complete atlanto-occipital disarticulation of the spine with a fracture to the odontoid and a laceration to the underlying spinal cord, extensive hemorrhaging into the paraspinal muscles, subdural bleeding in the right posterior parietal and occipital lobes of the brain, a contusion to the inner surface of the scalp with no underlying skull fractures, laceration to the frenulum, loss of the frontal central incisors, contusion/abrasion to right upper and lower eyelids, and a contusion to the lower lip. She was unresponsive and in cardiac arrest at the time the paramedics arrived. The paramedics began CPR. She was transported by ambulance to a local hospital. Upon arrival, her pupils were fixed and dilated. She was transferred to the pediatric intensive care unit of an area trauma center where she expired two days later.

A second ambulance arrived shortly after the crash to evaluate the driver of the Corsica. She refused to be transported.

Both vehicles were towed from the scene and impounded by the police.

Vehicle Data - 1995 Ford Windstar van

The 1995 Ford Windstar GL 4x2 van was identified by the Vehicle Identification Number (VIN): 2FMDA5140SBxxxxxx. The vehicle odometer read 255,800 km (158,947 miles) at the time of inspection. The vehicle had been purchased used by the current owner. According to the owner, the vehicle had been involved in a previous crash on the right side but there were no air bag deployments. The Windstar was equipped with a 3.8 liter, six-cylinder engine, front wheel drive, four-speed automatic transmission, front disc/rear drum brakes, and a tilt steering wheel. The Windstar was configured with Hankook Radial H714 P215/70R15 tires on the front, a Bridgestone Touresna P215/65R15 tire on the left rear, and a Goodyear Integrity P215/70R15 tire on the right rear. The vehicle manufacturer's recommended cold tire pressure was 221 kPa (32 psi). The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	269 kPa (39 psi)	6 mm (8/32 in)	No	None
LR	269 kPa (39 psi)	4 mm (5/32 in)	No	None
RR	248 kPa (36 psi)	4 mm (5/32 in)	No	None
RF	276 kPa (40 psi)	5 mm (6/32 in)	No	None

The seating in the Ford Windstar was configured with fabric covered front van type bucket seats with integral head restraints and second and third row bench seats with folding backs. The driver's seat was adjusted to the full rearward track position at the time of inspection. The seat back was at a 68 degree angle. The front right seat was adjusted to the full rearward track position at the time of inspection. The seat back was at an 83 degree angle.

VEHICLE DAMAGE

Exterior Damage - 1995 Ford Windstar

Damage Description: The 1995 Ford Windstar sustained minor front end damage as a result of the impact with the Chevrolet Corsica. The hood on the right side had shifted slightly. There were white paint transfers across the front end and the right light was cracked. The windshield was cracked, but this appeared to be existing damage and not related to this crash. All the doors remained closed and operational.

CDC: 12FDEW1

Delta V:	Total	9.0 km/h (5.6 mph)
	Longitudinal	-8.9 km/h (-5.5 mph)
	Latitudinal	1.6 km/h (1.0 mph)
	Energy	12,727 joules (9,387 ft lbs)

The direct damage began at the front left bumper corner and extended 160.0 cm (62.9 in) laterally across the entire front end of the vehicle. Six crush measurements were documented as follows: C1 = 3.0 cm (1.1 in), C2 = 0.0 cm (0.0 in), C3 = 0.0 cm (0.0 in), C4 = 0.0 cm (0.0 in), C5 = 0.0 cm (0.0 in), C6 = 4.0 cm (1.6 in).



Figure 4. Front, 1995 Ford Windstar

Interior Damage - 1995 Ford Windstar

The Ford Windstar sustained minor interior damage as a result of occupant contacts. There were white scuffs/transfers to the center console and the glove box. The scuffing on the glove box measured 9.0 cm (3.5 in) wide by 28.0 cm (11.0 in) long. The mirror was not found in the vehicle.

Manual Restraints - 1995 Ford Windstar

The 1995 Ford Windstar was configured with manual 3-point lap and shoulder belts for the front seats, the second row seats, and the outboard third row seats. All the lap and shoulder belts were equipped with emergency locking retractors and sliding latch plates. There were indications of historical usage for all the seat belts. The front belts were equipped with shoulder anchorage adjusters that were in the full up position. There were no indications of any loading. According to the police, there was a child seat available in one of the rear seats but it was not being used at the time of the crash.



Figure 5. White transfers to glove box

Supplemental Restraint System - 1995 Ford Windstar

The 1995 Ford Windstar was equipped with frontal air bags for the driver and front right passenger positions. The frontal air bags deployed as a result of the longitudinal deceleration of the Windstar during the impact with the Corsica. At the time of the vehicle inspection, both frontal air bags had been removed.

The driver's air bag deployed from the center of the steering wheel hub through H-configuration module cover flaps. The top flap measured 21.0 cm (8.3 in) wide by 17.0 cm (6.7 in) high. The bottom flap measured 21.0 cm (8.3 in) by 10.0 cm (3.9 in) high.

The front right passenger's air bag deployed from a front mount module with a rectangular cover flap that was hinged at the top. The module cover flap measured 33.0 cm (12.9 in) wide and 13.0 cm (5.1 in) high.



Figure 6. Driver's air bag, police photo



Figure 7. Front right passenger's air bag, police photo



Figure 8. Driver's air bag module



Figure 9. Front right passenger's air bag module

VEHICLE DATA - 1993 Chevrolet Corsica

Description: 1993 Chevrolet Corsica four door sedan
VIN: 1G1LT53T4PYXXXXXX
Odometer: Unknown
Engine: 3.1 liter, V6
Reported Defects: None noted
Cargo: Unknown
Damage Description: Minor contact damage to right rear quarter panel. Police estimate cost of damage at \$250.
CDC: 03RZEW1 - from police photographs
Delta V:
Total 14.0 km/h (8.7 mph)
Longitudinal -2.4 km/h (-1.5 mph)
Latitudinal -13.8 km/h (-8.6 mph)
Energy 34,574 joules
(25,51 ft lbs)



Figure 10. 1993 Chevrolet Corsica, right side damage

OCCUPANT DEMOGRAPHICS - 1995 Ford Windstar

	Driver	Occupant 2	Occupant 3
Age/Sex:	42/Male	3/Female	7/Female
Seated Position:	Front left	Front right	Second row, right
Seat Type:	Fabric covered box mounted seat	Fabric covered box mounted seat	Fabric covered bench seat with a folding back
Height:	173 cm (68 in)	97 cm (38 in), per coroner	124 cm (49 in)
Weight:	109 kg (240 lbs)	16 kg (35 lbs), per coroner	36 kg (80 lbs)
Occupation:	Supermarket employee	NA	NA
Pre-existing Medical Condition:	None noted	None	None
Alcohol/Drug Involvement:	None	NA	NA
Driving Experience:	>20 years	NA	NA
Body Posture:	Normal, upright	Normal, upright. Seated height approximately 54.7 cm (21.5 in) ¹ .	Normal, upright
Hand Position:	Left hand on steering wheel, unknown o'clock position	Unknown	Unknown
Foot Position:	Right foot on brake, left on floor	Unknown	Unknown
Restraint Usage:	Manual 3-point lap and shoulder belt, used	Manual 3-point lap and shoulder belt not used	Manual 3-point lap and shoulder belt, used
Air bag:	Steering wheel mounted front air bag, deployed	Front right IP mounted air bag, deployed	NA

¹Center for Health Statistics, Anthropometric Reference Data, United States, 1988-1994

OCCUPANT DEMOGRAPHICS - 1993 Chevrolet Corsica

	Driver
Age/Sex:	30/Female
Seated Position:	Front left
Seat Type:	Unknown
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Manual 3-point lap and shoulder belt used, per police

OCCUPANT INJURIES -1995 Ford Windstar

Driver: No reported injuries.

Front row right occupant: Injury information obtained from autopsy report and emergency room records.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Laceration of the cervical spinal cord, complete atlanto-occipital disarticulation, fracture of the odontoid	640250.5,6	Passenger air bag	Certain
Contusion to inner surface of scalp to the right of the midline and just behind the hairline. No underlying skull fractures or overlying scalp injury	190402.1,1	Passenger air bag	Probable
Laceration, frenulum	243204.1,8	Passenger air bag	Certain
Avulsion, peridontal tissue overlying the upper central incisors	243206.1,8	Passenger air bag	Certain
Both central incisors missing	251404.1,8	Passenger air bag	Certain
Abrasions/contusions, right upper and lower eyelids	297202.1,1 297402.1,1	Passenger air bag	Certain
Contusion, lower lip to the left of the midline	290402.1,8	Passenger air bag	Probable
0.3 cm (0.8 in) round contusion, inner surface of scalp on the left side	190402.1,2	Passenger air bag	Probable
Laceration, right foot	890602.1,1	Unknown	Unknown
Abrasion, anterior neck	390202.1,5	Passenger air bag	Probable
Lacerations, oropharynx	340606.3,5	Passenger air bag	Probable

Second row right occupant: No reported injuries.

OCCUPANT INJURIES - 1993 Chevrolet Corsica

Driver: No reported injuries.

OCCUPANT KINEMATICS - 1995 Ford Windstar

Driver kinematics

The 42-year-old male driver was seated in an upright posture and restrained by the 3-point manual lap and shoulder belt. The box mounted van type bucket seat was adjusted to the rearmost track position. The seat back was at a 68 degree angle. The driver had his left hand on the steering wheel. Just prior to impact, he recalled throwing his right arm in a reflexive, protective way to the right. His right foot was on the brake pedal, the left was on the floor. At impact, the frontal air bags deployed. The driver initiated a forward and slightly lateral trajectory. He likely loaded the lap and shoulder belt to some degree, but there were no witness marks found on the belt webbing. There was likely some interaction with the deployed air bag, but there were no resultant injuries. The driver was able to exit the vehicle under his own power. Post-crash, the driver exited the vehicle and went to the front right door to check on his daughter.

Front right occupant kinematics

The 3-year-old female front right passenger was most likely seated in an upright posture (based on her facial injuries). Her seated height was approximately 54.7 cm (21.5 in). She was not wearing the manual 3-point lap and shoulder belt. Witnesses report that the child had come to rest on the front floorboard. The child apparently had a backpack, but it is not known if it was being worn at the time of the crash. The seat was adjusted to the rearmost track position. The seat back was at an 83 degree angle. Prior to impact, the driver began braking. The 3-year-old began pitching forward in response to vehicle braking. At impact, the frontal air bags deployed. This occupant initiated a forward and slightly lateral trajectory and engaged the deploying air bag with her face. This contact likely caused the facial and mouth

abrasions/contusions. Her legs or shoes may have contacted the glove compartment. This occupant's head was forced rearward, causing a complete atlanto-occipital disarticulation and the accompanying fractures and lacerations. She was forced rearward in the seat back and then rebounded, coming to rest on the floor board. There were no indications of contact to the seat back. She was initially picked up by her father moments after the crash. She was unresponsive when the paramedics arrived. The paramedics began CPR. She was transported by ambulance to a local hospital. Upon arrival, her pupils were fixed and dilated. She was transferred to the pediatric intensive care unit of an area trauma center where she expired two days later.



Figure 11. Overview of front right passenger's seated area

Second row right occupant kinematics

The 7-year-old female second row right passenger was seated in an upright posture. She was wearing the manual 3-point lap and shoulder belt. Prior to impact, the driver began braking. The 7-year-old began pitching forward in response to vehicle braking. At impact, this occupant initiated a forward and slightly lateral trajectory. She likely engaged the lap and shoulder webbing to some extent, but there were no indications of loading. She was not injured. According to her father, she removed her own seat belt and exited the vehicle under her own power. She was taken from the scene back to her home (which was two blocks away) by the driver of the Corsica. The driver of the Corsica then returned to the scene.



Figure 12. Front right passenger seat back

Scene Diagram

