

On-scene Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS99048
1993 Jeep Grand Cherokee
Oregon
December 1995

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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. DS99048		2. Government Accession No.		3. Recipient Catalog No.	
4. Title and Subtitle In-Depth Accident Investigation				5. Report Date February 5, 2000	
				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. (TRAIS)	
				11. Contract or Grant no. DTNH22-94-D-27058	
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 <p>This crash occurred in Oregon in December 1995 at 0754 hours. This was a head-on type collision. The crash took place on a two-lane, undivided roadway. A double solid yellow centerline delineates the east and westbound travel lanes. The bituminous roadway was ice-covered in spots at the time of the crash. The police reported a speed limit of 40 km/h (25 mph) for westbound traffic and a speed limit of 56 km/h (35 mph) for eastbound traffic. The case vehicle, a 1993 Jeep Grand Cherokee 4 x 4 utility vehicle driven by a restrained 37-year-old female (102 cm/66 in., 79 kg/175 lbs), was traveling westbound at an unknown speed. The front right seat was occupied by an improperly restrained 4-year-old female. This occupant was likely wearing only the lap portion of the lap and shoulder belt. The other vehicle, a 1991 Ford Explorer 4 x 4 utility vehicle driven by a 33-year-old female, was traveling eastbound at a driver stated speed of 40 km/h (25 mph). According to the driver, the four-wheel drive was not engaged.</p> <p>Due to the slippery surface, the driver of the other vehicle lost control of her vehicle. The other vehicle veered into the path of the case vehicle and the two vehicles struck head-on. The case vehicle was assigned a CDC of 12FDEW2. Vehicle 2 was assigned a CDC of 01FZEW2. The case vehicle sustained a total delta v of 27 km/h (16 mph), a longitudinal delta v of -26 km/h (-16 mph), and a latitudinal delta v of 5 km/h (3 mph). The driver's side front air bag in Vehicle 1 deployed at this point. The other vehicle was pushed into a counterclockwise direction and overturned onto its left side.</p> <p>The driver of the case vehicle was fatally injured. EMS personnel arrived on the scene, began treatment, and transported the driver to a local hospital. The driver had sustained abrasions to both legs, the right arm, and left index finger. She also sustained an open fracture to the right ankle. Upon arrival at the hospital it was determined that there was internal bleeding. At 0940 hours she was taken to surgery. She underwent a laparotomy and a thoracotomy. It was determined that she had sustained devastating infra- and supradiaphragmatic caval injuries—essentially a complete disruption of the superior vena cava. The driver expired at 1049 hours—3 hours after the crash.</p> <p>The front right occupant of the case vehicle sustained a contusion to her head from contact with the instrument panel. She was transported to a local hospital. The driver of the other vehicle sustained some minor injuries of an unknown nature. She was transported to a local hospital.</p>					
17. Key Words Air bag, deployment, injury, accident, fatality, driver,			18. Distribution Statement		
19. Security Classif. (of this report)		20. Security Classif. (of this page)		21. No of pages	22. Price

Dynamic Science, Inc.
Accident Investigation
Case Number: DS99048

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BACKGROUND:

Description: This case was initiated in response to a report of an air bag deployment related driver fatality. This case is being conducted as an on-scene investigation. NHTSA was notified by the attorney representing the deceased. DSI was notified on October 4, 1999. The case vehicle was inspected during November, 1999. Several attorneys representing the decedent, as well as several reconstructionists, were present during the inspection.

Investigation Type: On-scene

Crash Location: Oregon

Crash Date: December 1995

Notification Date: October 4, 1999

Field Work Completed: November 10, 1999

SUMMARY:

This crash occurred in Oregon in December 1995 at 0754 hours. This was a head-on type collision. The crash took place on a two-lane, undivided roadway. A double solid yellow centerline delineates the east and westbound travel lanes. The bituminous roadway was ice-covered in spots at the time of the crash. The police reported a speed limit of 40 km/h (25 mph) for westbound traffic and a speed limit of 56 km/h (35 mph) for eastbound traffic.

The case vehicle, a 1993 Jeep Grand Cherokee 4 x 4 utility vehicle driven by a restrained¹ 37-year-old female (102 cm/66



Figure 1. Exterior, Vehicle 1

¹Usage was determined during the vehicle inspection. There was a slight amount of belt loading and markings in the D-ring.

in., 79 kg/175 lbs.)², was traveling westbound at an unknown speed. The front right seat was occupied by an improperly restrained 4-year-old female. This occupant was likely wearing only the lap portion of the lap and shoulder belt.

The other vehicle, a 1991 Ford Explorer 4 x 4 utility vehicle driven by a 33-year-old female, was traveling eastbound at a driver stated speed of 40 km/h (25 mph). According to the driver, the four-wheel drive was not engaged.

Due to the slippery surface, the driver of the other vehicle lost control of her vehicle. The other vehicle veered into the path of the case vehicle and the two vehicles struck head-on. The case vehicle was assigned a CDC of 12FDEW2. The other vehicle was assigned a CDC of 01FZEW2. The case vehicle sustained a total delta v of 26.5 km/h (16.4 mph), a longitudinal delta v of -26.1 km/h (-16.2 mph), and a latitudinal delta v of 4.6 km/h (2.9 mph)³. The driver's frontal air bag in the case vehicle deployed at this point. The other vehicle was pushed into a counterclockwise direction and overturned onto its left side.

The driver of the case vehicle was fatally injured. EMS personnel arrived on the scene, began treatment, and transported the driver to a local hospital. Events related to the transport are shown below. The driver had a GCS of 15 upon EMS arrival and a GCS of 14 when they departed.

<u>Event</u>	<u>Time</u>
Crash	0754
EMS contacted	0754
EMS dispatched	0807
EMS arrival	0814
EMS departure	0837
EMS arrival @ hospital	0844

The driver had sustained abrasions to both legs, the right arm, and left index finger. She also sustained an open fracture to the right ankle. Upon arrival at the hospital it was determined that there was internal bleeding. At 0940 hours she was taken to surgery. She underwent a laparotomy and a thoracotomy⁴. It was determined that she had sustained devastating infra- and supradiaphragmatic caval injuries—essentially a complete disruption of the superior vena cava. The driver expired at 1049 hours—3 hours after the crash.

The front right occupant of the case vehicle sustained a contusion to her head from contact with the instrument panel. She was transported to a local hospital. The driver of the other vehicle sustained some minor injuries of an unknown nature. She was transported to a local hospital.

²Obtained from 1994 medical examination

³Calculated using WinSmash

⁴Incisions into the abdominal and chest wall.

Scene Diagram

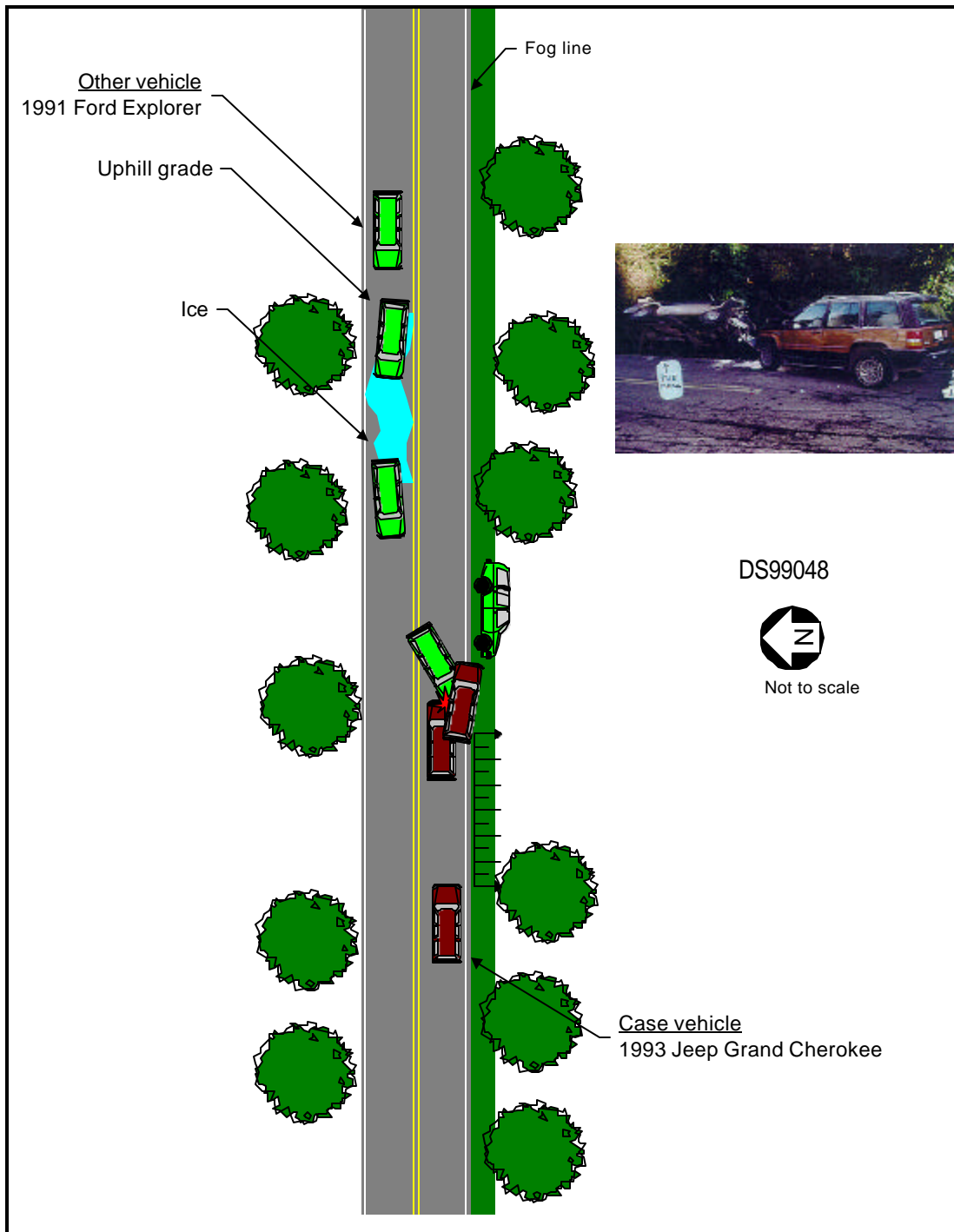


Figure 2. Scene diagram

DETAILED INFORMATION

Vehicles

Case vehicle

Description:	1993 Jeep Grand Cherokee 4x4 SUV	
VIN:	1J4GZ8846PCxxxxxx	
Odometer:	82,102 km (51,016 miles)	
Engine:	5.2L 8 cylinder	
Reported Defects:	None	
Cargo:	Lap top computer	
Damage Description:	Moderate frontal crush	
CDC:	12FDEW2	
Delta V:	Total	26.5 km/h (16.4 mph)
	Longitudinal	-26.1 km/h (-16.2 mph)
	Latitudinal	4.6 km/h (2.9 mph)
	Energy	43,219 joules (31,899 ft-lbs.)



Figure 3. Exterior, case vehicle

There was no intrusion nor any integrity loss.

The case vehicle was equipped with a single, driver's frontal air bag which deployed during impact. The circular air bag had a diameter of 58 cm (22.8 in.) and there were 6 vertical folds. There were two vent holes just to the right and left of the 12 o'clock position on the back of the air bag. There were no tethers. The air bag module was housed in the steering wheel and the cover had an "H" configuration opening pattern. There was no contact to the cover flap. There was no damage to either the air bag or the module cover flaps.

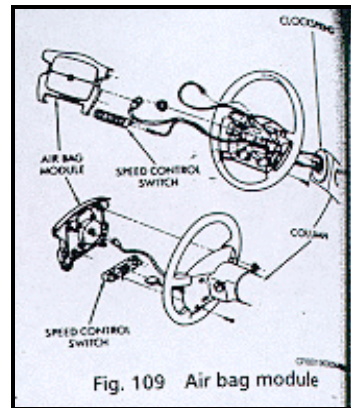


Figure 4. Air bag system



Figure 5. Driver's frontal air bag



Figure 6. Driver's air bag—back

DETAILED INFORMATION**Vehicles**Other vehicle

Description:	1991 Ford Explorer	
VIN:	Unknown	
Odometer:	94,957 km (59,004 miles) per police report	
Engine:	Unknown	
Reported Defects:	None noted	
Cargo:	Unknown	
Damage Description:	Moderate to heavy damage through front plane.	
CDC 1:	01FZEW2 (based on police photos)	
CDC 2:	00LDAO2	
Delta V:	Total	25.2 km/h (15.7 mph)
	Longitudinal	-24.1 km/h (-15.0 mph)
	Latitudinal	-7.8 km/h (-4.9 mph)
Energy	63,507 joules (46,844 ft-lbs.)	



Figure 7. Exterior, other vehicle

Occupants

<u>Case vehicle</u>	Occupant 1	Occupant 2
Age/Sex:	37/Female	4/Female
Seated Position:	Front left	Front right
Seat Type:	Bucket, leather covered, adjusted to between forward most and middle track position	Bucket, leather covered, adjusted to middle track position
Height:	102 cm (66 in.)	Unknown
Weight:	79 kg (175 lbs.)	Unknown
Occupation:	Unknown	NA
Pre-existing Medical Condition:	Possibly using some form of thyroid medication according to EMS report.	Unknown
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Presumed to be greater than ten years	NA
Body Posture:	Unknown—presumed to be normal and upright	Unknown
Hand Position:	Both hands likely on steering wheel	NA
Foot Position:	Based on the knee contact to the lower instrument panel it would appear that the right foot was still in line with the accelerator pedal when impact occurred. It does not appear that there was any pre-impact braking.	Unknown
Restraint Usage:	Lap and shoulder belts used	Lap portion of lap and shoulder belt used
Air bag:	Deployed	NA

OccupantsOther vehicle

Age/Sex:	33/Female
Seated Position:	Front left
Seat Type:	Unknown
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	Unknown
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt used

Injuries and Injury MechanismsCase vehicle

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Retroperitoneal hematoma	Not codeable. Related to the vena cava injury.	868.04	Air bag
	Complete disruption inferior vena cava	421806.4,4	902.10	Air bag
	Ecchymosis near sternal notch (spot)	490402.1,	922.1	Air bag
	Open fracture in calcaneus region of right foot – laceration approximately 4 cm	851400.2,1	891.0	Toe pan
	Head contusion, unknown aspect	190402.1,9	920.0	Unknown
	Abrasion, right leg	890202.1,1	916.8	Instrument panel
	Abrasion, left leg	890202.1,1	916.8	Instrument panel
	Abrasion, right arm	790202.1,1	913.8	Air bag
	Abrasion, left index finger	790202.1,2	915.0	Windshield
Front right occupant	Contusion, forehead	290402.1,7	920.0	Instrument panel

Other vehicle

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Injured, unknown severity			

Occupant Kinematics

The case vehicle was equipped with an electric seat adjuster. The leather-covered front left seat was adjusted to a position where the leading edge of the seat cushion was forward of the steering wheel rim. The seat back was adjusted so that it was fully upright. There was 46 cm (18 in.) of clearance between the face of the air bag module and the seat back. The post-crash excursion of the air bag was 42 cm (17 in.). At impact, the driver of the case vehicle pitched forward and engaged the deploying air bag with her chest. This movement loaded the steering column causing 4 cm (1.6 in.) of compression. Given the proximity of the driver to the steering wheel, there would only be a minimal amount of belt loading prior to engagement. There was no contact with the air bag module cover nor was there any rim deformation. The driver continued forward and struck the lower instrument panel with her right knee. The driver's left hand came off the steering wheel and impacted the windshield. The driver's right foot likely struck the toe pan—causing the calcaneus fracture. High heels were found in the vehicle, but it is not known if they were being worn at the time of the crash. The driver sustained an abrasion to her right arm—probably due to contact with the deploying air bag.

The driver's fatal chest injuries appear to have been caused by the deploying air bag and the subsequent loading of the steering wheel.

The front right occupant was wearing just the lap portion of the lap and shoulder belt. At impact, she pitched forward—rotating about the lap belt—and struck her head on the instrument panel. She sustained a minor contusion.



Figure 8. Interior, case vehicle (seat in pre-crash position)



Figure 9. Front left—shows right knee contact

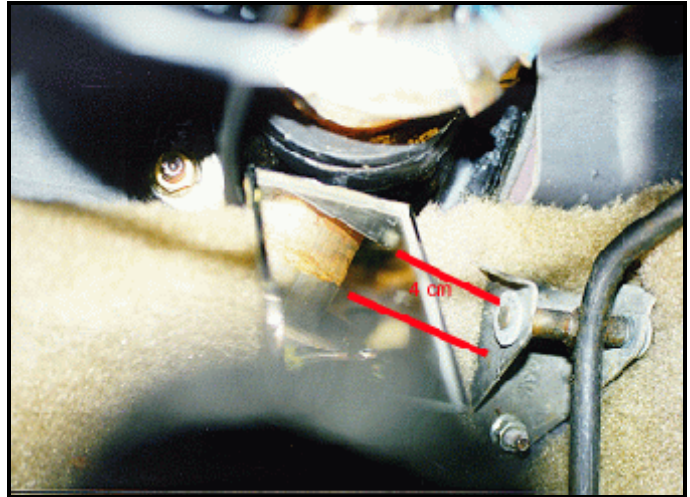


Figure 10. Under instrument panel view showing stroke from steering column compression.



Figure 11. Right instrument panel–skin transfer