INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER

School of Public and Environmental Affairs
222West Second Street
Bloomington, Indiana 47403-1501
(812) 855-3908 Fax: (812) 855-3537

REMOTE AIR BAG DEPLOYMENT REPORT

CASE NUMBER - IN99-028
LOCATION - Ohio
VEHICLE - 1998 PLYMOUTH NEON
CRASH DATE - May 1998

Submitted:

September 15, 1999

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Contract Number: DTNH22-94-D-17058

Prepared for:

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National Center for Statistics and Analysis
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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

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Remote air bag deployment investigation involving a 1998 Plymouth Neon, with manual safety belts and dual redesigned front air bags, a 1977 Chevrolet pickup, a 1993 Ford Probe, and a parked vehicle

16. *Abstract*

This report covers a remote investigation of an air bag deployment crash that involved a 1998 Plymouth Neon (case vehicle), a 1977 Chevrolet pickup (1st Other Vehicle), a 1993 Ford Probe (2nd Other Vehicle), and a parked and unoccupied passenger vehicle. This crash is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of crash events. The unrestrained case vehicle driver (75-year-old male) was fatally injured as a result of contacting his air bag and steering assembly. The case vehicle was traveling west in the westbound lane of a two-lane, undivided, city street. Both the Chevrolet and the Ford were traveling east in the eastbound lane of the same roadway. The unoccupied and parked vehicle was located along the south curb, facing east. The case vehicle began passing a non-contact westbound vehicle, when its left side impacted the left side of the eastbound Chevrolet, likely causing the case vehicle's driver and front right passenger air bags to deploy. The Chevrolet was redirected across the westbound travel lane, jumped the north curb, and came to rest across the north sidewalk, facing north. The case vehicle continued west in the eastbound lane, impacting the Ford head-on. The case vehicle was deflected counterclockwise towards the south curb and came to rest with its front left bumper against the concrete curb, heading southwest. The Ford was deflected clockwise and its right side contacted the parked vehicle's front left corner. The Ford came to rest heading southeast and the parked vehicle remained in its position parallel to the south curb line. The crash severity for the case vehicle's second (most severe) impact was high [greater than 40 km.p.h. (25 m.p.h.)]. The case vehicle driver contacted his air bag and steering wheel and sustained a completely transected aorta, lacerated lungs with bilateral hemothoraces, bilateral rib fractures, a ruptured left hemidiaphragm, and liver lacerations. Right windshield contact resulted in a thoracic spine fracture at T5 with compression injury to the cord. Left tibia and fibula fractures resulted from knee bolster contact

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BACKGROUND

IN99-028

This case was brought to the NHTSA's attention by a review of the 1998 Fatality Analysis Reporting System (FARS) in February 1999. The crash involved a 1998 Plymouth Neon (case vehicle), a 1977 Chevrolet pickup truck (1st Other Vehicle), a 1993 Ford Probe (2nd Other Vehicle), and a parked and unoccupied passenger vehicle. The crash occurred in May 1998, at 11:10 a.m., in Ohio, and was investigated by the applicable municipal police department. This case is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of collision events. The unrestrained driver (75-year-old male) was fatally injured, with the most severe injuries being a completely transected aorta, lacerated lungs with bilateral hemothoraces, bilateral rib fractures with bilateral intercostal lacerations, a subarachnoid hemorrhage at the right cerebral hemisphere, a thoracic spine fracture at T_5 with compression injury to the cord, a ruptured left hemidiaphragm, liver lacerations, and fractures to the left fibula and tibia. The Police Crash Report was received in March 1999. The complete autopsy and police photographs were received in August. This report is based on the Police Crash Report, the autopsy report, police photographs, occupant kinematic principles, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling west in the westbound lane of a two-lane, undivided, city street and intended to continue westward. Initially, there was a non-contact vehicle traveling westbound ahead of the case vehicle. Both the Chevrolet and Ford were traveling east in the eastbound lane of the same two-lane, undivided, city street and intended to continue eastward (**Figure 1**). The parked vehicle was unoccupied and parked along the south curb line, facing east. It was daylight and there was no adverse weather. The street was asphalt, dry, straight, level, and each side had a concrete curb line that varied in height [from police photographs there seemed to be areas where the curbs were at least 10-centimeter (four-inch) barrier curbs]. The posted speed limit was 56 km.p.h. (35 m.p.h.). There was a four-leg, cross intersection east of the first impact. The only traffic control devices present were hanging, vertical traffic control signals (two per intersection leg) and a single broken yellow centerline with a single solid yellow no passing line [for eastbound traffic, extending approximately 30 meters (100 feet) west of the intersection]. The control devices were clearly visible and functioning correctly. Of the five vehicles (including the non-contact vehicle) involved in this three-impact crash, there is only a slight inference on the police diagram that the Ford may have steered right (south) to avoid impact #2. All three impacts took place in the eastbound lane.

Figure 1: Eastbound view of crash scene; Note: case vehicle is white car at center right, the Chevrolet is on the tilt-bed wrecker at top right-center, and the Ford's left rear corner is visible at the bottom right (case photo #02)

For some unknown reason, the case vehicle began passing a non-contact, westbound vehicle. The police report does not indicate if the non-contact vehicle had made a left-hand turn from the intersection's south leg, a right-hand turn from the north leg, or was continuing westbound straight across the intersection.

Figure 2: Southeast view of final rest positions of the case vehicle (top visible at top left), the Ford (center-left), and the parked vehicle (center-right) (case photo #12)

Similarly, it is not known if the non-contact vehicle was starting from a stop, was slow-moving, or if the case vehicle was traveling so fast that an attempted pass was necessary to avoid a rear-end collision. Knowing which of these scenarios was correct might indicate that the left-of-center movement may have been, in fact, a successful crash avoidance maneuver by the case vehicle in evading an impact with the non-contact vehicle, rather than a passing attempt. Nevertheless, the left side of the case vehicle impacted the left side of the Chevrolet (separating the Chevrolet's left front wheel and tire from the axle), likely causing the case vehicle's driver and front right passenger air bags to deploy. The Chevrolet was redirected into a counterclockwise, post-impact travel path that crossed the westbound travel lane, jumped the north curb line, and came to rest across the north sidewalk, facing north. The case vehicle continued west in a slight counterclockwise curved travel path, impacting the Ford head-on. The case vehicle was deflected counterclockwise towards the south curb line and came to rest with its front left bumper corner against the concrete curb, facing southwest. The Ford was deflected clockwise and its right side contacted the parked vehicle's front left corner (**Figure 2**). The Ford came to rest facing southeast, with its front right corner approximately 1.1 meter (3.5 feet) from the south curb line. The parked vehicle remained in a parked position along the south curb line, facing east.

Case Vehicle

The case vehicle was a front wheel drive, 1998 Plymouth Neon, five-passenger, four-door sedan (VIN: 1P3ES47C9WD------), equipped with a 2.0 liter, I-4, gasoline engine. Although the front seat interior was cluttered with paper and the perspective of police photographs did not allow definitive analysis of components' existence, it was determined that the transmission for the case vehicle was most likely a three-speed automatic with the shift lever on the steering column's right side. Four-wheel anti-lock brakes were an option for this vehicle, but it is not known if the case vehicle was so equipped. The wheelbase for the case vehicle was 264 centimeters (104.0 inches). No odometer reading was reported. The case vehicle was towed from the scene due to disabling damage.

The case vehicle sustained direct contact from the crash sequence's first impact (left side contact) with the Chevrolet to the wrap-around portion of its front left bumper corner, the left front fender, the left front tire and wheel, the left upper A-pillar, the left front door, the left rear door, and the left rocker panel. The left side of the windshield was splintered due to the upper left A-pillar contact and the left side rearview mirror was torn off. Based on police photographs, the case vehicle's first (left side) CDC was estimated

to be **12-LYAW-2**. Impact #1 is not in scope for the WinSMASH reconstruction program. The case vehicle's photographically estimated crash severity for this first event was 14-23 km.p.h. (9-14 m.p.h.) and likely caused the case vehicle's driver and front right passenger air bags to deploy (see the discussion of the Chevrolet, below).

Figure 3: Case vehicle damaged planes, side damage on the left and head-on damage across frontal plane (case photo #03)

Additional direct contact damage was sustained by the case vehicle during the crash sequence's second impact (head-on) with the Ford (**Figure 3**). Damaged components included: the front bumper and fascia pushed rearward; the front grille shattered; the left and right headlamp assemblies shattered; the front radiator and engine compartment brackets shoved rearward; the front of the hood was overridden, buckled, and the right rear corner contacted the right upper A-pillar; and the right front fender was pushed rearward into the lower right A-pillar. The interior right side of the windshield was contacted by the driver's head. Induced damage included: the right front door buckled vertically in the middle and sprung open; the right roof rail buckled at the right B-pillar; the right rear door was sprung open; and the left side of the windshield was splintered. The CDC for the case vehicle's second impact (head-on), estimated from police photographs, is: **12-FDEW-2**, with a principal direction of force of 0 degrees. The WinSMASH reconstruction program was used to calculate Delta V based on a CDC-only estimated crush profile. These CDC-only calculations provide a borderline reconstruction, but the results appear to be reasonable. The case vehicle's estimated Total, Longitudinal, and Lateral Delta Vs are, respectively: 48 km.p.h. (30 m.p.h.), -48 km.p.h. (-30 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The crash severity for the case vehicle was high [greater than 40 km.p.h. (25 m.p.h.)].

Case Vehicle Driver

The case vehicle's driver [75-year-old male; White (unknown if Hispanic), 178 centimeters, 98 kilograms (70 inches, 215 pounds)] was not restrained by his available, manual, three-point, lap and shoulder safety belt system. His pre-crash seat adjustments, steering wheel position, and posture are not known. He was declared dead at the crash scene. He was the only occupant in the case vehicle. The following discussion of the case vehicle driver's injuries is based on a complete autopsy report, on-scene police photographs, and occupant kinematic principles.

The case vehicle's driver was probably seated in a normal driving posture with his back against the seat back, at least one hand on the steering wheel, and his feet on a foot control or the floor. Shortly after going through a signalized, four-leg intersection, the case vehicle began passing a non-contact vehicle for some unknown reason. This maneuver caused the case vehicle's travel path to veer left-of-center into the opposing eastbound lane. The left, then right, steering maneuvers required to pass the non-contact vehicle would have caused the case vehicle's unrestrained driver to, first, move slightly to the right, then, slightly back to the left. The case vehicle had just straightened from its left-of-center move when it impacted with the Chevrolet in a left side to left side collision. It was estimated that this impact (the first of three in this

Figure 4: Case vehicle's deployed, dual, redesigned air bags (case photo #16)

crash sequence) had sufficient velocity change to meet the deployment threshold for the case vehicle's driver and front right passenger air bags. The driver would have moved slightly forward as the left sides of the two vehicles rubbed against each other and their respective left front tires and wheels came together (with the Chevrolet's tire and wheel separating from the vehicle). Contact with the air bag resulted in the case vehicle's driver sustaining abrasions to the neck and left lower arm and contusions to the right wrist, right thumb, right index finger, and left lower arm. After this first impact, the case vehicle's travel path was a counterclockwise, elliptical arc that allowed its wheel track to straddle the centerline, then return to the eastbound travel lane. This travel arc caused the driver to, first, lean left and, then, to lean right. Impact #2 of the crash sequence then occurred, involving a head-on collision between the case vehicle and the Ford. As the driver was already leaning slightly to his right, he struck both his deflated air bag and the steering wheel rim right-of center as his body moved forward (**Figure 4**). Contact with the steering wheel rim, hub, and/or spokes resulted in the following driver injuries: a complete transection of the aorta, lacerated lungs with bilateral hemothoraces, bilateral rib fractures with intercostal lacerations between the fifth and sixth ribs bilaterally, ruptured left hemidiaphragm, and lacerations to the liver. Contact with the left knee bolster resulted in the following case vehicle driver injuries: a fractured left fibula and tibia, a right knee contusion, and abrasions to the right knee and left knee. When the case vehicle began to rotate counterclockwise, the driver's leaning to the right was exacerbated and the lower right windshield and, perhaps, the right A-pillar were contacted and resulted in a subarachnoid hemorrhage of the right cerebral hemisphere and a thoracic spine fracture at T_5 with compression injury to the cord. The driver's post-impact position was laying diagonally, with his head atop the right instrument panel near the windshield/A-pillar seam and his feet extended between the front seat's bucket seats.

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.	Complete transection of the aorta at the isthmus, hemorrhage confined to the mediastinum	420216.5 critical	Steering wheel rim, hub and/or spokes	Probable	Autopsy
2.	Bilateral lung lacerations with 700 cc right and 1,000 cc left hemothorax	441456.5 critical	Steering wheel rim, hub and/or spokes	Probable	Autopsy
3.	Fractured ribs, left 5 - 9 and right 3 - 8	450240.4 severe	Steering wheel rim, hub and/or spokes	Probable	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
4.	Subarachnoid hemorrhage, base of right cerebral hemisphere	140684.3 serious	Windshield	Probable	Autopsy
5.	Fracture, vertebra T5, with compression injury of cord	640404.3 serious	Windshield	Possible	Autopsy
6.	Rupture, left hemidiaphragm	440604.3 serious	Steering wheel rim, hub and/or spokes	Probable	Autopsy
7.	Lacerations of the liver, both lobes, full-thickness on right	541824.3 serious	Steering wheel rim, hub and/or spokes	Probable	Autopsy
8.	Fracture, left fibula NFS	851605.2 moderate	Knee bolster	Probable	Autopsy
9.	Fracture, left tibia NFS	853404.2 moderate	Knee bolster	Probable	Autopsy
10.	Neck abrasion, right	390202.1 minor	Driver air bag	Probable	Autopsy
11.	Contusions, right knee	890402.1 minor	Knee bolster	Probable	Autopsy
12.	Abrasions, bilateral knees	890202.1 minor	Knee bolster	Probable	Autopsy
13.	Bruises, right forearm, wrist, thumb and fingers	790402.1 minor	Driver air bag	Possible	Autopsy
14.	Abrasion, left forearm	790202.1 minor	Driver air bag	Possible	Autopsy
15.	Intercostal lacerations associated with rib fractures, bilateral	490600.1 minor	Steering wheel rim, hub and/or spokes	Probable	Autopsy

1st Other Vehicle

The 1st Other Vehicle was a rear wheel drive, 1977 Chevrolet C10, 4x2, conventional 1/2-ton, pickup truck (VIN: CCU1477------), equipped with a V-8 gasoline engine and an unknown transmission type and selector lever location. The Chevrolet was not equipped with four-wheel anti-lock brakes. Its wheelbase was either 298 or 334 centimeters (117.5 or 131.5 inches). An odometer reading was not reported. The Chevrolet was towed from the scene due to disabling damage.

Figure 5: Chevrolet's left side damage from side impact with the case vehicle's left side; Note: missing left front tire and wheel (case photo #08)

From the collision with the case vehicle (event

#1 in the crash sequence), direct contact damage to the Chevrolet included: the wrap-around portion of the front left bumper corner scraped and the left third of the front bumper bent forward; the left side of the left headlamp assembly's chrome molding dented; the left front fender pushed back and scraped; the left front tire and wheel torn off; and the lower forward edge of the left door seam scraped (**Figure 5**). Based on available police photographs, the CDC for the Chevrolet is: **12-LYEW-2**. The WinSMASH reconstruction program was not run for this left side to left side impact. The Chevrolet was equipped with aftermarket cast aluminum recessed wheels. It appears that the left front wheel snagged against the case vehicle's left front tire and wheel and the Chevrolet's wheel broke off at the lug nuts, leaving the wheel's hub attached to the axle. The force required to cause such a break was likely sufficient to deploy the case vehicle's air bags. The Chevrolet's driver [27-year-old male; race, ethnicity, height, and weight unknown] did not have his restraint use reported. He was the only occupant in the Chevrolet. He sustained minor, visible injuries and was transported by ambulance to a medical facility.

2nd Other Vehicle

The 2nd Other Vehicle was a front-wheel drive, 1993 Ford Probe, four-passenger, two-door coupe (VIN: 1ZVCT20A1P5------), equipped with a 2.0 liter, I-4, gasoline engine and a five-speed, manual transmission with a console-mounted shift lever. An anti-lock brake system is an option for this vehicle, but it is not known if the Ford was so equipped. The Ford's wheelbase was 261 centimeters (102.9 inches). An odometer reading was not reported. The Ford was towed from the scene due to disabling damage.

Figure 6: Ford's frontal damage from head-on collision with the case vehicle; Note: this was the second of three crash sequence impacts (case photo #13)

From the collision with the case vehicle (impact #2 in the crash sequence), direct contact damage to the Ford included: the front bumper and fascia pushed rearward; the front grille shattered; both headlamp assemblies shattered; the right front turn signal assembly dangling by a wire and its lens broken; the left front and right front fenders pushed rearward; and the front of the hood pushed rearward, with the back two-thirds moderately tented (**Figure 6**). The bottom right corner of the windshield was splintered due to contact with the back right corner of the hood. Based on available police photographs, the CDC for the Ford's impact (the second of three in this crash sequence) with the case vehicle was: **12-FDEW-2**, with a principal direction of force of 0 degrees. The WinSMASH reconstruction program was used to calculate Delta V based on a CDC-only estimated crush profile. These CDC-only calculations provide a borderline reconstruction, but the results appear reasonable. The Ford's estimated Total, Longitudinal, and Lateral Delta Vs are, respectively: 48 km.p.h. (30 m.p.h.), -48 km.p.h. (-30 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.).

The Ford rotated clockwise after its first impact (event #2) and contacted the parked vehicle, parked on the south curb line and unoccupied (event #3). The Ford's estimated CDC for this impact (the third

of three for this crash sequence) is: **04-RYEW-2**. The Ford's driver [22-year-old female; race, ethnicity, height, and weight unknown] was wearing her available, manual, three-point, lap and shoulder safety belt system. She was the only occupant in the Ford. She sustained minor, visible injuries and was transported by ambulance to a medical facility.

Parked Vehicle

Recall that the parked vehicle was unoccupied. According to the Police Crash Report, the parked vehicle was a 1985 Lincoln Town Car. If that is correct, then it is a rear wheel drive, six-passenger, four-door sedan. No vehicle identification number (VIN) was provided on the police report. The parked vehicle did not contact the case vehicle. Direct contact damage to the parked vehicle was limited to the front left bumper corner, the front left bumper flashing, and the front of the left front fender (**Figure 7** above). An estimated CDC for the parked vehicle's impact (the third of three in this crash sequence) with the Ford was: **10-LFEE-1**.

Figure 7: Unoccupied and parked vehicle's front left corner damage from third of three crash sequence events (case photo #14)