Remote Combination ODI Passenger Air Bag Deployment Investigation
Dynamic Science, Inc. (DSI), Case Number 2007-75-135J
2007 Dodge Charger
Colorado
November 2007

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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 Combination Office of Defects Investigation (ODI) Passenger Air Bag Deployment Investigation focused on the frontal air bags installed in a 2007 Dodge Charger. The Charger was involved in a two vehicle crash that occurred in November 2007 at night. The subject vehicle was being driven by a restrained 24-year-old male. The other vehicle was a 2000 Ontario Orion V city bus. The Dodge Charger was traveling eastbound in the outboard lane of a four-lane divided roadway. The Ontario bus was stopped in front of the Charger in the same lane. The driver of Dodge Charger failed to stop and rear-ended the bus. Both frontal air bags in the Dodge Charger deployed. The driver of the Dodge Charger sustained serious injuries and was hospitalized for 16 days.

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Background

This Remote Combination Office of Defects Investigation (ODI) Passenger Air Bag Deployment Investigation focused on the frontal air bags installed in a 2007 Dodge Charger (**Figure 1**). The Charger was involved in a two vehicle crash that occurred in November 2007 at night. The subject vehicle was being driven by a restrained 24-year-old male. The other vehicle was a 2000 Ontario Orion V city bus. The Dodge Charger was traveling eastbound in the outboard lane of a four-lane divided roadway. The Ontario bus was stopped in front of the Charger in the same lane. The driver of Dodge Charger failed to stop and rear-ended the bus. Both frontal air bags in the Dodge Charger deployed. The driver of the Dodge Charger sustained serious injuries and was hospitalized for 16 days.

Figure 1. 2007 Dodge Charger

This investigation was initiated in response to a Field Safety Notification (FSN) from the National Automotive Sampling System (NASS). The 2007 Dodge Charger was equipped with multi-stage Certified Advanced Compliant (CAC) driver and front right passenger air bags. The FSN reported that the passenger air bag in this CAC vehicle deployed even though there was no passenger present. A copy of the electronic case and the police report were requested and obtained from the Zone Center. The Dodge was a rental vehicle that was declared a total loss. Efforts were undertaken to locate the subject vehicle and to remove the Event Data Recorder (EDR). The salvage company contacted the private buyer who refused to cooperate. A title search was conducted and results repeatedly came back listing the original owner rather than the current owner. Efforts to locate the vehicle were discontinued due to the age of the case. The following information was obtained from the NASS electronic case and the police report.

Summary

Crash Site

This two-vehicle crash occurred on a four-lane, two-way urban roadway. The crash occurred in November 2007 at 2029 hours. At the time of the crash, there were no adverse weather conditions and the asphalt roadway was dry. The roadway was configured with three eastbound travel lanes and a left hand turn lane. The through lanes were delineated by dashed white lines. The roadway was separated by a raised concrete median. There was a covered bus shelter on the south side of the roadway. It was dark at the time of the crash and the streetlights were on. The posted speed limit was 56 km/h (35 mph).

Figure 2. Eastbound approach for 2007 Dodge Charger

Pre Crash

The Dodge Charger was traveling eastbound in the outboard lane (**Figure 2**) at a police reported speed of 113 km/h (70 mph). The Ontario bus was being driven by a 41-year-old male (**Figure 3**). The driver of the bus had brought the vehicle to a controlled stop just west of the bus shelter in the outboard travel lane. The door of the bus was open and passengers were entering and exiting the bus. A total of 30 passengers were on the bus. The driver of the Charger applied the brakes prior to impact; there was no evidence of lockup.

Figure 3. Exemplar view of 2000 Ontario Orion V city bus

Crash

The front of the Dodge Charger struck the rear of the Ontario Orion bus (**Figure 4**). The impact was severe, and resulted in the deployment of the frontal air bag system in the Charger. The Barrier algorithm of the WinSmash program computed a total delta V of 51 km/h (31.6 mph), based on the Charger's front end crush profile. The Charger came to rest at approximately the same location as the impact.

Figure 4. Area of impact/final rest

Post Crash

The driver of the Dodge Charger sustained serious injuries. He was removed from the vehicle while unconscious and was transported to a trauma center where he was hospitalized for 16 days.

Eleven bus passengers were injured and transported from the scene.

The Dodge Charger was towed from the scene due to damage. It was later declared to be a total loss by the insurance company and was sold to a private party.

Vehicle Data - 2007 Dodge Charger

The 2007 Dodge Charger was identified by the Vehicle Identification Number (VIN): 2B3KA43R07xxxxxx. The date of manufacture was June 2007. The vehicle's odometer could not be read due to unknown reasons. The Dodge Charger was a 4-door, 5-passenger sedan that was equipped with a 3.3 liter, 6-cylinder engine, rear wheel drive, an automatic transmission, rack and pinion steering, and 4-wheel disc brakes. The Charger was equipped with Goodyear Integrity P215/65R17 tires. The vehicle manufacturer's recommended cold tire pressure was 207 kPa (30 psi) for the front and rear. The tire manufacturer's maximum tire pressure was 303 kPa (44 psi). The specific tire information was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Tire Flat	9 mm (11/32 in)	Yes	Tire debeaded
LR	Tire Flat	9 mm (11/32 in)	Yes	Tire cut
RR	Tire Flat	9 mm (11/32 in)	No	Unknown
RF	Tire Flat	9 mm (11/32 in)	No	Tire debeaded

The seating in the Charger was configured with front bucket seats with adjustable head restraints and a rear bench seat. The driver's seat was located between the middle and rear most track positions. The front right passenger seat was located at the rear most track position.

Vehicle Damage

Exterior Damage - 2007 Dodge Charger

The 2007 Dodge Charger sustained severe front end damage as a result of the impact with the bus (**Figure 5**). The direct damage extended from bumper corner to bumper corner. The direct damage width measured 144 cm (56.7 in). The Charger sustained substantial underrride damage. The hood deformed upward and rearward, and both fenders were deformed. The windshield was fractured and all four doors were jammed shut. The vehicle wheelbase was shortened by 19 cm (7.5 in) on the left and 15 cm (5.9 in) on the right. Both front tire rims were fractured and all four tires were flattened at the time of the vehicle inspection. Two sets of crush measurements were taken, one at the bumper level and one at the upper radiator support level. Per NASS protocol, the two crush profiles were averaged. The resultant crush measurements were documented as follows: C1 = 52 cm (20.5 in), C2 = 54 cm (21.2 in), C3 = 59 cm (23.2 in), C4 = 62 cm (24.4 in), C5 = 61 cm (24.0 in), C6 = 56 cm (22.0 in). The Collision Deformation Classification (CDC) for the impact with the bus was 12FDEW3.

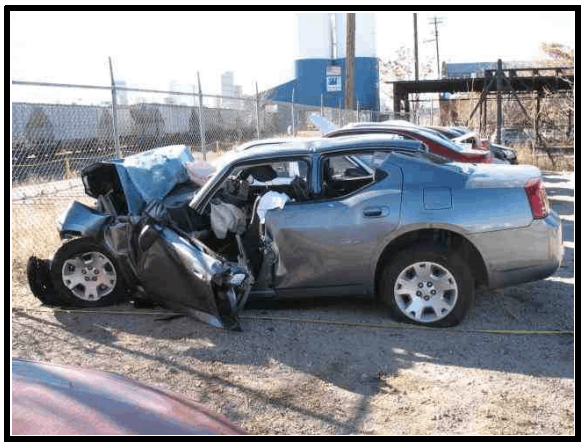

Figure 5. Lateral view of frontal crush

Interior Damage - 2007 Dodge Charger

The 2007 Dodge Charger sustained moderate interior damage as a result of passenger compartment intrusion and occupant contacts. The toe pan, instrument panel, steering assembly, and seat backs intruded longitudinally. The floor pan intruded vertically.

The left lower instrument panel exhibited scuffing and deformation from the driver's knees and lower legs (**Figure 6**). The steering wheel rim was deformed and fully collapsed with 10 cm (3.9 in) of forward movement. Blood was located on the driver's air bag. The driver's seat back was deformed and there was also deformation of the brake pedal.

Figure 6. View of lower instrument panel contacts/damage

The specific passenger compartment intrusions were documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
Front row left	Toe pan	22 cm (8.7 in)	Longitudinal
Front row left	Instrument panel	10 cm (3.9 in)	Longitudinal
Front row left	Brake pedal	11 cm (4.3 in)	Longitudinal
Front row left	Steering assembly	9 cm (3.5 in)	Longitudinal
Front row middle	Instrument panel	4 cm (1.6 in)	Longitudinal
Front row right	Toe pan	19 cm (7.5 in)	Longitudinal
Front row right	Floor pan	14 cm (5.5 in)	Vertical
Front row right	Instrument panel	9 cm (3.5 in)	Longitudinal
Second row left	Second seat back	10 cm (3.9 in)	Longitudinal
Second row middle	Second seat back	17 cm (6.7 in)	Longitudinal
Second row right	Second seat back	14 cm (5.5 in)	Longitudinal

Manual Restraints - 2007 Dodge Charger

The 2007 Dodge Charger was equipped with 3-point manual lap and shoulder belts for each seating position. Both front seat safety belts were equipped with retractor pretensioners. The adjustable D-ring for the driver's belt was in the full up position; the D-ring for the front right passenger belt was in the mid position. The driver's safety belt was configured with a sliding latch plate and an Emergency Locking Retractor (ELR). It is not known if either retractor pretensioner actuated. The webbing for the driver's belt had been cut (presumably by rescue personnel) and the latch was still in the buckle at the time of the vehicle inspection. Post-crash, the webbing had been used to tie the left door closed.

Supplemental Restraint System - 2007 Dodge Charger

The 2007 Dodge Charger was equipped with dual-stage frontal air bags and safety belt retractor pretensioners for the driver and front right passenger positions. Both frontal air bags deployed as a result of the longitudinal deceleration of the Charger during the impact with the bus (**Figures 7-8**). Based on the information found in the EDS, it was not known if either pretensioner actuated.

Figure 7. Deployed driver's air bag

The supplemental restraint system consisted of the following:

- Air bag Control Module (ACM),
- Air bag warning light,
- Driver and front right passenger air bags,
- Front acceleration sensors,
- Driver and front passenger seat belt pretensioners.

Figure 8. Deployed front right passenger air bag

The ACM is designed to inflate the frontal air bags if the collision meets the deployment threshold. The front airbag inflators are designed to provide different levels of air bag inflation speeds based on the collision severity. The ACM also monitors the readiness of the system whenever the ignition switch is in the START or ON positions. The ACM also operates the Air bag Warning Light in the instrument panel for 6 to 8 seconds as a self-check when the ignition is first engaged. After the self-check, the air bag warning light will turn off. If the ACM detects a malfunction in any part of the system, it illuminates the air bag warning light. A single chime will sound if the light comes on again after initial start up.

The vehicle was designed with an Occupant Classification System (OCS). The OCS includes the Occupant Classification Module (OCM) and a seat weight sensor. The system was designed to internally disable the passenger air bag and seat belt pretensioner deployment circuits if the OCM detects that the passenger front seat is unoccupied or that it is occupied by a load that is inappropriate for an air bag deployment.

The driver's air bag deployed from the center of the steering wheel hub through H-configuration module cover flaps (**Figure 7**). There were patches of blood found on the right upper quadrant of the air bag face. There were no reports of any damage to the air bag or the air bag module flaps.

The front right passenger's air bag deployed from a top mount module with a rectangular cover flap (**Figure 8**). Based on the system configuration and the absence of a passenger in the front row right

seat, the passenger air bag was not designed to deploy. There were no reports of any damage or occupant contact to the air bag or the air bag module flap.

Searches were conducted to determine if the Charger had been involved in any previous crashes in which there may have been a previous deployment, but no reports were located

OCCUPANT DEMOGRAPHICS - 2007 Dodge Charger

	Driver
Age/Sex:	24/Male
Seated Position:	Front left
Seat Type:	Bucket
Height:	183 cm (72 in)
Weight:	91 kg (200 lbs)
Alcohol/Drug Involvement:	None
Body Posture:	Upright
Hand Position:	Unknown
Foot Position:	Driver braking, unknown foot position
Restraint Usage:	Lap and shoulder belt used
Air bag:	Driver's air bag deployed

OCCUPANT KINEMATICS

Driver Kinematics

The 24-year-old male driver was seated in an upright posture and was restrained by the 3-point manual lap and shoulder belt. The seat was positioned between the middle and rear most track positions. The driver was braking just prior to impact. At impact, the frontal air bags deployed. It is not known if the pretensioner actuated. The driver initiated a forward trajectory. He loaded the safety belt and engaged the deployed driver's air bag. His lower legs engaged the steering column and lower instrument panel, causing tibia, fibula, and patella fractures. The driver engaged and loaded the steering wheel rim, causing ulna and radius fractures, internal injuries, facial injuries, and a concussive head injury (**Figure 9**). He was transported from the scene to a local trauma center. He arrived at the hospital with a Glasgow Coma Score (GCS) of 14. He was admitted and hospitalized for 16 days.

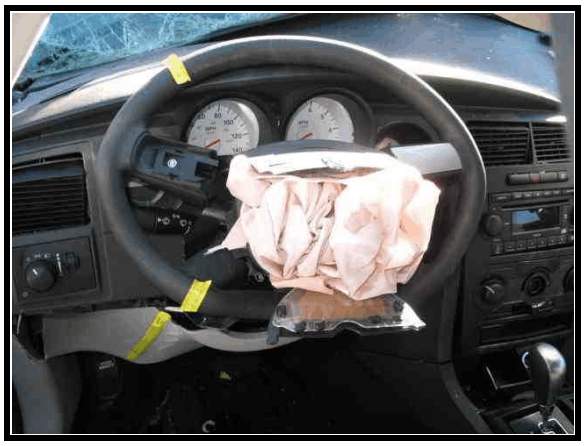

Figure 9. Steering wheel rim loading

OCCUPANT INJURIES - 2007 Dodge Charger

Driver: Injuries obtained from post-ER medical records.

Injury	AIS Code	Injury Mechanism	Confidence Level
Tibia fracture, right	853408.3,1	Steering column	Certain
Patella fracture, open, right	852400.2,1	Steering column	Certain
Tibia fracture shaft, Grade 3, right	853422.3,1	Steering column	Certain
Fibula fracture, displaced/comminuted, right	851606.2,1	Steering column	Certain
Tibia fracture shaft, displaced/comminuted, right	853420.2,1	Foot controls	Certain
Tibia fracture shaft, displaced, left	853422.3,2	Left lower instrument panel	Certain

Fibula fracture, displaced, left	851606.2,2	Left lower instrument panel	Certain
Radius fracture, displaced/comminuted, left	752804.3,2	Steering wheel rim	Certain
Ulna stylus fracture, 100% displaced, left	753204.3,2	Steering wheel rim	Certain
Maxilla fracture, left	250800.2,2	Steering wheel rim	Certain
Colon laceration , no perforation (OIS Grade I or II)	540822.2,8	Steering wheel rim	Certain
Mesentery laceration	542020.2,8	Steering wheel rim	Certain
Concussion with length of unconsciousness < 1 hour	160202.2,0	Steering wheel rim	Certain
Facial laceration, left cheek	290602.1,2	Steering wheel rim	Certain
Eyelid contusion, left	297402.1,2	Steering wheel rim	Certain
Facial contusion, chin	290402.1,8	Steering wheel rim	Certain
Left shoulder contusion	790402.1,2	Seat belt webbing	Certain
Left hip abrasion	890202.1,2[1]	Seat belt webbing	Probable
Left hip contusion	890402.1,2[1]	Seat belt webbing	Probable
Abdominal abrasion	590202.1,8	Steering wheel rim	Certain
Abdominal contusion	590402.1,8	Steering wheel rim	Certain

[1]SCI change

Attachment 1. Scene Diagram