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CALSPAN REMOTE AIR BAG DEPLOYMENT INVESTIGATION CALSPAN CASE NO. 94-43 VEHICLE - 1994 FORD MUSTANG LOCATION - LOCATION - VA ACCIDENT DATE - 1994

Contract No. DTNH22-94-D-07058

Prepared for:

U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590

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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 are 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 STANDARD TITLE PAGE

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1. Report No. 94-43	2. Gov	vernment Accession No.	3	3. Recipient's Catalog N	<i>lo</i> .
4. Title and Subtitle Calspan Remote Air Bag Deployment Investigation Vehicle: 1994 Ford Mustang Location: VA			5	5. Report Date: Septem	ber, 1995
			6	6. Performing Organizat	tion Code
7. Author(s) Accident Research Group			8	3. Performing Organizat Report No.	ion
9. Performing Organization Name and Address Transportation Sciences Center Accident Research Group Division of Calspan Corporation			1	0. Work Unit No.	
			11. Contract or Grant No. DTNH22-94-D-07058		
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590			1	3. Type of Report and P Technical Report Crash Date:	Period Covered
			1	4. Sponsoring Agency C	iode .
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17. Key Words Remote investigation Head-on impact configuration Supplemental driver and passenger side air bags Air bag deployment Child occupant			18. Distribution Statement General Public		
19. Security Classif. (of this repo	rt)	20. Security Classif. (of this Unclassified	s page)	21. No. of Pages	22. Price

CALSPAN REMOTE AIR BAG DEPLOYMENT INVESTIGATION CALSPAN CASE NO. 94-43 VEHICLE: 1994 FORD MUSTANG

LOCATION VA

SUMMARY

This remote investigation focused on a two vehicle off-set, head-on crash that resulted in the deployment of the driver and passenger side air bag system in a 1994 Ford Mustang. The 4 year old male child occupant, who was seated in the right front position of the Ford Mustang, was not restrained by the available 3-point lap and shoulder belt system. He was displaced forward by the pre-impact braking of the vehicle and was subsequently impacted by the deploying passenger side air bag. Based on contact damage within the vehicle and occupant injury data, the child was probably initially contacted in the thoracic area by the air bag and accelerated into the windshield of the vehicle. The combination of air bag contact and windshield loading resulted in subluxation of C_2/C_3 with the absence of cerebral blood flow and brain swelling. He expired approximately 12 hours following the crash.

The crash occurred on a rural two lane asphalt roadway in 1994, during daylight hours. In the vicinity of the crash site, the asphalt road surface was straight with a slight grade, negative to the north. There were no pavement markers or improved shoulders adjacent to the travel lanes. The surface was dry and was posted with a 89 km/h (55 mph) speed limit.

The subject vehicle was a 1994 Ford Mustang, 2 dr. coupe, that was equipped with a Supplemental Restraint System which consisted of driver and passenger side air bags. In addition to the automatic restraint system, the Mustang was equipped with manual 3-point lap and shoulder belts in the four outboard seated positions. The vehicle was identified by vehicle identification number 1FALP4043RF (production number deleted) and had a reported odometer reading of 3,148 km (1,955 miles). The Mustang was occupied by the 28 year old make driver and his 4 year old son who was seated in the right front position of the vehicle. Although the driver stated that the child passenger was restrained by the manual belt system, contact evidence within the vehicle does not support belt usage.

The principal other vehicle (POV) involved in the crash was a 1990 Nissan 4 x 4 pickup truck. The vehicle was equipped with oversized tires that were mounted on wide alloy type wheels. The Nissan was identified by vehicle identification number 1N6SD11Y3LC and had a reported odometer reading of 106,904 km (66,400 miles). The driver of the Nissan pickup truck was a 20 year old male. He was reported as restrained by the vehicle's manual 3-point lap and shoulder belt system.

The Nissan pickup truck was traveling in a southerly direction on the rural two lane road at a police reported speed of 96.6 km/h (60 mph). The driver had negotiated a left curve and was ascending the grade when he initiated a lane change maneuver to overtake a slower moving southbound vehicle. The Ford Mustang was traveling in a northerly direction at a police reported speed of 80 km/h (50 mph). The driver of the Nissan apparently failed to detect the Mustang as he entered the northbound travel lane. The driver of the Mustang steered toward the right roadedge and braked in an attempt to avoid the encroaching pickup truck. The Virginia DMV Crash Team documented 12.7 m (41.6') of right front tire marks from the Mustang as it skidded in a near tracking mode off road where it impacted the Nissan pickup truck. The driver of the Nissan pickup truck braked with sufficient force to lock the wheels of his vehicle. The Nissan skidded in a locked four wheel skid pattern in a near tracking orientation in the northbound travel lane for a reported distance of 22.6 m (74'). The skid marks from the Nissan clearly indicate the vehicle was traveling in the northbound travel lane prior to avoidance action. As a result of pre-impact braking, the Ford Mustang underwent an equivalent velocity loss of 47.5 km/h (29.5 mph) while the Nissan underwent an equivalent velocity loss of 62.8 km/h (39.0 mph).

The vehicles impacted in a head-on, off-set configuration involving the left front corner areas. Resultant directions of force were 12 o'clock for both vehicles. Initial contact damage on the Mustang began on the front bumper outboard of the left headlamp and continued longitudinally onto the left front fender for a length of approximately 114.3 cm (45.0"). Residual bumper crush was estimated at 12.7-15.2 cm (5-6"). The Nissan pickup truck sustained approximately 20.3-25.4 cm (8-10") of front bumper crush from engagement with the front bumper and left front tire of the Mustang. In addition, the Nissan pickup truck sustained approximately 15.2-20.3 cm (6-8") of sheetmetal deformation at the corner of the left front fender. The Collision Damage Classification (CDC) for the Mustang and the pickup truck were 12-FLEE-4 and 12-FLEE-2 respectively. Due to the impact configuration which resulted in side engagement with the Mustang, the CRASH Program could not be utilized to compute velocity changes, therefore a velocity change was estimated at 16-20 km/h (10-12 mph). The impact induced deceleration was of sufficient magnitude to deploy the supplemental driver and passenger side air bag system.

The vehicles came to rest fully engaged at or near the point of impact. At rest, the Ford Mustang was straddling the right roadedge with the left side tires on the edge of the asphalt road surface and the right side tires resting in a shallow drainage ditch which paralleled the roadway. The Nissan pickup truck came to rest obstructing the northbound travel lane with its left side tires adjacent to the east roadedge. Both vehicles sustained disabling damage and were towed from the crash scene.

The driver of the Ford Mustang was a 28 year old male. It was unknown if he was restrained by the 3-point manual lap and shoulder belt system. At impact, he probably loaded the deployed driver's side air bag which prevented him from involvement with the steering assembly and/or the windshield. He was reported as not injured by the investigating police officer.

The right front occupant of the Ford Mustang was the driver's 4 year old son. His height and weight were estimated by the medical examiner at 111.8 cm (44.0") and 24.3 kg (54.0 lbs.). The

driver and the investigating police officer reported him as restrained, however, contact evidence within the vehicle indicated that the child was not restrained by the manual 3-point lap and shoulder belt system. Improper usage of the restraint system such as the child wearing the lap belt with the shoulder belt placed behind his back, would have prevented the child from contact with the windshield of the vehicle due to his size and the restraint of his pelvis region.

The child occupant was seated in an unknown posture in the right front position of the Ford Mustang. He was displaced forward by the rapid braking force and was probably against or within a close proximity to the passenger side air bag module as the SRS deployed at impact. The child occupant apparently attempted to brace against the upper instrument panel by raising and extending his right arm forward of his body. The passenger side air bag module was a mid mount configuration, mounted in the vertical surface of the right instrument panel between the glove box door and the upper panel. As the passenger side air bag deployed, the module cover flap probably contacted the upper chest of the child occupant resulting in a horizontally orientated contusion that extended between the clavicles. The deploying air bag contacted and contused his right anterior neck and abraded the underside area of his chin and anterior neck. This contact displaced the child occupant's head in an upward and rearward direction (hyperextension) resulting in subluxation of C₂/C₃ of the cervical spine and produced malignant brain swelling with the absence of cerebral blood flow. In addition, the deploying air bag contacted his right anterior chest (contusion), his right axilla area (abrasion), the anterior aspect of his right forearm (linear contusion), and his mid abdominal region (abrasion).

The child was subsequently displaced in a upward direction as his head was hyperextended by the deploying air bag. His mid forehead area impacted the vehicle's windshield with sufficient force to crack the laminated glazing and bow the windshield in an outward direction. The head contact was located at the upper right quadrant of the windshield adjacent to the right A-pillar. The autopsy report identified an abrasion to the mid forehead which resulted from the windshield contact. This contact sequence could have contributed to the severity of the C-spine and cerebral injuries noted above. In addition to the head contact with the windshield, the child occupants right hand contacted the windshield left of the head contact location, thus indicating that the child probably attempted to brace with his right arm as he initiated his trajectory in response to the pre-crash braking force. He sustained abrasions to the dorsal aspect of the right mid forearm and multiple small lacerations with abrasions of the dorsal aspect of the right hand from the windshield contact. The occupant sustained an abrasion with contusion over the lateral posterior aspect of the upper right thigh from possible rebound contact into the right door panel. He reportedly came to rest in a slumped position on the right front seat.

The child was removed from the vehicle by rescue personnel and was transported to a local hospital where he was admitted for treatment of his injuries. The lack of cerebral blood flow resulted in non-responsive brain activity and he expired approximately eleven hours post-crash.

The passenger side air bag module partially separated from the instrument panel mount (refer to Photograph No. 13). The rearward displacement probably resulted from deployment of the system, however, the mechanism which allowed the separation was not known.

HUMAN FACTORS/OCCUPANT DATA

Ford Mustang

Right Front Passenger:

4 year old male

Height:

111.8 cm (44")

Weight:

24.5 kg (54 lbs.)

Manual Restraint Usage:

None

Usage Source:

Occupant kinematics/injuries and injury sources

Medical Treatment:

Transported by ambulance to a local hospital where he

expired approximately 11 hours following the crash.

PASSENGER INJURIES

Injury	Injury Severity (OIC/AIS)	Injury Mechanism
Subluxation of C ₂ /C ₃ with malignant brain swelling with absence of cerebral blood flow	Serious (650204.36) Critical (140666.59)	Passenger side air bag
Contusion (ecchymosis) of the right anterior neck	Minor (390402.15)	Passenger side air bag
Abrasion of the anterior neck and underside of the chin	Minor (390202.15) Minor (290202.18)	Passenger side air bag
Abrasion over the upper right quadrant of the chest	Minor (490202.14)	Passenger side air bag
Abrasion of the right axilla area	Minor (790202.11)	Passenger side air bag
Horizontally orientated contusion (ecchymosis) across the upper chest between the clavicles	Minor (490402.10)	Upper module cover flap from the passenger side air bag
Linear contusion of the right anterior forearm	Minor (790402.11)	Passenger side air bag
Abrasions of the upper mid abdominal area	Minor (590202.14)	Passenger side air bag
Abrasion of the mid forehead	Minor (290202.17)	Windshield

Abrasion of the dorsal aspect of the mid right forearm	Minor (790202.11)	Windshield
Multiple lacerations with abrasions of the dorsal aspect of the right hand	Minor (790600.11) Minor (790202.11)	Windshield
Abrasion with contusion over the right lateral/posterior upper right thigh	Minor (890202.11) Minor (890402.11)	Right door panel (possible rebound contact)
Bilateral periorbital edema	N/A, (not codeable)	Passenger side air bag

SELECTED PRINTS CALSPAN CASE NO. 94-43 VA



1. Pre-crash trajectory of the northbound Ford Mustang.



2. Pre-crash skidding of the Ford Mustang.



3. Pre-crash skidding of the Nissan pickup truck.



4. Engagement of the vehicles at final rest.





5. & 6. Additional views of the final rest positions of the vehicles.



7. Close-up view of the damage to the Ford Mustang.



8. Left frontal view of the impact damage.



9. Exterior view of the windshield contacts by the 4 year old child occupant of the Mustang.



10. Additional view of the windshield contacts.



11. Outward bowing of the windshield from the head contact.



12. Overall interior view of the deployed air bags and windshield contacts.



13. Rearward displacement/separation of the passenger side air bag module.



14. Close-up view of the passenger side air bag module.



15. Frontal damage to the Nissan pickup truck.

ATTACHMENT A

Police Accident Report



