

Remote / Vehicle vs Tractor Trailer vs Vehicle vs Vehicle vs Vehicle  
Dynamic Science, Inc. / Case Number: DS97023  
1996 Mercedes Benz E320 4-door  
California  
September, 1997

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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 collision occurred in California on September, 1997 at 2145 hours. This was a five vehicle collision with multiple impacts. The collision occurred on a heavily traveled northbound Interstate. The collision occurred during night hours with the roadway being lighted by street lights. It was raining, and the roadway was wet. Vehicle 1, was a 1996 Mercedes Benz E320 4-door sedan driven by a properly restrained 17-year-old female (48 kg, 106 in / 167.6 cm, 66 in), and traveling northbound on the acceleration lane. Vehicle 2, was a 1996 White Freightliner 3-axle tractor towing a trailer driven by a 37-year-old male, and traveling northbound in the far right lane. Vehicle 3, was a 1994 Mazda MP4 driven by a 38-year-old male, and traveling northbound in the far left lane. Vehicle 4, was a 1985 Lincoln Town Car driven by a 62-year-old male, and traveling northbound in the second lane from the right. Vehicle 5, a 1994 Honda Civic driven by a 21-year-old male, traveling in the second lane from the right, directly behind Vehicle 4. The front right seat of Vehicle 5 was occupied by a 21-year-old male. Vehicle 1 was accelerating to merge onto the Interstate. Due to the wet roadway, the driver lost control of the vehicle and began a clockwise rotation. The driver over-corrected the vehicle to the left, and started to spin counterclockwise in a westerly direction across all northbound travel lanes. The driver of Vehicle 2 saw Vehicle 1 out of control and applied his brake, but was unable to stop. The front of Vehicle 2 struck the left side of Vehicle 1 at the left rear door. At impact, the driver's door mounted side air bag in Vehicle 1 deployed. Vehicle 1 continued in a westerly direction and the driver of Vehicle 3 saw Vehicle 1 about to cross into the lane he was traveling in. The driver of Vehicle 3 applied the brakes, but was unable to stop and the front of Vehicle 1 collided with the right side of Vehicle 3. The braking by Vehicle 2, in order to avoid colliding with Vehicle 1, caused Vehicle 2 to "jack knife". The driver of Vehicle 4 saw Vehicle 2 jackknifing and applied the brakes. Vehicle 4 was unable to stop and with the front collided with the left side of the trailer being towed by Vehicle 2. Vehicle 5 saw Vehicle 4 collide into Vehicle 2 and braked, but was unable to stop. The front of Vehicle 5 struck the back of Vehicle 4. At impact, the driver's and front right air bags in Vehicle 5 deployed. Vehicle 1 is equipped with Supplemental Restraint System which includes driver and front right air bags, dual front door mounted side air bags, electronic Emergency Tensioning Retractors (ETR) which also incorporate mechanical belt force limiters, and knee bolsters. Neither front nor side air bags will deploy if the seat is empty (less than eleven pounds detected). Neither front air bag deployed in this collision. The driver's door mounted side air bag did deploy, and the driver's ETR activated. The driver of Vehicle 1 had little recollection of the collision. She indicated that she only remembers beginning to spin out and then blacked out. She sustained injuries consisting of a neck and lower lumbar strains. She was transported by ground ambulance to a local hospital where she received emergency room treatment and was released. She believed that it was the side air bag that prevented possible chest injuries. Vehicle 1 sustained major damage to its front end (2 <sup>nd</sup> event 11FYEW2), left side (1 <sup>st</sup> event), and back end (06BZEW2). Vehicle 1 was not inspected and a CDC of 10LZEW3 was assigned to the deployment of the driver's side air bag, the first event. Delta-V for the event was computed using the barrier routine of WinSmash, and it produced a longitudinal Delta-V of -12.7 km/h (7.9 MPH) and a latitudinal Delta-V of 15.2 km/h (9.5 MPH).					
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**Dynamic Science, Inc.**  
**Accident Investigation**  
**Case Number: DS97023**

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**BACKGROUND:**

Description: This case was initiated in response to a driver's door mounted side air bag deployment. This case is being conducted as a remote investigation. NHTSA was notified by Dynamic Science, Inc.

Crash Location: California

Crash Date: September, 1997

Notification Date: October 19, 1997

Field Work Completed: October, 1997

**SUMMARY:**

This collision occurred in California in September, 1997 at 2145 hours. This was a five vehicle collision with multiple impacts. The collision occurred on a heavily traveled northbound Interstate. At the point of impact, there are four travel lanes, plus two High Occupant Vehicle lanes, plus one acceleration lane. The Interstate travel lanes have a rained grooved surface with the acceleration lane being an asphalt surface. There were no traffic controls, and the posted speed limit is 105 km/h (65 mph). The collision occurred during night hours with the roadway being lighted by street lights. It was raining, and the roadway was wet.

Vehicle 1 was a 1996 Mercedes Benz E320 4-door sedan driven by a properly restrained 17-year-old female (48 kg, 106 in / 167.6 cm, 66 in), and traveling northbound in the acceleration lane. Vehicle 2 was a 1996 White Freightliner 3-axle tractor towing a trailer driven by a 37-year-old male, and traveling northbound in the far right lane. Vehicle 3 was a 1994 Mazda MP4 driven by a 38-year-old male, and traveling northbound in the far left lane. Vehicle 4, was a 1985 Lincoln Town Car driven by a 62-year-old male, and traveling northbound in the second lane from the right. Vehicle 5 a 1994 Honda Civic driven by a 21-year-old male, was traveling in the second lane from the right, directly behind Vehicle 4. The front right seat of Vehicle 5 was occupied by a 21-year-old male.

Vehicle 1 was accelerating to merge onto the Interstate. Due to the wet roadway, the driver lost control of the vehicle and began a clockwise rotation. The driver over-corrected the vehicle to the left, and started to spin counterclockwise in a westerly direction across all northbound travel lanes. The driver of Vehicle 2 saw Vehicle 1 out of control and applied his brake, but was unable to stop. The front of Vehicle 2 struck the left side of Vehicle 1 at the left rear door. At impact, the driver's door mounted side air bag in Vehicle 1 deployed. Vehicle 1 continued in a westerly direction and the driver of Vehicle 3 saw Vehicle 1 about to cross into the lane he was traveling in. The driver of Vehicle 3 applied the brakes, but was unable to stop and the front of Vehicle 1 collided with the right side of Vehicle 3.

The braking by Vehicle 2, in order to avoid colliding with Vehicle 1, caused Vehicle 2 to "jack knife".

The driver of Vehicle 4 saw Vehicle 2 jackknifing and applied the brakes. Vehicle 4 was unable to stop and with the front collided with the left side of the trailer being towed by Vehicle 2. Vehicle 5 saw Vehicle 4 collide into Vehicle 2 and braked, but was unable to stop. The front of Vehicle 5 struck the back of Vehicle 4. At impact, the driver's and front right passenger's air bags in Vehicle 5 deployed.

The final rest position of Vehicle 1 is not known. After colliding with Vehicle 1, Vehicle 2 came to rest straddling the far two right lanes with the trailer jackknifed and the tractor heading in a westerly direction. Vehicle 3's final rest position is not known. Vehicle 4 came to final rest straddling the far two right lanes, against the left side of Vehicle 2's trailer heading east. Vehicle 5 came to final rest in the second lane from the left heading north.

Vehicle 1 is equipped with a Supplemental Restraint System which includes a driver's and a front right passenger's air bag, dual front door mounted side air bags, electronic Emergency Tensioning Retractors (ETR) which also incorporate mechanical belt force limiters, and knee bolsters. Neither front nor side air bags will deploy if the seat is empty (less than eleven pounds detected). Neither frontal air bag deployed in this collision. The driver's door mounted side air bag did deploy, and the driver's ETR activated.

The driver of Vehicle 1 had little recollection of the collision. She indicated that she only remembers beginning to spin out and then blacked out. She sustained injuries consisting of a neck and lower lumbar strains. She was transported by ground ambulance to a local hospital where she received emergency room treatment and was released. She believed the side air bag prevented possible chest injuries.

Vehicle 1 sustained major damage to its front end (2<sup>nd</sup> event 11FYEW2), left side (1<sup>st</sup> event), and back end (06BZEW2). Vehicle 1 was not inspected but from photographs a CDC of 10LZEW3 was assigned to the deployment of the driver's door mounted side air bag, the first event. Delta-V for the event was computed using the barrier routine of WinSmash, and it produced the following results:

	Vehicle 1
Total:	19.8 km/h (12.3 mph)
Longitudinal:	-12.7 km/h (7.9 mph)
Latitudinal:	15.2 km/h (9.4 mph)

This is a borderline reconstruction, but the results fit the collision model and appear reasonable. Vehicle 1 was towed from the scene due to damage and was declared a total loss by the insurance company.

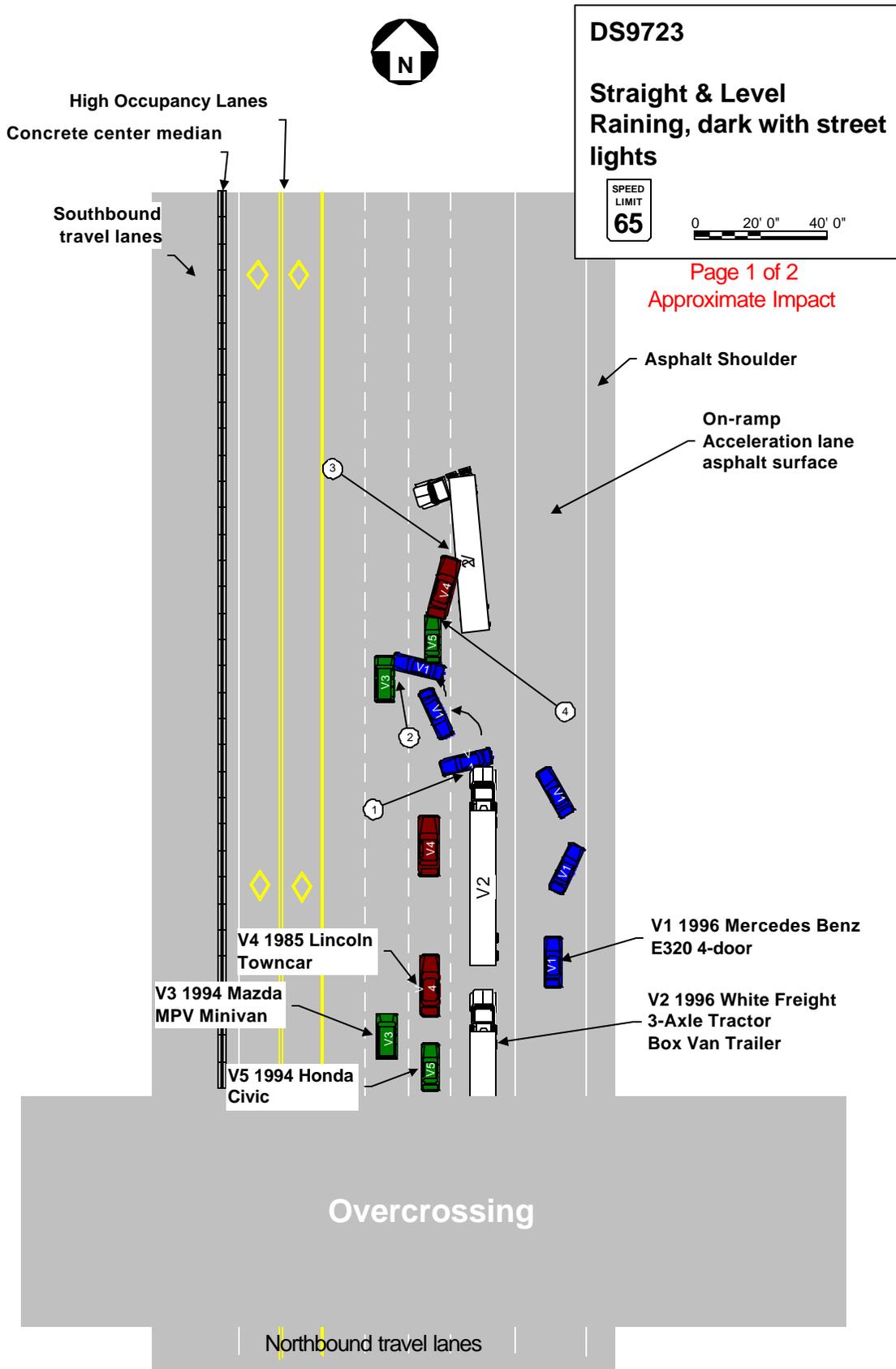
The PAR notes that the driver of Vehicle 2 was wearing the lap/shoulder restraints, and did not report any injuries. Vehicle 2 sustained damage to its front and left sides, and was towed from the scene.

The PAR notes that the driver of Vehicle 3 was wearing the lap/shoulder restraints, and did not report any injuries. Vehicle 3 was driven from the scene.

The PAR notes that the driver of Vehicle 4 was wearing the lap/shoulder restraints. He complained of pain to his right knee and stated that he would seek his own medical treatment. Vehicle 4 sustained moderate damage to its front and right side, and was towed from the scene.

The PAR notes only the deployment of the driver's and front right passenger's air bags in Vehicle 5. The driver did not report any injuries. The front right occupant sustained a dislocation of his right shoulder. He was transported to a local hospital via ground ambulance for medical treatment. Vehicle 5 sustained major damage to its front end, and was towed from the scene.

### SCENE DIAGRAM -1



Page 1 of 2  
Approximate Impact

V1 1996 Mercedes Benz  
E320 4-door

V2 1996 White Freight  
3-Axle Tractor  
Box Van Trailer

V4 1985 Lincoln  
Towncar

V3 1994 Mazda  
MPV Minivan

V5 1994 Honda  
Civic

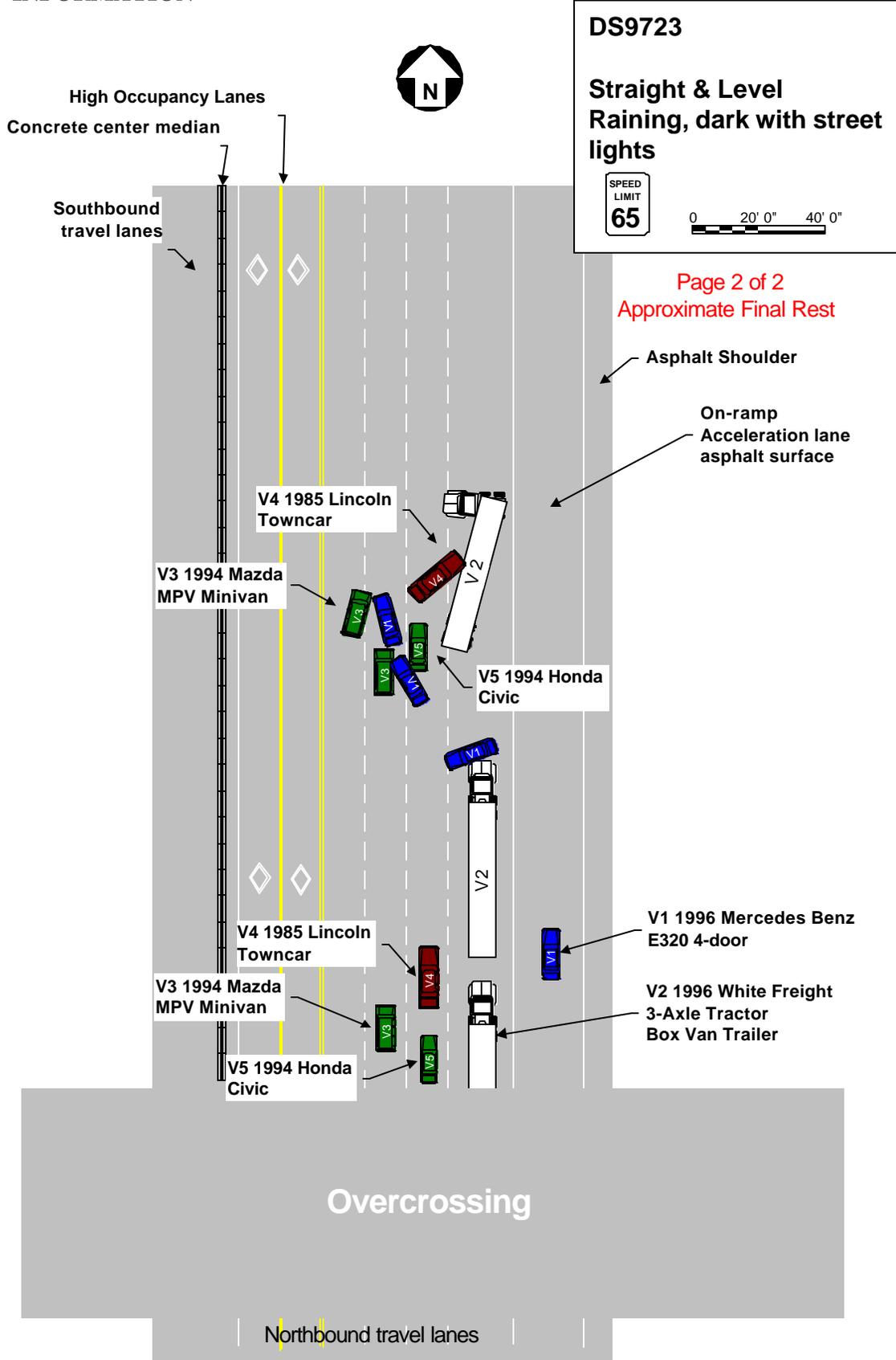
Overcrossing

Northbound travel lanes

### SCENE DIAGRAM -2

#### DETAILED INFORMATION

#### Vehicles



Vehicle 1

Description: 1996 Mercedes Benz E320 4-door  
 VIN: WDBJF55F4TJXXXXXX  
 Odometer: Unknown digital display  
 Engine: V6 / 3.2-liter  
 Reported Defects: None  
 Cargo: None visible  
 Damage Description: Major damage to the hood, grille area, both front quarter panels, the entire left side, the back end, hood, and rear right quarter panel. There was damage to the rear axle, with both of the rear tires restricted. The vehicle was declared a total loss by the insurance company.

CDC Impact # 1 Vehicle 1 vs Vehicle 2  
 Driver's side air bag deployment event  
 (not the highest Delta-V): 10LZEW3



**Figure 1.** Left side damage.

Impact Speed :	Unknown	
Delta V <sup>1</sup> :	Total	19.8 km/h (12.3 MPH)
	Longitudinal	-12.7 km/h (-7.9 MPH)

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<sup>1</sup> Damage (CDC only from photographs) barrier algorithm of WinSmash.

Latitudinal	15.2 km/h (9.4 MPH)
Energy	41,995 joules (31,007 ft-lbs)

This is a borderline reconstruction, but the results fit the collision model and appear reasonable.

**Supplemental Restraint System:**

Vehicle 1 is equipped with a Supplemental Restraint System which includes a driver and a front right passenger air bag, dual front door mounted side air bags, electronic Emergency Tensioning Retractors (ETR) which also incorporate mechanical belt force limiters, and knee bolsters. Neither front nor side air bags will deploy if the seat is empty (less than eleven pounds detected). Neither frontal air bag deployed in this collision. The driver's door mounted side air bag did deploy, and the driver's ETR activated.



**Figure 2.** Driver's side ETR and air bag.

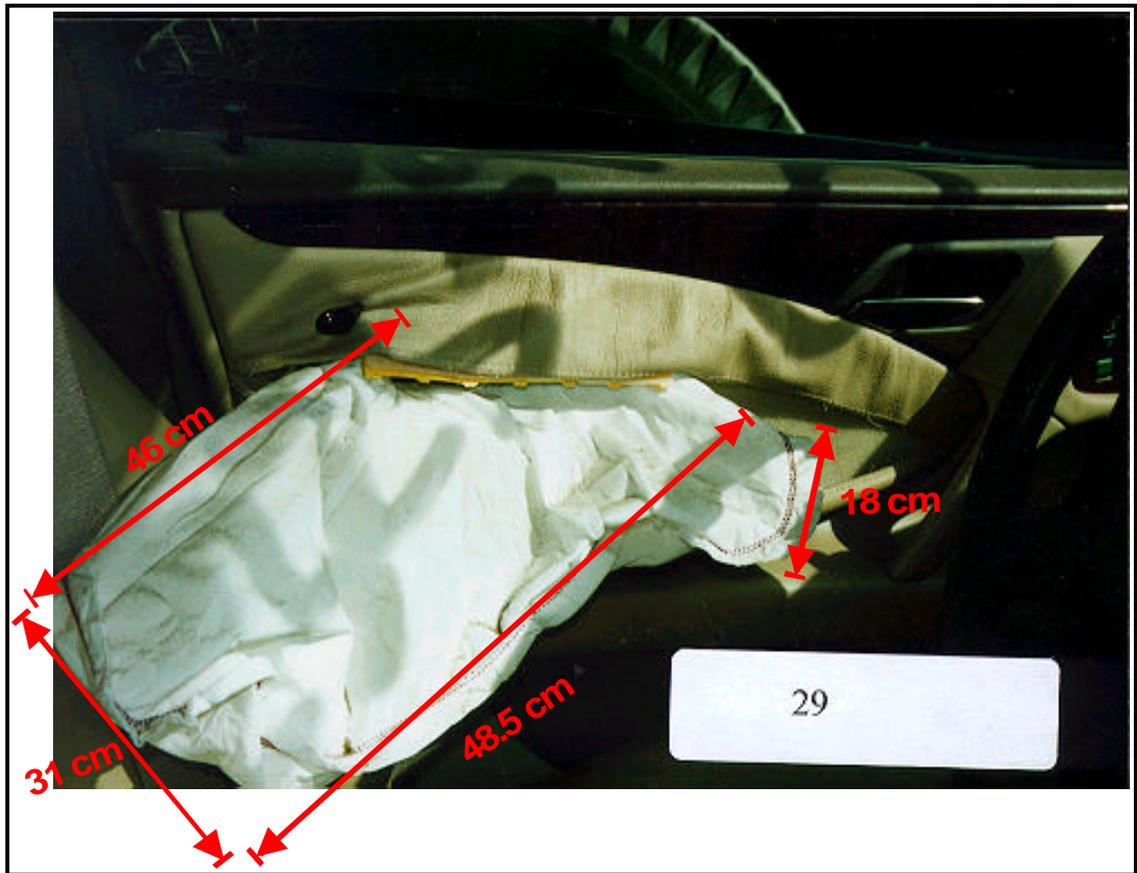


Figure 3. Driver's door mounted side air bag.

Vehicle 2

Description:	1996 Freight/White 3-axle tractor towing a 1988 Utility box van
VIN:	Unknown
Odometer:	Unknown
Engine:	Unknown
Reported Defects:	None noted
Cargo:	Unknown
Damage Description:	Damage noted on the PAR to the front, and the right side of the tractor
CDC Impact # 1, Vehicle 1 vs Vehicle 2:	Unknown
Impact Speed:	Unknown
Delta V :	Not calculated, insufficient data

Vehicle 3

Description:	1994 Mazda MPV Van	
VIN:	Unknown	
Odometer:	Unknown	
Engine:	Unknown	
Reported Defects:	None noted	
Cargo:	Unknown	
Damage Description:	PAR noted moderate damage to the right side	
CDC Impact # 2, Vehicle 1 vs Vehicle 3:	Unknown	
Impact Speed:	Unknown	
Delta V <sup>2</sup> :	Total	30.8 km/h (19.1 MPH)
	Longitudinal	-8.0 km/h (-5.0 MPH)
	Latitudinal	-29.8 km/h (-18.5 MPH)
	Energy	112,885 joules (83,327 ft-lbs)

This is a borderline reconstruction, but the results fit the collision model and appear reasonable.

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<sup>2</sup> CDC only of Vehicle 1, and the Missing Vehicle algorithm of WinSmash.

Vehicle 4

Description:	1985 Lincoln Towncar
VIN:	Unknown
Odometer:	Unknown
Engine:	Unknown
Reported Defects:	None noted
Cargo:	Unknown
Damage Description:	PAR noted moderate damage to the front end
CDC Impact # 3 Vehicle 4 vs Vehicle 2:	Unknown
Impact Speed:	Unknown
Delta V :	Not calculated, insufficient data

Vehicle 5

Description:	1994 Honda Civic
VIN:	Unknown
Odometer:	Unknown
Engine:	Unknown
Reported Defects:	None noted
Cargo:	Unknown
Damage Description:	PAR noted major damage to the front end
CDC Impact # 4, Vehicle 5 vs Vehicle 4:	Unknown
Impact Speed:	Unknown
Delta V :	Not calculated, insufficient data

**Occupants**

<u>Vehicle 1</u>	Occupant 1
Age/Sex:	17/Female
Seated Position:	Left front
Seat Type:	Bucket
Height:	168 cm (66 in)
Weight:	48 kg (106 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	Unknown
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Assumed normal, upright
Hand Position:	Assumed both on steering wheel
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belts used/pre-tensioner fired
Supplemental Restraint System:	The steering wheel mounted frontal air bag did not deploy. Driver's door mounted side air bag deployed. Driver's side ETS activated.

**Occupants (cont.)**

<u>Vehicle 2</u>	Occupant 1
Age/Sex:	37/Male
Seated Position:	Left front
Seat Type:	Unknown
Height:	178 cm (70 in)
Weight:	77 kg (170 lbs)
Occupation:	Truck driver
Pre-existing Medical Condition:	Unknown
Alcohol/Drug Involvement:	None
Driving Experience:	. 20 years
Body Posture:	Assumed normal, upright
Hand Position:	Presumably on steering wheel
Foot Position:	Right foot on brake pedal
Manual Restraint/Usage:	Lap and shoulder belts used according to PAR
Supplemental Restraint System:	None

**Occupants (cont.)**

<u>Vehicle 3</u>	Occupant 1
Age/Sex:	38/Male
Seated Position:	Left front
Seat Type:	Unknown
Height:	188 cm (74 in)
Weight:	84 kg (185 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	Unknown
Alcohol/Drug Involvement:	None
Driving Experience:	. 22 years
Body Posture:	Assumed normal, upright
Hand Position:	Presumably on steering wheel
Foot Position:	Right foot on brake pedal
Manual Restraint/Usage:	Lap and shoulder belts used per PAR
Supplemental Restraint System:	None

**Occupants (cont.)**

<u>Vehicle 4</u>	Occupant 1
Age/Sex:	62/Male
Seated Position:	Left front
Seat Type:	Unknown
Height:	178 cm (70 in)
Weight:	77 kg (170 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	Unknown
Alcohol/Drug Involvement:	None
Driving Experience:	. 46 years
Body Posture:	Assumed normal, upright
Hand Position:	Presumably on steering wheel
Foot Position:	Right foot on brake pedal
Manual Restraint/Usage:	Lap and shoulder belts used per PAR
Supplemental Restraint System:	None per PAR

**Occupants (cont.)**

<u>Vehicle 5</u>	Occupant 1	Occupant 2
Age/Sex:	21/Male	21/Male
Seated Position:	Left front	Right front
Seat Type:	Bucket	Bucket
Height:	165 cm (65 in)	Unknown
Weight:	66 kg (145 lbs)	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	Unknown	Unknown
Alcohol/Drug Involvement:	None	NA
Driving Experience:	. 5 years	NA
Body Posture:	Presumed normal, upright	Unknown
Hand Position:	Presumably on steering wheel	NA
Foot Position:	Right foot on brake pedal	NA
Manual Restraint/Usage:	3-point lap and shoulder belts, unknown if used	3-point lap and shoulder belts, unknown if used
Supplemental Restraint System:	Driver's air bag mounted in the steering wheel hub, deployed on impact with Vehicle 4.	Mid-mounted front right air bag, deployed on impact with Vehicle 4.

## Injuries and Injury Mechanisms

### Vehicle 1

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Neck strain	640278,1.6	847.0	Inertial motion
	Lower lumbar strain	640678,1.8	847.2	Inertial motion

## Occupant Kinematics

The driver of Vehicle 1 was seated in the left front seat. She was wearing the available 3-point lap and shoulder belts. Initially both hands were probably on the steering wheel and her right foot was on the accelerator. As she began to lose control of the vehicle, she began to turn the steering wheel to the left and it is unknown where her hands were located upon impact with Vehicle 2. At impact with Vehicle 2, her upper torso began to move laterally to the left when door mounted side air bag deployed. The ETS activated retracting and locking the 3-point lap and shoulder belts. The secondary impact involving the front of Vehicle 1 and the right side of Vehicle 3 caused the driver of Vehicle 1 to move slightly forward; the ETS maintained a locked position.

Vehicle 2

INJURY

Driver: Not injured

Vehicle 3

INJURY

Driver: Not injured

Vehicle 4

INJURY

Driver: Complained of pain to right knee. Not a codeable injury

Vehicle 5

INJURY

OIC CODE

ICD-9

SOURCE

Driver: Not injured

Front right occupant:	Dislocated right shoulder	751030,2.1	831.00	Unknown
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