Remote SCI/NASS Combination Side Air Bag Investigation
Dynamic Science, Inc. (DSI), Case Number 2008-74-083K
2002 Dodge Neon
Nebraska
April 2008

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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 remote SCI/NASS Combination Side Air Bag Investigation focused on a seat mounted side air bag deployment and the injuries sustained by the vehicle's occupant. This two-vehicle crash occurred in April 2008 at 0010 hours. The subject vehicle was a 2002 Dodge Neon 4-door sedan that was being driven by an 18-year-old female. The front row right occupant was a 19-year-old female. The other vehicle was a 2005 Ford F150 pickup that was being driven by a 24-year-old male. The crash occurred within the confines of a four-way intersection which was controlled by a traffic signal. The subject vehicle was traveling north, and the other vehicle was traveling west. The vehicles entered the intersection at the same time; the Ford entered against a red light according to the police report. The front end of the Ford impacted the right side of the Dodge in the passenger compartment area. The impact resulted in the deployment of the Dodge's frontal air bags and the right seat mounted side air bag. During the impact, the hood of the Ford contacted the deployed seat mounted side air bag and the first row right occupant of the Dodge. The 18-year-old female driver of the Dodge sustained non-incapacitating injuries and was transported and released. The 19-year-old female front right occupant sustained incapacitating injuries due to contact from the Ford's hood and from the interior door panel/hardware. Her injuries included multiple head and brain injuries, and multiple pelvic fractures. She was transported from the scene to a trauma center and admitted for three days.

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BACKGROUND

This remote SCI/NASS Combination Side Air Bag Investigation was initiated in response to a report by the local National Automotive Sampling System (NASS) Crashworthiness Data System (CDS) team of a seat mounted side air bag deployment and the injuries sustained by the vehicle's right front occupant. This two-vehicle crash occurred in April 2008 at 0010 hours. The subject vehicle was a 2002 Dodge Neon 4-door sedan that was being driven by an 18-year-old female **(Figure 1**). The front row right occupant was a 19-year-old female. The vehicle was equipped with frontal air bags and seat mounted side air bags for the first row outboard seating positions. The other vehicle was a 2005 Ford F150 pickup that was being driven by a 24-year-old male. The crash occurred within an intersection. The subject vehicle was traveling north, and the other vehicle was traveling west. The vehicles entered the intersection at the same time; the Ford entered against a red light according to the police report. The front end of the Ford impacted the right side of the Dodge in the passenger compartment area. The impact resulted in the deployment of the Dodge's frontal air bags and the right seat mounted side air bag. During the impact, the hood of the Ford contacted the deployed seat mounted side air bag and the first row right occupant of the Dodge. The 18-year-old female driver of the Dodge sustained non-incapacitating injuries and was transported and released. The 19-year-old female front right occupant sustained incapacitating injuries due to contact from the Ford's hood and from the interior door panel/hardware. Her injuries included multiple head and brain injuries, and multiple pelvic fractures. She was transported from the scene to a trauma center and admitted for three days.

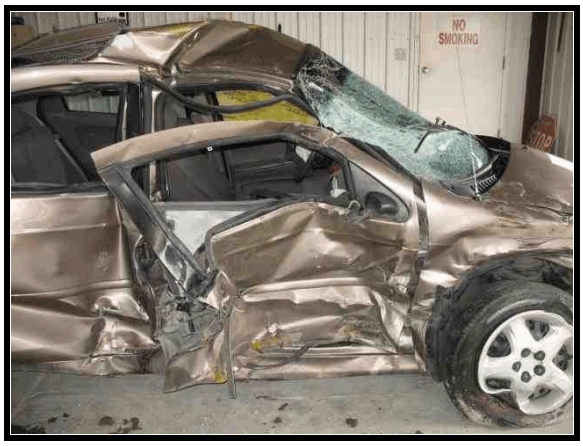

Figure 1. Right side damage to 2002 Dodge Neon

DSI was assigned the case on July 23, 2008. A copy of the electronic case was uploaded and the police report was obtained. The electronic case was updated in April 2009. The following information was generated from the updated electronic case, the police report, and email correspondences regarding the investigation.

SUMMARY

Crash Site

The crash occurred within the confines of a four-way intersection which was controlled by a traffic signal. The south leg of the intersection was comprised of two northbound travel lanes, a left turn lane, a median strip, and two southbound travel lanes. The asphalt roadway was dry and there was a >2% downhill grade. The east leg of the intersection was comprised of a right turn lane, two westbound travel lanes, a left turn lane, a median strip, and two eastbound travel lanes. The asphalt roadway was dry and level. The weather was clear and the streetlights were functioning at the time of the crash. The posted speed limit was 64 km/h (45 mph) for both roadways.

Pre Crash

The subject vehicle was traveling northbound (**Figure 2**) and the other vehicle was traveling westbound (**Figure 3**). The vehicles entered the intersection at the same time. According to the police report, the Ford entered the intersection against a red light.

Figure 2. Northbound approach

Figure 3. Westbound approach

Crash

The front end of the Ford (**Figure 4**) impacted the right side of the Dodge in the passenger compartment area. The impact resulted in the deployment of the Dodge's frontal air bags and the right seat mounted side air bag. During the impact, the hood of the Ford contacted the deployed seat mounted side air bag and the first row right occupant of the Dodge. The Damage algorithm of the WinSmash program computed a total delta V of 69 km/h (42.8 mph), based on the Dodge's right side crush profile. The longitudinal and lateral components were -24 km/h (-14.9 mph) and -65 km/h (-40.4 mph), respectively. The Dodge was redirected into a clockwise rotation and traveled in a northwest direction. The Dodge crossed the curb at the northwest corner of the intersection, departed the roadway, struck a fire hydrant with its back end, and came to rest facing southeast. The Damage algorithm of the WinSmash program computed a total delta V of 11 km/h (6.8 mph), based on the Dodge's back end crush profile. The Ford was redirected in a clockwise direction across the intersection, and came to rest in the intersection facing southeast.

Figure 4. Frontal damage to 2005 Ford F150 pickup

Post Crash

The 18-year-old female driver of the Dodge sustained abrasions to the head, face, and upper and lower extremities; contusions to the feet and both knees. She was transported to a local hospital where she arrived with a Glasgow Coma Score (GCS) of 15. She was treated and released.

The 19-year-old female front right occupant sustained brain/head injuries, pelvic fractures, and a left hand fracture. She was transported from the scene to a trauma center where she arrived with a GCS

of 14. She was hospitalized for three days.

Both vehicles were towed from the scene due to damage.

Vehicle Data - 2002 Dodge Neon

The 2002 Dodge Neon 4-door sedan was identified by the Vehicle Identification Number (VIN): 1B3AS46C12xxxxxx. The Dodge was manufactured in February 2002. The Dodge was equipped with a 2.0 liter, 4-cylinder engine, automatic transmission, front wheel drive, and a tilt column. The Dodge was configured with Hercules P185/60R15 tires. The tire manufacturer's stated maximum pressure was 303 kPa (44 psi); the vehicle manufacturer's recommended cold pressure was 221 kPa (32 psi).

The specific tire information was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	228 kPa (33 psi)	6 mm (8/32 in)	No	None
LR	234 kPa (34 psi)	6 mm (8/32 in)	No	None
RR	241 kPa (35 psi)	6 mm (8/32 in)	No	None
RF	Tire Flat	6 mm (8/32 in)	Yes	Tire cut

The seating in the Dodge Neon was configured with a front bucket seats and adjustable head restraints for the outboard seat positions and a rear bench seat with folding backs.

Vehicle Damage

Exterior Damage - 2002 Dodge Neon

The Dodge sustained severe right side damage from the impact with the Ford (**Figure 5**). The direct damage began at the right front bumper corner and extended 250 cm (98.4 in) rearward along the right side plane. The induced damage began at the right front bumper corner and extended 272 cm (107 in) rearward along the right side plane. Six crush measurements were documented at the sill level as follows: C1 = 6 cm (2.4 in), C2 = 38 cm (14.9 in), C3 = 34 cm (13.3 in), C4 = 27 cm (10.6 in), C5 = 9 cm (3.5 in), C6 = 0 cm. The maximum lateral crush was located at C2. The Collision Deformation Classification (CDC) for the impact with the Ford was 02RYAW3.

Figure 5. Right side damage

The impact was to the passenger area and measurements were taken to determine the vehicle's sill height, maximum crush height, and the resultant Door Sill Differential (DSD). The sill height measured 22 cm (8.7 in). The maximum crush height measured 30 cm (11.8 in). Based on vehicle photographs, the DSD was determined to be approximately 5 cm (2 in).

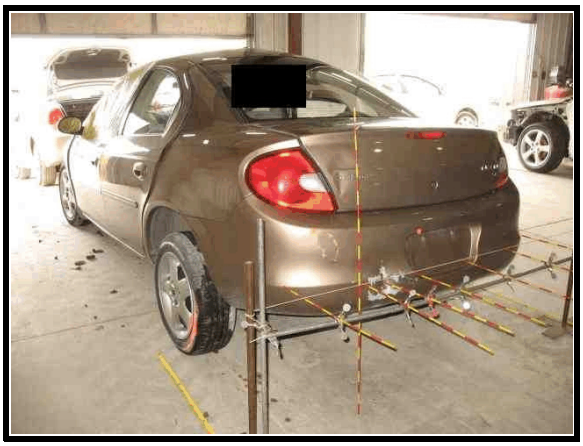

Figure 6. Rear end damage from fire hydrant

The Dodge sustained minor back end damage from the impact with the fire hydrant (**Figure 6**). The direct damage began 12 cm (4.7 in) from C1 and extended 48 cm (18.9 in) laterally to the right along the rear bumper. The field L was distributed from bumper corner to bumper corner and measured 141 cm (55.5in). Six crush measurements were documented at the bumper level as follows: C1 = 1 cm (0.4 in), C2 = 0 cm, C3 = 0 cm, C4 = 0 cm, C5 = 0 cm, C6 = 0 cm. The CDC for the impact with the fire hydrant was 06BYEW1.

The right front, left rear, and right rear doors of the Dodge were jammed shut. The windshield was cracked, and the right front and right rear glazing was disintegrated from impact forces.

Interior Damage -2002 Dodge Neon

The Dodge sustained moderate interior damage from passenger compartment intrusions and occupant contacts. Contacts were documented to the sun visors, center mirror, and right roof side rail. There was lateral intrusion through the right side that included the A- and B-pillars, floor pan, door panel, roof, and roof side rail. There was longitudinal intrusion from the right seat back and the right instrument panel.

The specific passenger compartment intrusions were documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
Front seat right	A-pillar	44 cm (17.3 in)	Lateral
Second seat right	Front seat back	26 cm (10.2 in)	Longitudinal
Front seat right	Floor pan	22 cm (8.7 in)	Lateral
Front seat right	Door/forward lower quadrant	20 cm (7.9 in)	Lateral
Second seat right	B-pillar	20 cm (7.9 in)	Lateral
Second seat right	Door/forward upper quadrant	20 cm (7.9 in)	Lateral
Second seat right	Floor pan	20 cm (7.9 in)	Lateral
Second seat right	Roof	16 cm (6.3 in)	Lateral
Second seat right	Roof side rail	16 cm (6.3 in)	Lateral
Front seat right	Seat cushion	15 cm (5.9 in)	Lateral
Front seat right	Instrument panel right	12 cm (4.7 in)	Longitudinal
Front seat right	Roof side rail	3 cm (1.2 in)	Lateral
Front seat right	Roof	3 cm (1.2 in)	Lateral

Manual Restraints - 2002 Dodge Neon

The 2002 Dodge Neon was configured with 3-point manual lap and shoulder belts for all five seating positions. The driver's seat belt anchorage adjustment was in the full down position; the front right passenger's seat belt anchorage adjustment was in the full up position. The front seat belts were configured with Emergency Locking Retractors (ELR) and sliding latch plates. The rear seat belts were configured with ELR and light weight/cinching latch plates. The Dodge was not equipped with seat belt pretensioners.

Supplemental Restraint Systems - 2002 Dodge Neon

The 2002 Dodge Neon was equipped with "Next Generation" redesigned frontal air bags for the driver and front right passenger positions and seat mounted side air bags located at the outboard position of the front seats. The frontal air bags and the right seat mounted side air bag deployed as a result of the impact with the Ford.

Figure 7. Driver's air bag

The driver's air bag was housed in the center of the steering wheel with a single cover flap design (**Figure 7**). No contact evidence was documented to either the module cover or the bag surface. The air bag was vented by two ports located at the 11 and 1 o'clock sectors on the rear aspect of the air bag. The air bag was tethered, evidenced by the circular stitching on the center of the air bag. The front right passenger air bag deployed from the right mid instrument panel area with a single cover flap design hinged at the top aspect (**Figure 8**). No contact evidence was documented to either the module cover or the bag surface.

The right seat mounted side air bag deployed from the outer aspect of the right front seat back (**Figure 9**). The side air bag was designed to protect the head and torso. The air bag was tethered, as evidenced by the horizontal stitching one-third of the way from the top of the bag. The air bag was vented by two ports one-third of the way from the bottom of the air bag. The ports were located on both the inboard and outboard aspects of the air bag. There was an unidentified brownish stain located above and below the inner facing vent ports. Just aft of the vent ports was a stain which was probably blood.

Figure 8. Overview of driver and front right passenger air bags

Figure 9. Front right seat mounted side air bag

OCCUPANT DEMOGRAPHICS - 2002 Dodge Neon

	Drive	**Front Right Passenger**
Age/Sex:	18/Female	19/Female
Seated Position:	Front left	Front right
Seat Type:	Bucket	Bucket
Seat Track Position:	Rear most track position	Rear most track position
Height:	170 cm (67 in)	170 cm (67 in)
Weight:	77 kg (170 lbs)	57 kg (126 lbs)
Alcohol/Drug Involvement:	None	N/A
Body Posture:	Normal	Normal
Hand Position:	Unknown	Unknown
Foot Position:	Right foot presumed to be on accelerator	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap and shoulder belt available, used
Air bag:	Steering wheel mounted frontal air bag deployed. Seat mounted side air bag did not deploy.	Instrument panel mounted frontal air bag deployed. Seat mounted side air bag deployed.

OCCUPANT INJURIES - 2002 Dodge Neon

Driver: Injuries obtained from emergency room records and the interview.

Injury	AIS Code	Injury Mechanism	Confidence Level
Minor scalp laceration	190602.1,1	Flying glass	Certain
Facial abrasion	290202.1,7	Flying glass	Certain
Facial laceration	290602.1,7	Flying glass	Certain
Right upper extremity laceration	790602.1,1	Flying glass	Certain
Bilateral upper extremity abrasions	790202.1,3	Flying glass	Certain

Right lower leg abrasion	890202.1,1	Center lower instrument panel	Certain
Right foot/ toe contusion	890402.1,1	Foot controls	Certain
Left knee contusion	890402.1,2	Left lower instrument panel	Certain
Right knee contusion	890402.1,1	Center lower instrument panel	Certain

Front right occupant: Injuries obtained from post-emergency room records.

Injury	AIS Code	Injury Mechanism	Confidence Level
Cerebrum diffuse axonal injury (white matter shearing), left	140628.5,2	Hood edge	Probable
Cerebral contusion, left	140606.3,2	Hood edge	Probable
Cerebrum hematoma/hemorrhage	140652.4,1	Hood edge	Probable
Pelvic fracture, open/displaced/comminuted , right	852604.3,1	Right armrest/hardware	Certain
Pelvic fracture, closed	852602.2,6	Right armrest/hardware	Certain
Pelvic fracture, closed	852602.2,5	Right armrest/hardware	Certain
Clavicle fracture, left	752200.2,2	Other occupant	Possible
Upper extremity contusion	790402.1,1	Right forward upper quadrant	Certain

OCCUPANT KINEMATICS

Driver Kinematics

The 18-year-old female driver of the Dodge was seated in a normal posture with the seat back slightly reclined and the seat track adjusted to the rear most track position. She was restrained by the available 3-point lap and shoulder belt system. At impact, the driver initiated a forward/right trajectory in response to the 2 o'clock impact force. She probably contacted the deployed frontal air bag and loaded the lap and shoulder belt. Her lower extremities were displaced forward and both knees contacted the lower instrument panel, causing bilateral knee contusions. Her right lower leg contacted the center lower instrument panel,

causing a lower leg abrasion. She sustained a contusion to her right foot/toe from contact with the floor controls. As she was displaced laterally, she may have contacted the front right occupant; there was no resultant injury from this possible contact. She remained in her seat until final rest and was able to exit the vehicle with some assistance. She was transported to a local trauma center where she was treated and released.

Front Right Occupant Kinematics

The 19-year-old female front right occupant was seated in a normal posture with the seat track at the rear most track position. The seat back angle was not known. She was restrained by the available 3-point lap and shoulder belt system. At impact, the front right occupant initiated a forward/right trajectory in response to the 2 o'clock impact force. She impacted the interior of the right front door and the door armrest/hardware which resulted in multiple pelvic fractures. She also came into contact with the deployed side air bag. During the impact, the hood of the Ford contacted the deployed seat mounted side air bag and also likely contacted the right side of the occupant's head. Exemplar vehicles were located and measurements were taken to illustrate the height of the Ford hood as compared to the Neon's lower window frame (**Figure 10**). She sustained left and right brain injuries, with the left brain injuries likely being contrecoup-type injuries. She also sustained a left clavicle fracture, possibly due to contact with the driver. She was removed from the vehicle due to perceived serious injuries. She was transported to a local trauma center where she was hospitalized for three days.

Figure 10. Comparison of Ford hood line and Neon's lower side window frame

Attachment 1. Scene Diagram