Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (1999-75-112B)

1998 Dodge 1500 Ram Pickup

Colorado

July/1999

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16. Abstract

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Dodge 1500 Ram pickup truck. This two vehicle front to side, "T"-type crash occurred during the night time hours of July, 1999. This crash took place on an undivided rural two-lane roadway which consists of a series of curves. The bituminous roadway surface was dry and the westbound travel lane had a negative grade (>2%) while the eastbound travel lane had an uphill grade (>2%). The east/westbound travel lanes are separated by a double yellow (no passing) centerline and there are no traffic controls present. The roadway is bordered by sand/gravel shoulders and the posted speed limit is 56 km/h (35 mph). Vehicle 1, a 1992 Volkswagen Golf GTI three-door hatchback, was being driven by an 18 year-old-female (165 cm/ 65 in., 56 kg/ 123 lbs.) who was properly restrained by the available two-point automatic (non-motorized) shoulder belt and the manual two-point lap belt. The front right seat was occupied by a 15 year-old-female (158 cm/ 62 in., 43 kg/ 95 lbs.) who was wearing the two-point automatic shoulder belt, but not the manual lap belt. Vehicle 1 was traveling westbound and the driver was negotiating a left curve in the roadway when the vehicle's right side tires departed the roadway, onto the sand/gravel shoulder. Driver 1 was able to place the vehicle back onto the roadway as it initiated a slight counterclockwise yaw. The driver of Vehicle 1 applied an aggressive right steering input which over-corrected the vehicle attitude as Vehicle 1 initiated a clockwise rotation. Vehicle 1 traversed the double yellow centerlines and entered the eastbound travel lane. Vehicle 2, a 1998 Dodge Ram 1500 pickup truck was being driven by a 54 year-old-male (183 cm/ 72 in., 104 kg/ 229 lb.) who was properly wearing the available three-point manual lap and shoulder belt. Driver 2 was proceeding eastbound in lane 1 at a police reported speed of 56 km/h (35 mph). Driver 2 had previously negotiated a sharp right curve and entered a stretch of the roadway that had a slight left curve. The full frontal plane of Vehicle 2 (12FDEW2) impacted the left side of Vehicle 1 (09LYAW5). The frontal air bag systems in Vehicle 2 (Dodge Ram) deployed as a result of the moderate/severe frontal impact. Vehicle 2 continued in its forward trajectory while it was deflected slightly to the right. Vehicle 1 (Volkswagen Golf) was pushed approximately 8.7 m (28.7 ft.) in an easterly direction before coming to rest straddling the south road edge line and facing northeast. Vehicle 2 was slightly askew in the eastbound travel lane and was facing easterly. The 18 year-old-female driver of Vehicle 1 was killed while the front right seated occupant sustained numerous severe anatomic brain injuries (AIS 3-5), severe thoracic injuries involving numerous fractured ribs, contused lungs with pneumothorax and a lacerated spleen that required a splenectomy. She was hospitalized and survived the crash. The driver of Vehicle 2 (Dodge ram) sustained abrasions and contusions to his left forearm (AIS-1) due to interacting with the depowered driver's air bag. The driver sustained a fractured distal patellar due to falling out of the vehicle (post-impact). Several paramedic units arrived on-scene and transported the passenger in Vehicle 1 to a Trauma Center and the driver of Vehicle 2 was transported to a local Medical Center. Two separate towing agencies arrived on-scene and removed the vehicle 's to their respective locations.

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Summary

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Dodge 1500 Ram pickup truck. This two vehicle front to side, "T"-type crash occurred during the night time hours of July, 1999. This crash took place on an undivided rural two-lane roadway which consists of a series of curves. The bituminous roadway surface was dry and the westbound travel lane had a negative grade (>2%) while the eastbound travel lane had an uphill grade (>2%). The east/westbound travel lanes are separated by a double yellow (no passing) centerline and there are no traffic controls present. The roadway is bordered by sand/gravel shoulders and the posted speed limit is 56 km/h (35 mph).

Figure 1. Pre-impact trajectory of Vehicle 1

Vehicle 1, a 1992 Volkswagen Golf GTI three-door hatchback, was being driven by an 18 year-old-female (165 cm/ 65 in., 56 kg/ 123 lbs.) who was properly restrained by the available two-point automatic (non-motorized) shoulder belt and the manual two-point lap belt. The front right seat was occupied by a 15 year-old-female (158 cm/ 62 in., 43 kg/ 95 lbs.) who was wearing the two-point automatic shoulder belt, but not the manual lap belt. Vehicle 1 was traveling westbound and the driver was negotiating a left curve in the roadway when the vehicle's right side tires departed the roadway, onto the sand/gravel shoulder. Driver 1 was able to place the vehicle back onto the roadway as it initiated a slight counterclockwise yaw. The driver of Vehicle 1 applied an aggressive right steering input which over-corrected the vehicle attitude as Vehicle 1 initiated a clockwise rotation. Vehicle 1 traversed the double yellow centerlines and entered the eastbound travel lane.

Figure 2. Vehicle 1 traverses roadway center lines

Vehicle 2, a 1998 Dodge Ram 1500 pickup truck was being driven by a 54 year-old-male (183 cm/ 72 in., 104 kg/ 229 lb.) who was properly wearing the available three-point manual lap and shoulder belt. Driver 2 was proceeding eastbound in lane 1 at a police reported speed of 56 km/h (35 mph). Driver 2 had previously negotiated a sharp right curve and entered a stretch of the roadway that had a slight left curve.

Crash Events

The full frontal plane of Vehicle 2 (12FDEW2) impacted the left side of Vehicle 1 (09LYAW5). The frontal air bag systems in Vehicle 2 (Dodge Ram) deployed as a result of the moderate/severe frontal impact. The calculated latitudinal delta V for Vehicle 1 was 69.05 km/h (42.9 mph) and its impact speed was calculated at 29.9 km/h (18.6mph)[1]. Vehicle 2's longitudinal delta V was calculated at -31.8 km/h (-19.7 mph) with an estimated impact speed of 64.6 km/h (40.1 mph). The impact was sufficient to deploy the frontal air bags.

Figure 3. Point of impact and final rest position

Vehicle 2 continued in its forward trajectory while it was deflected slightly to the right. Vehicle 1 (Volkswagen Golf) was pushed approximately 8.7 m (28.7 ft.) in an easterly direction before coming to rest straddling the south road edge line and facing northeast. Vehicle 2 was slightly askew in the eastbound travel lane and was facing easterly.

Figure 4. Left side deformation to Vehicle 1 (VW Golf GTI)

The 18 year-old-female driver of Vehicle 1 was killed while the front right seated occupant sustained numerous severe anatomic brain injuries (AIS 3-5), severe thoracic injuries involving numerous fractured ribs, contused lungs with pneumothorax and a lacerated spleen that required a splenectomy. She was hospitalized and survived the crash. The driver of Vehicle 2 (Dodge ram) sustained abrasions and contusions to his left forearm (AIS-1) due to interacting with the depowered driver's air bag. The driver sustained a fractured distal patellar due to falling out of the vehicle (post-impact). Several paramedic units arrived on-scene and transported the passenger in Vehicle 1 to a Trauma Center and the driver of Vehicle 2 was transported to a local Medical Center. Two separate towing agencies arrived on-scene and removed the vehicle's to their respective locations.

Figure 5. Frontal damage to Vehicle 2 (1998 Dodge Ram 1500)

[1] Calculated Utilizing the Damage and Trajectory Routine of the WinSmash 1.2.1 program

Table 1. Delta V

	Case Vehicle		Other Vehicle	
	km/h	mph	km/h	mph
Total	31.9	19.8	69.1	42.9
Longitudinal	-31.8	-19.8	-12.4	-7.7
Lateral	.9	0.6	67.9	42.2
Impact Speed	64.6	40.1	29.9	18.5

Figure 6. Full frontal view of Vehicle 2 (1998 Dodge Ram)

Figure 7. Three-quarter view of Vehicle 2–showing frontal deformation

Exterior of Case Vehicle

Table 2. Vehicle Information

Model year, make and model	1998 Dodge 1500 Ram Pickup
VIN	1B7HF16Z0WS
CDC	12FDEW2

Table 3. Crush Measurements

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	164	44	32	26	19	12	16
	64.6	17.3	12.6	10.2	7.5	4.7	6.3

Interior of Case Vehicle

The interior of the 1998 Dodge Ram 1500 pickup truck was basically undamaged due to the moderate/severe frontal impact. The Dodge Ram maintained its integrity and there were no intruding components. The interior was void of any detectable occupant contact evidence. The laminated windshield was cracked at the driver's side due to the impact forces. This vehicle is equipped with a cloth covered split bench seat with folding back(s). The front seat outboard positions are equipped with integral head restraints. The front left seat track was adjusted to its rearmost track position and the shoulder belt manual adjuster was in the full up position.

Case Vehicle Occupant Protection Systems

The 1998 Dodge Ram was equipped with the redesigned air bag systems. This system consists of a control diagnostic module which is centrally located above the transmission tunnel and immediately below the instrument panel. The control module houses the single crash sensor which activates both the driver's air bag and the front passenger air bag. The air bag readiness lamps is located in the left instrument panel gauge cluster.

The driver's air bag is housed in the steering wheel hub and encases the nylon air bag unit. The module cover consists of a single rectangular flap door that opened at its designated tear points. The circular air bag is tethered by four straps and is equipped with only one exhaust vent port located at the 12 o'clock position. The rigid plastic knee bolster was undamaged and did not reveal any detectable occupant contacts.

The front, right passenger air bag is located in the right hand side of the instrument panel (mid-mount) immediately above the glove box door. The single, rectangular module deployment door opened at its designated tear points. Upon deployment, the encased air bag fully deployed. The non-tethered air bag was undamaged and was not equipped with exhaust vent ports.

Figure 8. View showing deployed driver's air bag

Figure 9. View showing deployed passenger air bag

Case Vehicle Occupant Demographics

	Occupant 1	
Age/Sex:	54/Male	
Seated Position:	Front, Left	
Seat Type:	Split bench with folding back(s)	
Height (cm/in:):	183	72.05
Weight (kg/lbs).:	104	229.3
Pre-existing Medical Condition:	None Reported	
Body Posture:	Upright, facing forward	
Hand Position:	Both hands on steering wheel rim. Left hand at the 10 o'clock position and the right hand at the 2 o'clock position	
Foot Position:	Right foot on the accelerator pedal and the left foot on the floor panel	
Restraint Usage:	Manual, three-point lap and shoulder belt worn with the shoulder belt webbing extending across his chest and lap belt across his hips.	
Air bag:	Driver's air bag deployed as a result of the frontal impact	

Occupant Injuries

Table 4. Injuries

Injury	Injury Severity (AIS)	Injury Mechanism
Left forearm abrasion	1	Air Bag
Left forearm contusion (large)	1	Air Bag

Note: The driver sustained a small chip fracture of the right distal patella. This injury was due to falling onto the pavement as he exited the vehicle, post-crash.

Figure 10. View showing driver's position

Occupant Kinematics

The 54 year-old-male driver of the 1998 Dodge Ram 1500 pickup truck was fully restrained and responded to the 12 o'clock direction of force by moving directly forward. He loaded the applied lap belt webbing which prohibited extended forward movement of his lower torso. His upper torso engaged the applied shoulder belt webbing as the driver's air bag deployed. His left forearm was contacted significantly by the deploying air bag which resulted in contusions and abrasions (AIS-1) of his left forearm (ventral aspect) which extended down to the volar region (palm). The driver rebounded into the seatback support which did not result in any additional injuries.

The driver apparently unbuckled his lap and shoulder belt (post-crash) and exited the left door. He apparently lost his footing as he stepped down onto the pavement and fell onto his right knee. This resulted in a small chip fracture (1cm in diameter) to his patella. The driver was transported to a local hospital where he was treated and released.

Figure 11. View showing deployed air bag

Scene Diagram