

Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (1998-73-804F)

1998 Dodge Dakota Pick-up Truck

Indiana

October/1998

Technical Report Documentation Page

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16. Abstract <p>This remote investigation was focused on the redesigned air bag system deployment of a 1998 Dodge Dakota pick-up truck. This was a three vehicle crash that occurred during the afternoon hours of a weekday in October, 1998. The level bituminous roadway surface was wet due to rain. It was dark, but the roadway was lighted by overhead luminaires that were operating at the time of the crash. This crash occurred within a four-leg intersection in a business location. The north and southbound legs are comprised of an undivided two-lane roadway. The west leg consists of four travel lanes while the east leg is an undivided two-lane roadway. There are posted stop signs for the north, south and east legs of the intersection. An overhead traffic signal regulates traffic from the west leg of the intersection and the posted speed limit for each roadway is 56 km/h (35 mph). Vehicle 1, a 1998 Dodge Dakota pick-up truck, was driven by a 29 year-old-male (183 cm/72 in., 95 kg/209 lbs.) who was wearing the available three-point manual lap and shoulder belt. The front, right seated occupant was also a 29 year-old-male (180 cm/71 in., 73 kg/161 lbs.) who was properly restrained by the available three-point lap and shoulder belt. Driver 1 was traveling northbound approaching the intersection and stopped complying with the posted stop sign. When traffic looked clear, Driver 1 proceeded into the intersection with the intention of continuing northbound. Vehicle 2, a 1986 Oldsmobile Delta Eighty Eight, four-door sedan was driven by a 34-year-old-female who reportedly was wearing the lap and shoulder belt. Driver 2 was traveling westbound in lane 1 of the undivided four-lane roadway. The driver entered the intersection with the intention of continuing westbound while the overhead traffic signal was in the green signal phase. Vehicle 3, a 1998 Mercedes Benz sport utility vehicle, was driven by a 52 year-old-female who was reportedly restrained by the lap and shoulder belt. Vehicle 3 was stopped at the north leg of the intersection and was headed southbound. As Vehicle 1 entered the intersection, the front bumper of Vehicle 2 impacted the right side of Vehicle 1 (01RYEW3) in an "L"-type impact configuration. The calculated delta V was 9.1 km/h (5.7 mph) for Vehicle 1 with a longitudinal delta V of -7.9 km/h (-4.9 mph) which was <u>not</u> of sufficient force to deploy the redesigned frontal air bags. The 1 o'clock impact force deflected Vehicle 1 to the left towards the northwest intersection quadrant. Vehicle 1 rotated approximately 27 degrees in a counterclockwise rotation before its frontal plane (12FDEW1) impacted the front, left bumper area of Vehicle 3 (11FYEW1). Vehicle 3 was stationary (stopped) at the time of the second impact. The calculated delta V for Vehicle 1 was 11.2 km/h (7 mph) with a longitudinal delta V of -11.2 km/h (-7 mph). The second frontal impact deployed the frontal air bags, however, the longitudinal delta V was on the lower end of the threshold necessary for air bag deployment. Neither the driver or the front, right seated occupant of Vehicle 1 (Dodge Dakota) were injured. The driver of Vehicle 2 was transported to a local hospital with complaint of pain to her neck. The driver of Vehicle 3 was also uninjured in the crash.</p>			
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Summary

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Dodge Dakota pick-up truck. This was a three vehicle crash that occurred during the afternoon hours of a weekday in October, 1998. The level bituminous roadway surface was wet due to rain. It was dark, but the roadway was lighted by overhead luminaires that were operating at the time of the crash. This crash occurred within a four-leg intersection in a business location. The north and southbound legs are comprised of an undivided two-lane roadway. The west leg consists of four travel lanes while the east leg is an undivided two-lane roadway. There are posted stop signs for the north, south and east legs of the intersection. An overhead traffic signal regulates traffic from the west leg of the intersection and the posted speed limit for each roadway is 56 km/h (35 mph).

Vehicle 1, a 1998 Dodge Dakota pick-up truck, was driven by a 29 year-old-male (183 cm/72 in., 95 kg/209 lbs.) who was wearing the available three-point manual lap and shoulder belt. The front, right seated occupant was also a 29 year-old-male (180 cm/71 in., 73 kg/161 lbs.) who was properly restrained by the available three-point lap and shoulder belt. Driver 1 was traveling northbound approaching the intersection and stopped complying with the posted stop sign. When traffic looked clear, Driver 1 proceeded into the intersection with the intention of continuing northbound.

Vehicle 2, a 1986 Oldsmobile Delta Eighty Eight, four-door sedan was driven by a 34-year-old-female who reportedly was wearing the lap and shoulder belt. Driver 2 was traveling westbound in lane 1 of the undivided four-lane roadway. The driver entered the intersection with the intention of continuing westbound while the overhead traffic signal was in the green signal phase.

Vehicle 3, a 1998 Mercedes Benz sport utility vehicle, was driven by a 52 year-old-female who was reportedly restrained by the lap and shoulder belt. Vehicle 3 was stopped at the north leg of the intersection and was headed southbound.



Figure 1. Pre-impact Trajectory of Vehicle 1 (point of impact /foreground)



Figure 2. View showing location of Vehicle 3 (stopped at intersection)



Figure 3. View showing initial right side impact to Vehicle 1

As Vehicle 1 entered the intersection, the front bumper of Vehicle 2 impacted the right side of Vehicle 1 (01RYEW3) in an “L”-type impact configuration. The calculated delta V was 9.1 km/h (5.7 mph) for Vehicle 1 with a longitudinal delta V of -7.9 km/h (-4.9 mph)¹ which was not of sufficient force to deploy the redesigned frontal air bags. The 1 o’clock impact force deflected Vehicle 1 to the left towards the northwest intersection quadrant. Vehicle 1 rotated approximately 27 degrees in a counterclockwise rotation before its frontal plane (12FDEW1) impacted the front, left bumper area of Vehicle 3 (11FYEW1).



Figure 4. Secondary frontal impact to Vehicle 1

Vehicle 3 was stationary (stopped) at the time of the second impact. The calculated delta V for Vehicle 1 was 11.2 km/h (7 mph) with a longitudinal delta V of -11.2 km/h (-7 mph)². The second frontal impact deployed the frontal air bags, however, the longitudinal delta V was on the lower end of the threshold necessary for air bag deployment. Nether the driver or the front, right seated occupant of Vehicle 1 (Dodge Dakota) were injured. The driver of Vehicle 2 was transported to a local hospital with complaint of pain to her neck. The driver of Vehicle 3 was also uninjured in the crash.



Figure 5. View showing frontal damage to Vehicle 3

Table 1. Delta V (Primary Impact/ Second Event)

Frontal Plane	Case Vehicle		Other Vehicle	
	km/h	mph	km/h	mph
Total	11.2	7	12.2	7.6
Longitudinal	-11.2	-7	-10.6	-6.6
Lateral	0.0	0	6.1	3.8

¹ Calculated utilizing the Missing Algorithm of the WinSmash 1.2.1 program

² Calculated using the Damage Only Routine of WinSmash

Table 2. Delta V (Secondary Impact/ First Event)

Right Side Plane	Case Vehicle		Other Vehicle	
	km/h	mph	km/h	mph
Total	9.1	5.7	10.1	6.3
Longitudinal	-7.9	-4.9	-5.1	-3.2
Lateral	-4.6	-4.8	8.8	5.5

Exterior of Case Vehicle

Table 3. Vehicle Information


Model year, make and model	1998 Dodge Dakota Pick-up Truck	
VIN 1B7FL26X0WS	1B7FL26X0WS	
CDC (Primary-Second Event)	12FDEW1	
CDC (Secondary-First Event)	01RYEW3	

Figure 6. Three-quarter view showing initial right side impact and primary frontal impact

Table 3. Crush Measurements (Primary / Second Event)

Plane of Impact	Field L cm/in.	C1 cm/in.	C2 cm/in.	C3 cm/in.	C4 cm/in.	C5 cm/in.	C6 cm/in.
Front Bumper	155	0	0	4	6	2	2
	61	0	0	1.6	2.4	0.8	0.8

Table 4. Crush Measurements (Secondary / First Event)

Plane of Impact	Field L cm/in.	C1 cm/in.	C2 cm/in.	C3 cm/in.	C4 cm/in.	C5 cm/in.	C6 cm/in.
Right Side	294	1	1	14	5	3	2
	115.7	.4	.4	5.5	2.0	1.2	.8

Interior of Case Vehicle

The interior of the Dodge Dakota sustained minor damage due to occupant contacts and two separate impacts. The laminated windshield and tempered left front side window were undamaged. The right front side window glazing disintegrated due to the initial right side impact. The right front door panel intruded 5cm (2 in.) laterally. The driver’s left knee contacted the knee bolster as evidenced by a permanent residual scuff mark. There were scuff marks noted to both the driver’s and passenger’s frontal air bags.



Figure 7. Front, left view showing interior of case vehicle



Figure 8. Front, right view showing case vehicle interior

This vehicle is equipped with a split bench seat with separate seatbacks. The driver’s and passenger seat were adjusted to their rearmost track position. The two frontal seatbacks are equipped with integral head restraints which were not damaged during the impacts.

Table 5. Intrusions

Intruded Component	Location of Intrusion	Intruded Value cm/in.		Dominant Crush Direction
Door Panel	Front, Right	5	2	Lateral

Case Vehicle Occupant Protection Systems

The case vehicle, a 1998 Dodge Dakota, was equipped with redesigned air bags which use only one crash sensor (located within the Airbag Control Module (ACM)). The ACM is located inside the vehicle and is secured to the floor/transmission tunnel just below the instrument panel. The Airbag Control Module sends messages to the instrument cluster and then to the airbag indicator lamp which is located in the front, left mid-instrument panel. There is an air bag module located in the front left (steering wheel hub) and front right instrument panel (top-mount) which house the airbags and inflator units. The front, left and front, right seated positions are equipped with active three-point lap and shoulder belts.



Figure 9. View showing deployed drivers air bag

The front, left drivers air bag was housed in the steering wheel hub and was concealed by symmetrical double horizontal module cover flaps. The circular air bag was tethered by two straps and not equipped with exhaust vent port holes. The lower instrument panel is equipped with a rigid plastic knee bolster.

The front, right air bag was located in the instrument panel (top-mount level). The module cover flap door is rectangular in design and opens at predetermined break-out lines as the door pivots outward. There was no residual damage to the air bag and the module door opened at its designed tear points. The passenger air bag is equipped with a disarm switch or (PADS-Passenger Airbag Disarm Switch). The PADS switch is actuated with the ignition key in the switch key cylinder.

Case Vehicle Occupant Demographics

	Occupant 1	Occupant 2
Age/Sex:	29/Male	29/Male
Seated Position:	Front Left	Front Right
Seat Type:	Split bench with separate back(s)	Split bench with separate back (s)
Height (cm/in.):	183 72.05	180 70.87
Weight (kg/lbs.):	95 209.44	73 160.93
Pre-existing Medical Condition:	None Reported	None Reported
Body Posture:	Normal, Upright	Normal, Upright
Hand Position:	Both hands on steering wheel rim, O'clock position unknown	Both hands reportedly on lap
Foot Position:	Right foot on accelerator pedal, left foot on floor panel	Both feet on floor
Restraint Usage:	Active, three-point lap and shoulder belt with lap belt across hips and shoulder belt worn over left shoulder and snug on chest	Active, three-point lap and shoulder belt with lap belt worn low on lap and shoulder belt over the right shoulder across his chest
Air bag:	Driver air bag deployed as a result of the second impact to the frontal plane	Passenger air bag deployed as a result of the second impact to the frontal plane



Figure 10. View showing deployed passenger (front, right) air bag



Figure 11. Deployed drivers air bag



Figure 12. Deployed passenger air bag with occupant contacts highlighted

Occupant Injuries

Both the driver and the front, right seated occupant were uninjured in the crash. The applied manual lap and shoulder restraints in conjunction with the redesigned air bag units provided adequate protection for both occupants.

Occupant Kinematics

The 29 year-old-male driver of the Dodge Dakota was fully restrained by the available three-point manual lap and shoulder belt. He was upright and facing forward and had both hands on the steering wheel rim (exact position unknown). His right foot was on the accelerator pedal and his left foot was on the floor panel.

Driver 1 responded to the initial right side 30 degree impact force by moving forward and slightly to his right. The applied lap and shoulder belt secured the driver in his respective seated position. As the case vehicle was deflected to the left the driver rebounded back into his seatback support. He responded to the second impact to the frontal plane by moving directly forward. Again, the seatbelt retractor was activated which prohibited extended forward motion of his upper and lower torso. He probably made contact with the deploying air bag as evidenced by a documented scuff mark to the air bag nylon fabric. Driver 1 was uninjured in the crash.

The 29 year-old-male front, right seated occupant was facing forward and was fully restrained by the available three-point manual lap and shoulder belt. His feet were on the floor and his hands were reportedly on his lap.

The front right seated passenger responded to the initial 1 o'clock direction of force by moving forward and slightly to his right. He may have contacted the padded right door panel, however, no occupant contacts were noted. The lap and shoulder belt maintained the occupant in his respective seated position. He responded to the second impact to the frontal plane by moving directly forward. He loaded the applied lap and shoulder belt webbing which prohibited extended forward motion of his upper and lower torso. His hands probably flailed forward contacting the air bag fabric. His face pitched downward contacting the deploying air bag, as evidenced by a documented scuff mark.

Scene Diagram

