

Remote, Redesigned Air Bag Special Study
FOR NHTSA'S INTERNAL USE ONLY
Dynamic Science, Inc., Case Number (DS99045)
1998 Dodge Caravan
Oregon
September/1998

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16. Abstract <p>The crash occurred in September, 1998 at approximately 0445 hours. The crash occurred on a curved, two-way undivided state highway. The lanes are separated by a broken yellow line. There are asphalt shoulders on both sides of the roadway; these are marked by solid white lines. There is a gentle left-hand curve with a slight downhill slope for southbound traffic. The posted speed limit is 89 km/h (55 mph).</p> <p>The case vehicle, a 1998 Dodge Caravan driven by a 32-year-old male, was traveling northbound at an unknown speed. There were a total of eight additional occupants in the case vehicle. The other vehicle was a 1990 Freightliner COE 6x4 truck tractor hauling a 1981 Beal tank trailer traveling southbound. The trailer contained 44,020 kg (97,046 lbs) of CMS-2S cationic emulsified asphalt. The total length of the vehicle, including trailer, was (75 ft). This vehicle was being driven by a 58-year-old male. A 42-year-old unrestrained female was in the sleeper portion of the cab. According to the on-board tach-graph, the Freightliner was traveling 89 km/h (55 mph) at impact. The Dodge Caravan crossed the center line and struck the Freightliner head-on. The driver of the Freightliner saw the case vehicle but was unable to stop in time. The Caravan was pushed into a sharp counterclockwise rotation and departed the roadway on the east side, overturned, and came to rest on its left side. The Freightliner began a counterclockwise rotation after impact. The vehicle crossed the northbound travel lanes and departed the roadway. The trailer separated from the tractor and overturned. This vehicle came to rest off the roadway, on top of a fence, facing northwest.</p> <p>The driver of the Dodge Caravan was entrapped in the vehicle and fatally injured. Occupant 02 sustained a dislocated right hip, as well as multiple contusions, abrasions, and lacerations. She was transported to a local hospital where she was treated and released. Occupant 03 sustained lacerations, contusions, and abrasions of an unknown nature. She was transported to a local hospital where she was treated and released. Occupant 04 sustained lacerations, contusions, and abrasions of an unknown nature. She was transported to a local hospital where she was treated and released. Occupant 05 was fatally injured. Occupant 06 sustained lacerations to the head, as well as abrasions and contusions. Occupant 07 was fatally injured. Occupant 08 sustained lacerations to the head and face, as well as a right leg injury of unknown nature. Occupant 09 sustained minor abrasions and contusions.</p>			
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Summary

This remote investigation was initiated in response to a possible redesigned air bag deployment. The case was selected from the FARS data files. The redesigned air bag was installed in a 1998 Dodge Caravan.

The crash occurred in September, 1998 at approximately 0445 hours. The crash occurred on a curved, two-way undivided state highway. The lanes are separated by a broken yellow line. There are asphalt shoulders on both sides of the roadway; these are marked by solid white lines. There is a gentle left-hand curve with a slight downhill slope for southbound traffic. The posted speed limit is 89 km/h (55 mph).

The case vehicle, a 1998 Dodge Caravan driven by a 32-year-old male, was traveling northbound at an unknown speed. There were a total of eight additional occupants in the case vehicle as shown below.

FRONT LEFT (01) 32-year-old male	FRONT MIDDLE (02) 8-year-old female (seated on box between front seats)	FRONT RIGHT (03) 34-year-female - using lap and shoulder belt (04) 5-year-old female (seated on lap)
SECOND SEAT LEFT (05) 44-year-female		SECOND SEAT RIGHT (06) 25-year-old male
THIRD SEAT LEFT (07) 28-year-old male	THIRD SEAT MIDDLE (08) 33-year-old female - no restraint used	THIRD SEAT RIGHT (09) 8-year-old male- using lap belt

The other vehicle was a 1990 Freightliner COE 6x4 truck tractor hauling a 1981 Beal tank trailer traveling southbound. The trailer contained 44,020 kg (97,046 lbs) of CMS-2S cationic emulsified asphalt. The total length of the vehicle, including trailer, was (75 ft). This vehicle was being driven by a 58-year-old male. A 42-year-old unrestrained female was in the sleeper portion of the cab. According to the on-board tach-graph, the Freightliner was traveling 89 km/h (55 mph) at impact.



Figure 1. Front left, Dodge Caravan

Crash Events

The driver of the Dodge Caravan was apparently tired. A witness in the case vehicle indicated that he kept falling asleep. Just prior to the crash, she saw the driver adjust his seat and saw his hands slip off the steering wheel. The Dodge Caravan crossed the center line and struck the Freightliner head-on. A longitudinal delta v of -83.5 km/h (-51.9 mph) was calculated using the WinSmash barrier option for the Dodge Caravan using a CDC of 12FLAE9. The driver of the Freightliner saw the case vehicle but was unable to stop in time.



Figure 2. Front, Dodge Caravan

The Caravan was pushed into a sharp counterclockwise rotation and departed the roadway on the east side, overturned, and came to rest on its left side.

The Freightliner began a counterclockwise rotation after impact. The vehicle crossed the northbound travel lanes and departed the roadway. The trailer separated from the tractor and overturned. This vehicle came to rest off the roadway, on top of a fence, facing northwest.

The driver of the Dodge Caravan was entrapped in the vehicle and fatally injured. Occupant 02 sustained a dislocated right hip, as well as multiple contusions, abrasions, and lacerations. She was transported to a local hospital where she was treated and released. Occupant 03 sustained lacerations, contusions, and abrasions of an unknown nature. She was transported to a local hospital where she was treated and released. Occupant 04 sustained lacerations, contusions, and abrasions of an unknown nature. She was transported to a local hospital where she was treated and released. Occupant 05 was fatally injured. Occupant 06 sustained lacerations to the head, as well as abrasions and contusions. Occupant 07 was fatally injured. Occupant 08 sustained lacerations to the head and face, as well as a right leg injury of unknown nature. Occupant 09 sustained minor abrasions and contusions.



Figure 3. Freightliner at final rest

The driver of Freightliner did not report any injuries. The second occupant of this vehicle was thrown from the sleeper cab onto the roadway.

Table 1. Delta V

	Case Vehicle	
	km/h	mph
Total	83.5	51.9
Longitudinal	-83.5	-51.9
Lateral	0	0

Exterior of Case Vehicle

Table 2. Vehicle Information

Model year, make and model	1998 Dodge Caravan
VIN	1B4GP54L4Wbxxxxxx
CDC 1: CDC 2:	12FLAE9 00RDAO2

Interior of Case Vehicle

The Dodge Caravan was equipped with bucket seats in the front outboard seating positions and the second row outboard seating positions. The rear seat was a folding bench. The track locations and seat back angles are not known.

The case vehicles sustained substantial longitudinal intrusion of the left instrument panel, toe pan, and A-pillar. There was intrusion along the entire left side. There was integrity loss through the windshield, left front side window, and both left rear windows. There are photos that indicate there might be some integrity loss on the right rear side but this is most likely due to extrication efforts.

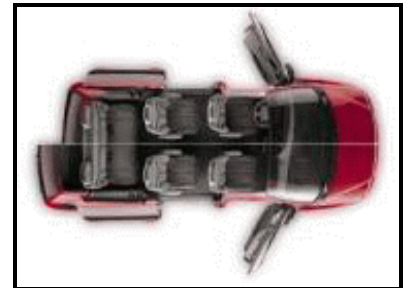


Figure 4. Exemplar view of Caravan interior

Case Vehicle Occupant Protection Systems

The Dodge Caravan was equipped with a Next Generation steering wheel mounted driver's air bag and front right passenger's air bag. Both air bags deployed as a result of the initial impact with the Freightliner. The case vehicle was equipped with lap and shoulder belt at all the outboard seat locations. There was a lap belt available in the middle of the third seat.

Case Vehicle Occupant Demographics

	Occupant 1	Occupant 2	Occupant 3	Occupant 4
Age/Sex:	32/Male	8/Female	34/Female	5/Female
Seated Position:	Front seat left	Front middle	Front right	Front right
Seat Type:	Bucket	None	Bucket	NA
Height (cm/in.):	183 72	Unk Unk	Unk Unk	Unk Unk
Weight (kg/lbs):	113 250	Unk Unk	Unk Unk	Unk Unk
Pre-existing Medical Condition:	None noted	None noted	None noted	None noted
Body Posture:	Slumped forward slightly	Unknown	Unknown	Unknown
Hand Position:	Possibly loosely on the steering wheel, but may have come off completely just prior to impact	Unknown	Unknown	Unknown
Foot Position:	Right foot likely on accelerator, left on floor	Unknown	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available – belts used	None	Lap and shoulder belt available - belts used	None
Air bag:	Air deployed	None	Air bag deployed	None

	Occupant 5		Occupant 6		Occupant 7		Occupant 8		Occupant 9	
Age/Sex:	44/Female		25/Male		28/Male		33/Female		8/Male	
Seated Position:	Second seat left		Second seat right		Third seat left		Third seat middle		Third seat right	
Seat Type:	Bucket		Bucket		Bench with folding back		Bench with folding back		Bench with folding back	
Height (cm/in.):	Unk	Unk	Unk	Unk	Unk	Unk	Unk	Unk	Unk	Unk
Weight (kg/lbs):	63.5 - 68	140-150	Unk	Unk	Unk	Unk	Unk	Unk	Unk	Unk
Pre-existing Medical Condition:	Periodontal disease		None noted		None noted		None noted		None noted	
Body Posture:	Unknown		Unknown		Unknown		Unknown		Unknown	
Hand Position:	Unknown		Unknown		Unknown		Unknown		Unknown	
Foot Position:	Unknown		Unknown		Unknown		Unknown		Unknown	
Restraint Usage:	Lap and shoulder belt available - none used		Lap and shoulder belt available - none used		Lap and shoulder belt available - unknown if used		Lap belt available - unknown if used		Lap and shoulder belt available - lap only used	

Occupant Injuries

Table 3. Injuries (Occupant 01)

Injury	Injury Severity (AIS)	Injury Mechanism
Neck fracture	650216.2,6	Windshield header (indirect)
Multiple chest injuries including open soft tissue injury around the left pectoralis major muscle	490804.2,2	Unknown
Fracture, left humerus	752600.2,2	Door side panel
Facial injury (based on photos)	215099.7,0	Windshield header

Table 4. Injuries (Occupant 02)

Injury	Injury Severity (AIS)	Injury Mechanism
Dislocated right hip	850610.2,1	Center instrument panel
Multiple contusions, abrasions, and lacerations	990200.1,0 990400.1,0 990600.1,0	Unknown

Table 5. Injuries (Occupant 03)

Injury	Injury Severity (AIS)	Injury Mechanism
Lacerations, contusions, and abrasions of an unknown nature	990200.1,0 990400.1,0 990600.1,0	Unknown

Table 6. Injuries (Occupant 04)

Injury	Injury Severity (AIS)	Injury Mechanism
Lacerations, contusions, and abrasions of an unknown nature	990200.1,0 990400.1,0 990600.1,0	Unknown

Table 7. Injuries (Occupant 05)

Injury	Injury Severity (AIS)	Injury Mechanism
Left parietal head trauma	115099.7,0	Interior side surface
Fracture, right humerus	752600.2,1	Unknown
Fracture, left tibia	853404.1,2	Seat back

Table 8. Injuries (Occupant 06)

Injury	Injury Severity (AIS)	Injury Mechanism
Lacerations to head	190600.1,9	Unknown
Multiple abrasions Multiple contusions	990200.1,0 990400.1,0	Unknown

Table 9. Injuries (Occupant 07)

Injury	Injury Severity (AIS)	Injury Mechanism
Large, open fracture and massive head injury of the left facial area, extending into the cranial contents	150406.4,2	Left side interior surface
Multiple contusions of the scalp	190402.1,0	Unknown
Mandible fracture	250600.1,9	Unknown
Malar eminence fracture	251800.2,9	Unknown
Missing left eye	240402.2,2	Left side interior surface
Seat belt mark along abdomen	590402.1,4	Seat belt

Table 10. Injuries (Occupant 08)

Injury	Injury Severity (AIS)	Injury Mechanism
Lacerations to face	290600.1,9	Unknown
Lacerations to head	190600.1,9	Unknown
Right leg injury	815099.7,1	Unknown

Table 11. Injuries (Occupant 09)

Injury	Injury Severity (AIS)	Injury Mechanism
Minor abrasions and contusions	990200.1,0 990400.1,0	Unknown

Occupant Kinematics

This was an extremely violent crash. At impact, all occupant pitched forward toward the 0 degree of principal force.

The unrestrained driver overwhelmed the deploying air bag. His face came into contact with the intruding windshield header. This forced his head rearward—causing the neck fracture. As he continued pitching forward his left upper arm came into the contact with the A-pillar/left side of the vehicle—causing the humerus fracture.

The unrestrained front middle occupant (02) likely pitched forward and engaged the center instrument panel and the windshield. She sustained a dislocated right hip, as well as multiple contusions, abrasions, and lacerations.

The restrained front right occupant (03) pitched forward at impact until loading the lap and shoulder belts. She likely engaged the deploying air bag at some point. She sustained lacerations, contusions, and abrasions of an unknown nature.

The second front seat occupant (04) was seated on the lap of occupant (03). She was not restrained. She likely engaged the deploying air bag at some point. She sustained lacerations, contusions, and abrasions of an unknown nature.

The unrestrained second seat left occupant (05) pitched forward and to the left at impact—striking the left interior surface and the back of the driver's seat. This occupant sustained a fatal head injury that was likely due to contact to the side of the case vehicle.

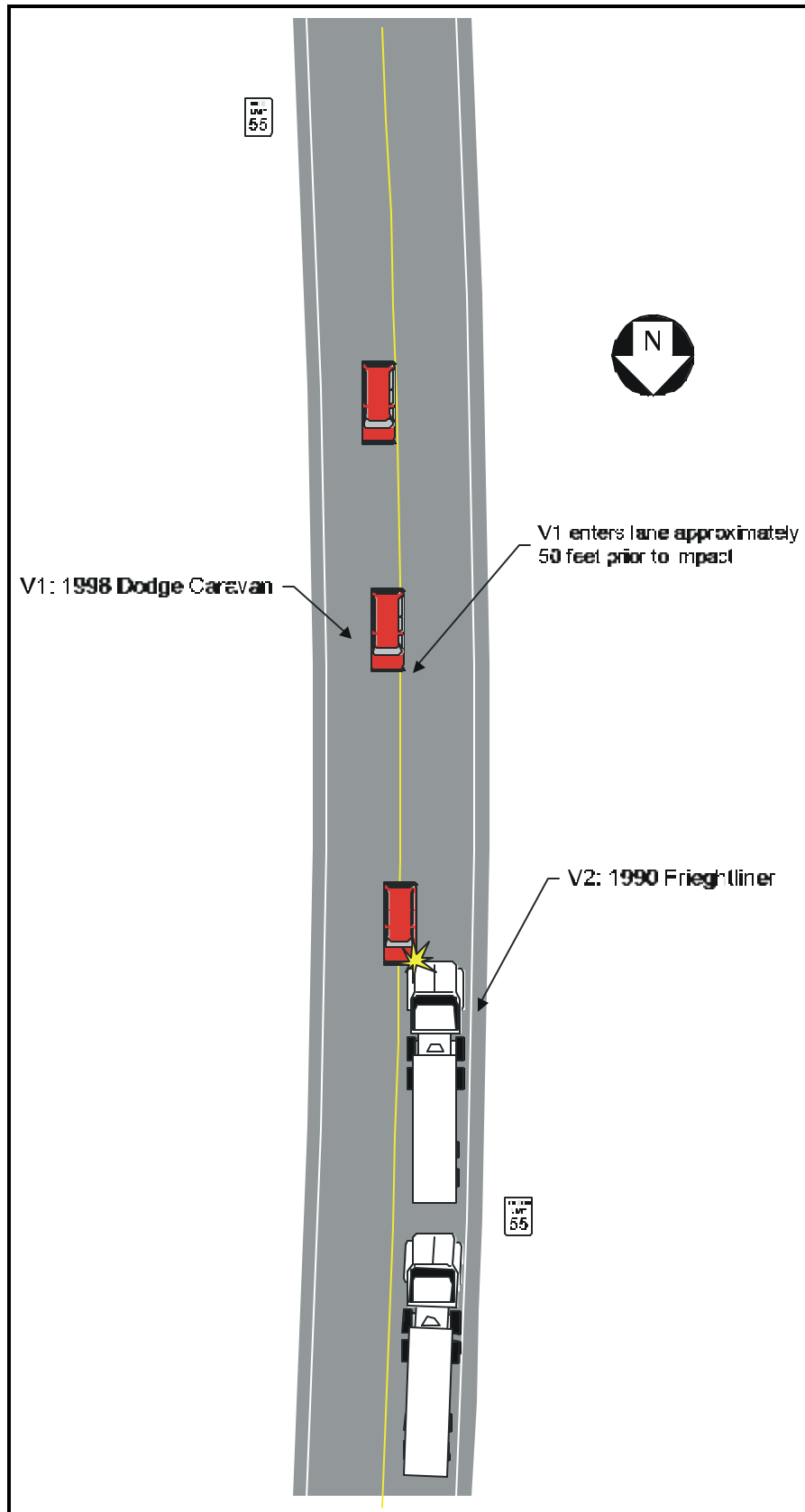
The unrestrained second seat right occupant (06) pitched forward and likely engaged the rear of the front left seat. He sustained lacerations to the head, as well as abrasions and contusions.

The restrained third seat occupant (07) pitched forward and to the left at impact—striking the left interior surface (C-pillar) with his head. He sustained fatal head injuries.

The unrestrained third seat middle occupant (08) pitched forward—possibly into the gap between the second seats. She sustained lacerations to the head and face, as well as a right leg injury of unknown nature.

The partially restrained third seat right occupant (09) pitched forward and possibly impacted the rear of the second seat. He sustained minor abrasions and contusions.

Scene Diagram



Scene Diagram (adapted from police diagram)

