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REMOTE AIR BAG DEPLOYMENT REPORT

CASE NUMBER - IN99-026

LOCATION - Maryland

VEHICLE - 1998 FORD MUSTANG

CRASH DATE - April 1998

Submitted:

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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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15. <i>Supplementary Notes</i> Remote air bag deployment investigation involving a 1998 Ford Mustang equipped with manual safety belts and dual redesigned frontal air bags, and a 1988 BMW 735i.					
16. <i>Abstract</i> This report covers a remote investigation of an air bag deployment crash that involved a 1998 Ford Mustang Coupe (case vehicle, vehicle #2) and a 1988 BMW 735i (vehicle #1). This crash is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of collision events. The case vehicle's restrained driver (16-year-old female) was killed and the restrained front right passenger (16-year-old female) sustained police-reported "A" (incapacitating) injuries. The case vehicle was traveling west in the westbound lane of a two-lane, undivided roadway, in an area where the roadway widens to four lanes to accommodate turning traffic at a Tee intersection. Vehicle #1 was traveling east in the eastbound lane of the same roadway. The case vehicle drifted left of center and the front of the case vehicle impacted the front left of vehicle #1 in the inside eastbound lane, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The crash severity for the case vehicle was high [greater than 40 km.p.h. (25 m.p.h.)]. It is not known if the case vehicle driver attempted any avoidance actions. The case vehicle's driver and front right passenger's pre-crash seat adjustments, steering wheel position, and postures are not known. The driver was wearing her available, active, three-point, lap and shoulder belt and sustained, according to her autopsy records, severe injuries which included: a hinge fracture through the petrous portions of the right and left temporal bones, subarachnoid hemorrhage over the surfaces of the cerebrum, an atlanto-occipital dislocation, and various minor injuries. She was transported by ambulance to a medical facility where her death was pronounced two hours and one minute after the crash occurred. The restrained front right passenger in the case vehicle sustained assorted abrasions and contusions and was transported by ambulance to a medical facility where she was treated and released. Three case vehicle second seat occupants were injured, transported to a medical facility, and admitted. Vehicle #1's driver-only air bag deployed, but the restrained driver was pronounced dead at the scene.					
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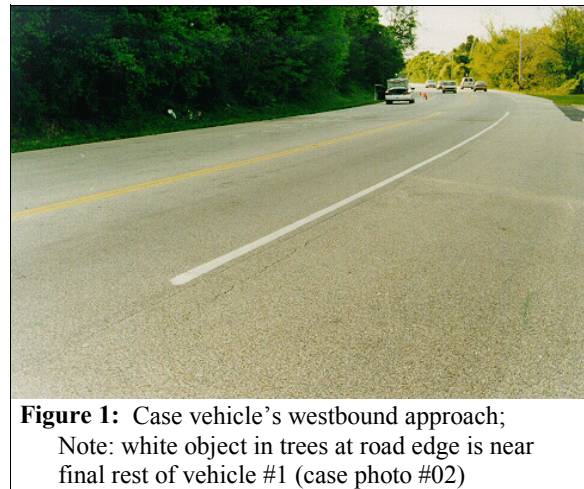
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This case was brought to the NHTSA's attention by a review of the 1998 Fatality Analysis Reporting System (FARS) in February 1999. This crash involved a 1998 Ford Mustang (case vehicle, vehicle #2) and a 1988 BMW 735i (vehicle #1). The crash occurred in April 1998, at 8:51 p.m., in Maryland, and was investigated by the applicable county 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 restrained driver (16-year-old female) was killed and the restrained front right passenger (16-year-old female) sustained police-reported "A" (incapacitating) injuries. The Police Crash Report was received in April 1999, the autopsy report in May, and the police photographs in June. 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 roadway and vehicle #1 was traveling east in the eastbound lane of the same roadway. The crash occurred near a Tee intersection where the roadway temporarily expands to include four lanes, to accommodate turning traffic (**Figure 1**). It was dark but lighted and raining. The bituminous roadway was level, wet and without defects, and curved left for westbound traffic. The posted speed limit for both travel directions was 80 km.p.h. (50 m.p.h.). Traffic controls consisted of a double solid yellow centerline, single solid white edge lines each side, a single solid white lane line for westbound traffic, a single solid white lane line that changed to a single broken white lane line for eastbound traffic. The case vehicle drifted across the centerline. It is not known if the case vehicle driver attempted any avoidance actions.



The crash occurred in the inside eastbound lane. The case vehicle's front (**Figure 2**) impacted the front left of vehicle #1, causing the case vehicle's driver and front right passenger air bags to deploy. The case vehicle rotated approximately 150 degrees counterclockwise and came to rest in the eastbound travel lane facing south. Vehicle #1 rotated approximately 90 degrees counterclockwise and came to rest off the south pavement edge, facing north-northeast.



The case vehicle was a rear wheel drive, 1998 Ford Mustang, four-passenger, two-door coupe (VIN: 1FAFP4044WF-----), equipped with a 3.8 liter, V-6, gasoline engine and a four-speed automatic transmission with the shift lever mounted in the console. Four-wheel anti-lock brakes were an option for this vehicle, but it is not known if the case vehicle was so equipped. The case vehicle's wheelbase was 257 centimeters (101.3 inches). No odometer reading was reported. The case vehicle was towed from the scene due to disabling damage.

The case vehicle sustained direct contact damage across the entire front end width. The front bumper fascia was torn off and the bumper itself was crushed rearward and to the left. The front frame was pushed back with the bumper. The grille and headlamp assemblies were shattered. The front engine compartment frame and brackets were shoved rearward. The radiator was pushed into the engine and the engine into the cowl. The hood was crushed into the lower windshield and hung by its right rear bracket, dangling over the side of the right front fender. The left front fender was crumpled rearward into the cowl. The front right fender was moved rearward, with its middle humped at the wheel well. The left front tire and wheel assembly was crushed back into the lower left A-pillar (**Figure 3**), causing the upper A-pillar and left roof rail to peak in an inverted "V" over the driver's seat. This caused the splintered windshield to be pulled upwards and created a top-to-bottom glazing separation near the right A-pillar. As well, the rearward crush of the left lower and upper A-pillars bent the left front door's forward edge inwards and sprung the door latch away from the left lower B-pillar, causing the door to come open. The left front door glazing was shattered (kernalized). The backlight glazing was also shattered, but this was probably due to extrication activities.

There was severe intrusion to the case vehicle's driver seat area. Intruding components included: the lower and upper portions of the left A-pillar, windshield, front left roof header, left side of instrument panel, toe pan and foot well, and the steering column and wheel (**Figure 4**). The driver's seat was tilted to the left (**Figure 3**), indicating deformation of the floor, and the seat cushion was deformed due to intrusion (**Figure 5**, below). The steering wheel was deformed and the area where the steering column joins the instrument panel was disturbed, suggesting substantial loading of the steering column.



Figure 3: Intruding components of case vehicle into driver space; Note: left front tire post-crash location at lower A-pillar (case photo #12)



Figure 4: Interior view of case vehicle; Note: damage to steering column and wheel rim (case photo #18)

The CDC for the case vehicle, estimated from police photographs, is **12-FDEW-5**, with principal direction of force 350 (-10) degrees. The WinSMASH reconstruction program, with CDC-only estimated crush profiles for both vehicles, was used to calculate Delta V for the case vehicle. These CDC-only results provide a borderline reconstruction, but the results appear reasonable. The Total, Longitudinal, and Lateral Delta Vs for the case vehicle are, respectively: 78 km.p.h. (48 m.p.h.), -77 km.p.h. (-48 m.p.h.), and 14 km.p.h. (9 m.p.h.).

CASE VEHICLE DRIVER

The case vehicle driver [16-year-old female; White (unknown if Hispanic), 155 centimeters, 69 kilograms (61 inches, 152 pounds)] was restrained by her available, active, three-point, lap and shoulder safety belt system. The driver's pre-crash seat adjustments, steering wheel position, and posture are not known. She was transported by ambulance to a medical facility where her death was pronounced two hours and one minute after the crash occurred. The following discussion of the driver's injuries is based on the autopsy report, on scene photographs, and occupant kinematic principles.

The case vehicle's driver was probably seated in a normal driving posture, with her back against the seat back, at least one hand on the steering wheel, and her feet either on the floor or a foot control (brake or accelerator pedal). There was no report of the case vehicle driver attempting any avoidance maneuver prior to the collision. This high-speed impact caused the case vehicle's driver and front right passenger air bags to deploy and the driver moved forward, upward, and slightly to the left, towards the 350 degree direction of principal force. As she was loading the safety belts and air bag, the windshield, front header, left side of the instrument panel and the left A-pillar were being shoved toward her, both rearward and inward. She sustained a chin abrasion and several chest abrasions when the air bag was contacted. The toe pan and foot well were pushed upward as the left front wheel assembly was crushed rearward against the lower left A-pillar, causing bilateral ankle abrasions. As the case vehicle began its counterclockwise rotation, the restrained driver rotated to the left and her head impacted the intruding left upper A-pillar. She sustained head and neck injuries, including a hinge fracture through the petrous portions of the right and the left temporal bones, subarachnoid hemorrhage over the surfaces of the cerebrum, atlanto-occipital dislocation and a contusion on the right side of her head.



Figure 5: Case vehicle's intruded driver seating area; Note: leading edge of seat (case photo #17)

In view of the case vehicle's high delta V (nearly 80 km.p.h. [50 m.p.h.]) and the heavy intrusion to the driver's seat area, including severe deformation of the steering assembly, left instrument panel, foot well and driver's seat (**Figure 5**), this contractor is of the opinion that the autopsy report is less than complete. There were no reported bone fractures below the head and no inspection of the spinal cord.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Basilar skull fracture: hinge fracture through the petrous portions of the right and left temporal bones	150206.4 severe	Left A-pillar	Possible	Autopsy
2.	Atlanto-occipital dislocation	650208.2	Left A-pillar	Possible	Autopsy
3.	Subarachoid hemorrhage, cerebrum NFS	140684.3	Left A-pillar	Possible	Autopsy
4.	Abrasion, chin	290202.1 minor	Driver's air bag	Probable	Autopsy
5.	Abrasions, upper-central chest	490202.1 minor	Driver's air bag	Probable	Autopsy
6.	Abrasions, bilateral ankles	890202.1 minor	Floor	Probable	Autopsy
7.	Contusion, right scalp	190402.1 minor	Left A-pillar	Possible	Autopsy

FRONT RIGHT PASSENGER

The case vehicle's front right passenger [16-year-old female; White (unknown if Hispanic), unknown height and weight] was restrained by her available, active, three-point, lap and shoulder belt system. Her pre-crash seat adjustment and posture are not known. Her body movements during impact and post-impact would have mirrored those of the driver. She was reportedly trapped in the vehicle. Once removed, she was transported from the scene in an ambulance to a medical facility where she was treated for assorted abrasions and contusions and released. Her injuries were assessed as disabling (incapacitating) by the investigating officer.

CASE VEHICLE REAR SEAT PASSENGERS

There were three passengers in the second seat row of the case vehicle. The two outboard passengers (9-year-old female and 16-year-old male) were restrained by their available, active, three-point, lap and shoulder belt system. Restraint use by the middle passenger (7-year-old male) is not known. All three were reportedly trapped in the vehicle. Once removed, all three were transported from the scene via ambulance to various medical facilities. All three were hospitalized for treatment. For all three, their injuries were assessed as disabling (incapacitating) by the investigating officer.

VEHICLE #1

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Vehicle #1 was a rear wheel drive, 1988 BMW 735i, five-passenger, four-door sedan (VIN: WBAGB4310J1-----), equipped with a 3.5 liter, I-6, gasoline engine and a four-speed automatic transmission with a console-mounted shift lever. Four-wheel anti-lock brakes were not an option for this vehicle. Wheelbase for vehicle #1 was 283 centimeters (111.5 inches). No odometer reading was reported. Vehicle #1 was towed from the scene due to disabling damage (**Figure 6**). Damage included: direct contact to the left side of the front bumper and fascia that pushed the left corner rearward and pulled the right corner forward; the grille and front headlamps were shattered; the left front of the hood was pushed at an angle to the middle of the engine compartment and its left rear edge raised to front header height; the windshield glazing was fractured, the left front fender and wheel assembly were shoved into the left lower A-pillar; the upper A-pillar was impacted above the belt line and moved to an almost vertical position; the forward third of the left front door was crushed inwards; and the left front door glazing was shattered (kernalized). The CDC for vehicle #1, estimated from police photographs, is **11-FYAW-7**, with principal direction of force 320 (-40) 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 estimated Total, Longitudinal, and Lateral Delta Vs for vehicle #1 are, respectively: 72 km.p.h. (45 m.p.h.), -62 km.p.h. (-38 m.p.h.), and 36 km.p.h. (22 m.p.h.).



Figure 6: Vehicle #1's front left damage (case photo #24)

Vehicle #1's driver [67-year-old male; White (unknown if Hispanic), height and weight unknown] was restrained by his available, active, three-point, lap and shoulder belt system. There was no other occupant in vehicle #1. The driver's pre-crash seat adjustments, steering wheel position, and posture are not known. He sustained police-report fatal injuries and was pronounced dead at the scene. He was entrapped and sustained extensive head, chest, and lower body injuries.