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REMOTE AIR BAG DEPLOYMENT REPORT

CASE NUMBER - IN99-085
LOCATION - MISSOURI
VEHICLE - 1998 DODGE DURANGO
CRASH DATE - June, 1998

Submitted:

December 23, 1999

Contract Number: DTNH22-94-D-17058

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

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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.

Technical Report Documentation Page

1. *Report No.* IN99-085	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* Remote Air Bag Deployment Report Vehicle - 1998 Dodge Durango Location - Missouri		5. *Report Date:* December 23, 1999 6. *Performing Organization Code*	
7. *Author(s)* Special Crash Investigations Team #2		8. *Performing Organization Report No.* Task # 0208	
9. *Performing Organization Name and Address* Transportation Research Center Indiana University 222 West Second Street Bloomington, Indiana 47403-1599		10. *Work Unit No. (TRAIS)* 11. *Contract or Grant No.* DTNH22-94-D-17058	
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation (NRD-32) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003		13. *Type of Report and Period Covered* Technical Report Crash Date: June, 1998 14. *Sponsoring Agency Code*	

15. *Supplementary Notes*
Remote air bag deployment investigation involving a 1998 Dodge Durango sport utility, with manual three-point safety belts and dual redesigned front air bags, and a 1996 Freightliner truck-tractor with trailer

16. *Abstract*

This report covers a remote investigation of an air bag deployment crash that involved a 1998 Dodge Durango, 4x4 sport utility vehicle (case vehicle, vehicle #2) and 1996 Freightliner, 6x4 truck tractor with a semi-trailer (vehicle #1). This crash is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of the crash events and the vehicle's restrained driver (47-year-old female, White, non-Hispanic) sustained fatal injuries from underriding vehicle #1's trailing unit. The case vehicle was traveling south in the southbound lane on a two-lane undivided U.S. route and was entering a curve left. Vehicle #1 was traveling north in the northbound lane on the same roadway, entering a curve right. The roadway was wet and the driver of vehicle #1 was traveling at excessive speed. Vehicle #1's trailer began to slide sideways into the southbound lane, eventually blocking the entire southbound lane and adjacent shoulder. The case vehicle driver steered right onto the southbound shoulder and braked attempting to avoid the crash. The crash occurred on the southbound shoulder. The front left of the case vehicle impacted and underrode the left side of vehicle #1's trailer, causing the case vehicle's driver and front right passenger air bags to deploy. The case vehicle traveled almost completely under vehicle #1's trailer contacting the right main spring and brake actuator. The case vehicle was subsequently dragged back northbound while underneath vehicle #1's trailing unit approximately 76 meters (250 feet) to final rest. The case vehicle driver sustained, according to her certificate of death, fatal cervical and head injuries. The case vehicle's front right passenger (12-year-old female, race/ethnicity unknown) was restrained by her available, active, three-point, lap-and-shoulder belt. She sustained, according to the police report, serious injuries including head trauma, head laceration, and an unknown lung injury. The case vehicle's right rear passenger (14-year-old male, race/ethnicity unknown) was restrained by his available, active, three-point, lap-and-shoulder belt. He sustained, according to the police report, moderate injuries including a fractured left clavicle, left arm laceration, and a sprained left ankle.

17. *Key Words* Redesigned Air Bag Deployment Motor Vehicle Traffic Crash Injury Severity		18. *Distribution Statement* General Public	
19 *Security Classif. (of this report)* Unclassified	20. *Security Classif. (of this page)* Unclassified	21. *No. of Pages* 6	22. *Price* $2,500

Form DOT 1700.7 (8-72) Reproduction of completed page authorized

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Additional photographs are available in SCI EDCS case IN99-085

BACKGROUND

This case was brought to the NHTSA's attention by a review of the 1998 Fatality Analysis Reporting System (FARS) in July, 1999. This crash involved a 1998 Dodge Durango 4x4 sport utility vehicle (case vehicle, vehicle #2) and a 1996 Freightliner 6x4 truck tractor with a semi-trailer (vehicle #1). The crash occurred in June, 1998, at 9:20 p.m., in Missouri and was investigated by the applicable state highway patrol. This crash is of special interest because case vehicle was equipped with redesigned air bags and the restrained driver (47-year-old female, White, non-Hispanic) sustained fatal head and neck injuries. The Police Crash Report was received in August, 1999, police photographs in October, 1999, and the death certificate in November, 1999. This report is based on the Police Crash Report and reconstruction report, police photographs, the police summary of the occupants' injuries, the driver's death certificate, occupant kinematic principles, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling south in the southbound lane of a two-lane, undivided, U.S. route and was approaching a curve left. Vehicle #1 was traveling north in northbound lane of the same roadway and was negotiating a curve right. The roadway was wet and the driver of vehicle #1 was traveling at excessive speed based on the roadway conditions (i.e., rate of curve and wet conditions). Vehicle #1's trailing unit began to slide across the centerline into the southbound lanes, eventually blocking the entire southbound lane and shoulder. The case vehicle's driver steered to the right and braked, attempting to avoid the crash. The crash occurred in the southbound shoulder of the roadway (**Figure 1**).

Figure 1: View looking south along southbound shoulder, just north of POI; NOTE: Gouges (case photo #04)

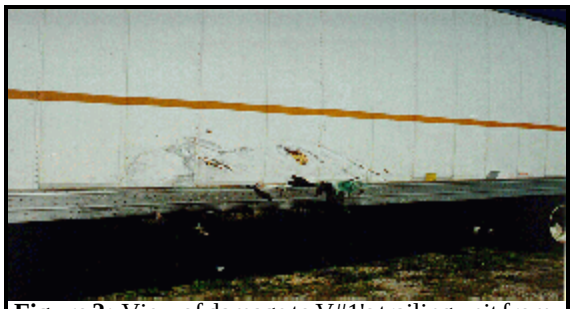

Figure 2: View of damage to V#1's trailing unit from overriding case vehicle (case photo #17)

Figure 3: Front left view of case vehicle, after extrication of the occupants (case photo #06)

The front left of the case vehicle was impacted by and subsequently underrode the left side of vehicle #1's trailer (**Figures 2** and **3**), causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. Vehicle #1's trailing unit passed almost entirely over the case

vehicle causing the case vehicle to rotate counter-clockwise and dragging it back northward approximately 76 meters (250 feet) while it was under the trailer (note, complete reversal of the case vehicle's motion). As the two vehicles traveled to final rest, the left side of vehicle #1's trailing unit struck a road sign (unknown type). At final rest the case vehicle was still under vehicle #1's trailing unit heading in a westerly direction. Vehicle #1 came to rest heading in a northerly direction in the southbound lane. The case vehicle driver was declared dead at the scene and taken directly to a funeral home. The case vehicle was towed due to damage. Vehicle #1's trailer was towed due to damage, while the power unit was driven. The crash severity for the case vehicle was high [greater than 40 km.p.h. (25 m.p.h.)].

CASE VEHICLE

The case vehicle was a four wheel drive 1998 Dodge Durango, five-passenger, four-door, sport utility vehicle (VIN: 1B4HS28Z5WF------) equipped with a 5.9 liter V-8 engine and a four-speed automatic transmission, with floor mounted selector lever. Four-wheel anti-lock brakes were an option for this model vehicle, but it is not known if the case vehicle was so equipped. The case vehicle's recorded mileage is unknown.

Figure 4: Left side of case vehicle after extrication; NOTE: inward deformation (case photo #07)

Figure 5: Right side of case vehicle after extrication; NOTE: outward deformation (case photo #12)

Figure 6: Angle view from front right of case vehicle; NOTE: V#1's brake actuator cover embedded into fender and right side components deformed outward (case photo #14)

The case vehicle steered to the right and braked trying to avoid the trailer. The impact with vehicle #1's trailer resulted in the case vehicle going completely under the trailer bed prior to being dragged while underneath for approximately 76 meters (250 feet). The case vehicle's entire roof and green house area were crushed downward on top of the seat backs **(Figures 4-5)**. The roof was cut and peeled off the case vehicle in order to extricate the injured occupants. Direct contact with vehicle #1's trailer extended across the entire front bumper and top of the case vehicle. The case vehicle's front end above the bumper contacted the right leaf spring and brake actuator of the trailer, probably preventing the vehicle from going completely under and out the other side of vehicle #1's trailing unit. Vehicle #1's brake actuator cover was embedded into the case vehicle's right front fender **(Figure 6)**. As the case vehicle rotated clockwise under the trailer, the tops of the case vehicle's left side doors were also crushed inward and down. The left back side of the case vehicle was also crushed inward and flattened with all four tires being aired out as well. The case vehicle's right side was shifted outward. The vehicle's

instrument panel was also compressed downward. The CDC, estimated from police photographs is **11-FDHA-9** [principal direction of force of 330 (-30) degrees]. Because of the severe underride and vehicle #1 being out of scope, the WinSMASH reconstruction algorithm could not be executed. The crash severity for the case vehicle was high [greater than 40 km.p.h. (25 m.p.h.)]. The case vehicle was towed due to damage.

CASE VEHICLE DRIVER

The case vehicle's driver (47-year-old female, White, non-Hispanic, unknown height and weight) was restrained by her available, active, three-point, lap-and-shoulder safety belt. Her seat adjustments and posture are not known. She was declared dead at the scene and was transported directly to a funeral home. The following discussion of the case vehicle driver's movements during the crash is based on the police reconstructionist's summary of her injuries, her death certificate and the principles of occupant kinematics.

The case vehicle's driver steered to the right and braked. As a result of these attempted avoidance maneuvers, she most likely moved slightly forward and to her left prior to impact. The case vehicle's impact with V#1's trailing unit resulted in the case vehicle's driver continuing forward and leftward. The impact also caused the driver's safety belt retractor to lock, but this did not prevent her from impacting the windshield, steering assembly, instrument panel, left A-pillar, left side and roof components as they intruded toward her. The impact with the side and undercarriage of the trailer resulted in the air bag deploying late during the duration of the impact. This late deployment occurred due to the prolonged change in time relative to the change in speed (i.e., ramp versus spike). This delay had no effect on the driver because of the severity of intrusion. As the case vehicle came to an abrupt stop upon hitting the leaf spring on the trailer's right side, the driver was probably already pinned to her seat back by the intruding roof. The subsequent reversal in direction (being dragged back northward) probably had little affect on the driver's movements or injuries.

CASE VEHICLE DRIVER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	"Head injuries" (Blunt head trauma, NFS)	115099.7 unknown	Windshield and left A-pillar	possible	Coroner
2	"Chest injuries" (Blunt chest injury, NFS)	415099.7 unknown	Steering wheel	possible	Police
3	"Left arm injuries" (Upper extremity injury, NFS)	715009.7 unknown	unknown	unknown	Police
4	"Cervical Fracture" (No other information)	not codeable	roof/indirect	possible	Coroner

The case vehicle's front right passenger (12-year-old female, unknown race/ethnicity, unknown height/weight) was restrained by her available, active, three-point, lap-and-shoulder safety belt. Her seat adjustments and posture are not known. She was transported directly to a hospital. The following discussion of the front right passenger's movements during the crash is based on the police reconstructionist's summary of her injuries and the principles of occupant kinematics.

The case vehicle's driver steered to the right and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and regardless of the use of her available safety belts, the case vehicle's front right passenger most likely moved slightly forward and to her left just prior to impact. The case vehicle's impact with the trailing unit resulted in her continuing forward and leftward as the case vehicle decelerated. The impact also caused the front right passenger's safety belt retractor to lock, which prevented her from moving further forward and leftward. The impact with the side and undercarriage of the trailer resulted in the air bag deploying late during the duration of the impact. This late deployment occurred due to the prolonged change in time relative to the change in speed (i.e., ramp versus spike). This delay had no effect on this passenger. The left front-to-right rear sweeping motion of the underride may have resulted in the roof contacting the front right seat's integral head restraint, causing the seat to collapse rearward such that the front right passenger did not sustain the intrusion-related contacts suffered by the driver. As the case vehicle came to an abrupt stop upon hitting the leaf spring on the trailer's right side, the front right passenger was probably laid back against her collapsed seat back. The subsequent change in direction (being dragged back northward) had little affect on her movement. At final rest the front right passenger was probably pinned against her seat back by the intruding roof.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Head injury, NFS	115099.7 unknown	Roof	Probable	Police
2	Head laceration, NSF	190600.1 minor	Roof	Probable	Police
3	Lung injury, NSF	441499.3 serious	Unknown	Unknown	Police

CASE VEHICLE REAR RIGHT PASSENGER

The case vehicle's right rear passenger (14-year-old male, unknown race/ethnicity, unknown height/weight) was restrained by his available, active, three-point, lap-and-shoulder safety belt. His seat adjustments and posture are not known. He sustained moderate injuries and was transported by ambulance to a hospital. The following discussion of the right rear passenger's movements during the crash is based on the police reconstructionist's summary of his injuries and the principles of occupant

kinematics.

The case vehicle's driver steered to the right and braked, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and regardless of the use of his available safety belts, the case vehicle's rear right passenger most likely moved slightly forward and to his left just prior to impact. The case vehicle's impact with the trailing unit resulted in him continuing forward and leftward as the case vehicle decelerated. The impact also caused the right rear passenger's safety belt retractor to lock, preventing him from moving further forward and leftward. The left front-to-right rear sweeping motion of the underride caused the front right seat back seat to collapse rearward as the rear right seat back also collapsed, possibly resulting in the rear right passenger being laid back with the front seat back over him, and thereby creating a relatively protected situation. As the case vehicle came to an abrupt stop upon hitting the leaf spring on the trailer's right side, the front right passenger was probably laid back in his seat. The change in direction (being dragged back northward) had little affect on his movement.

CASE VEHICLE RIGHT REAR PASSENGER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Left clavicle fracture	752200.2 moderate	Roof	Possible	Police
2	Left arm laceration	790600.1 moderate	Roof	Possible	Police
3	Left ankle sprain	850206.1 minor	Floor	Probable	Police

VEHICLE NUMBER 1

Vehicle #1 was a Freightliner 6x4 cab-behind-engine truck tractor, model USF-1E (VIN: 1FUYDSEB0TL------) pulling a Great Dane 48-foot refrigerated van semi-trailer (VIN: 1GRAA9627NB------). The power unit's wheelbase was 285 centimeters (112 inches). The vehicle was equipped with a Fuller RTX-1571C, 10-speed transmission and a 3.3 liter,V6 Diesel engine. Braking was achieved using a dual hydraulic, self adjusting front disk and rear drum system. The interior equipment is unknown. The vehicle's odometer reading is unknown.

Figure 7: View of struck side of vehicle #1 (contacted area highlighted); NOTE: forward left wheel and tire off trailer (case photo #16)

The case vehicle's impact with the left side of vehicle #1's trailer caused damage to the left wall of the trailer (**Figure 7**, above), the frame, right leaf spring and brake actuator, and the forward axle, including left and right forward tandem wheels and tires (**Figures 8 & 9**). The right side wall of the trailer sustained induced damage and was bowed outward.

Figure 8: Close-up of vehicle #1 trailer's right brake actuator cover embedded into the case vehicle's right front fender (case photo #15)

Figure 9: Close-up of vehicle #1 trailer's undercarriage showing struck right main spring and brake actuator (case photo #19)