Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (1998-49-176A)

1998 Ford Mustang GT

Texas

November/1998

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16. Abstract

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Ford Mustang GT two-door coupe. This was a two vehicle crash that occurred during the early morning hours of a weekday in November, 1998. The weather was clear and the concrete roadway surface was dry. This fatal crash took place on a one-way four-lane urban expressway. It was dark, but the roadway was lighted by overhead luminaires that were operating at the time of the crash . The U.S. expressway consists of four northbound travel lanes bordered by shoulders and concrete retaining walls. There are no traffic controls present and an overpass roadway may have obscured viewing conditions momentarily. The posted speed limit is 97 km/h (60 mph). Vehicle 1, a 1998 Ford Mustang GT two-door coupe was driven by an unrestrained 21 year-old-male (183 cm/ 72 in., 92 kg/202 lbs.). Driver 1 was reportedly under the influence of alcohol and driving erratically at speeds reported at 145-177 km/h (90-110 mph). Driver 1 was traveling northbound in lane three and had driven under an overpass roadway at a high rate of speed. Vehicle 2, a 1987 Chevrolet Astro van was being driven by a 35 year-old-male who reportedly was wearing the manual three-point lap and shoulder belt. Vehicle 2 was northbound in lane three and was traveling at a much slower rate of speed than Vehicle 1. Driver 1 detected the slower moving vehicle ahead of him (Vehicle 2) and applied a left steering input in an attempt to pass on the left.. The front, right bumper corner of Vehicle 1 (12FRAS6) impacted the left, rear bumper corner of Vehicle 2. Direct contact damage to the front of Vehicle 1 was documented to be 6cm (2.4 in.) and engaged along the right side plane, snagging the front, right wheel. The front, right tire engagement provided enough longitudinal deceleration to deploy the redesigned frontal air bags. Both vehicles initiated rapid clockwise rotations. Vehicle 1 rotated approximately 110 degrees before initiating a two-quarter turn rollover sequence (00TDDO4), leading with its left side plane. Vehicle 1 slid on its top plane reportedly 182.9 m (600 ft.) from the initial point of impact. The case vehicle traversed the 2nd and 1st travel lanes, before departing the right side (east) shoulder. Vehicle 1 continued in its northerly trajectory, leading with its rear plane while still on its roof. The left quarter-panel area of Vehicle 1(00RZES1) impacted the east retaining wall in a sideswipe type impact before coming to rest. At final rest, Vehicle 1 was on its roof with the front of the vehicle facing south. Vehicle 2 also traversed the 2nd and 1st travel lanes before impacting the east retaining wall with its frontal plane. At final rest, Vehicle 2 was also facing south and was straddling the east road edge line. During the rollover sequence, the unrestrained driver of Vehicle 1 was thrust rearward and was partially ejected through the backlight opening. The driver's head contacted the concrete roadway surface resulting in numerous sever head injuries. Driver 1 sustained a scalp laceration which measured 10 cm (3.9 in.) in length (AIS-2) . He sustained a right parietal, temporal and occipital skull fracture with the brain and dura exposed (AIS-4), a cerebral laceration (AIS-4), subdural hematoma (AIS-4), a subarachnoid hemorrhage (AIS-3) and a cerebral contusion (AIS-3) all noted to the right side. Driver 1 was fatally injured and had succumbed to his injuries at the crash scene. It was later determined that he had a blood alcohol level of .31%. The driver of Vehicle 2 sustained a cervical strain (AIS-1) and a left shoulder abrasion (AIS-1) from the shoulder belt webbing.

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Summary

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Ford Mustang GT two-door coupe. This was a two vehicle crash that occurred during the early morning hours of a weekday in November, 1998. The weather was clear and the concrete roadway surface was dry. This fatal crash took place on a one-way four-lane urban expressway. It was dark, but the roadway was lighted by overhead luminaires that were operating at the time of the crash. The U.S. expressway consists of four northbound travel lanes bordered by shoulders and concrete retaining walls. There are no traffic controls present and an overpass roadway may have obscured viewing conditions momentarily. The posted speed limit is 97 km/h (60 mph).

Vehicle 1, a 1998 Ford Mustang GT two-door coupe was driven by an unrestrained 21 year-old-male (183 cm/72 in., 92 kg/202 lbs.). Driver 1 was reportedly under the influence of alcohol and driving erratically at speeds reported at 145-177 km/h (90-110 mph). Driver 1 was traveling northbound in lane three and had driven under an overpass roadway at a high rate of speed.

Vehicle 2, a 1987 Chevrolet Astro van was being driven by a 35 year-old-male who reportedly was wearing the manual three-point lap and shoulder belt. Vehicle 2 was northbound in lane three and was traveling at a much slower rate of speed than Vehicle 1. Driver 1 detected the slower moving vehicle ahead of him (Vehicle 2) and applied a left steering input in an attempt to pass on the left.

The front, right bumper corner of Vehicle 1 (12FRAS6) impacted the left, rear bumper corner of Vehicle 2. Direct contact damage to the front of Vehicle 1 was documented to be 6 cm (2.4 in.) and engaged along the right side plane, snagging the front, right wheel. The front, right tire engagement provided enough longitudinal deceleration to deploy the redesigned frontal air bags.

Both vehicles initiated rapid clockwise rotations. Vehicle 1 rotated approximately 110 degrees before initiating a two-quarter turn rollover sequence (00TDDO4), leading with its left side plane. Vehicle 1 slid on its top plane reportedly 182.9 m (600 ft) from the initial point of impact. The case vehicle traversed the 2nd and 1st travel lanes, before departing the right side (east) shoulder. Vehicle 1 continued in its northerly trajectory, leading with its

Figure 1. Area of the initial impact

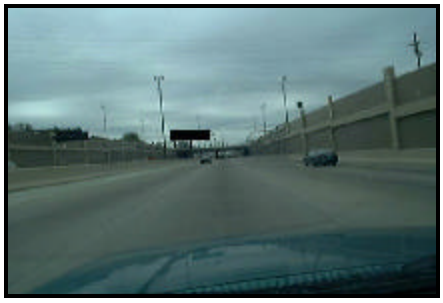

Figure 2. Area of Vehicle 1's rollover

Figure 3. Exterior Vehicle 1 showing initial front, right impact damage

rear plane while still on its roof. The left quarter-panel area of Vehicle 1 (00RZES1) impacted the east retaining wall in a sideswipe type impact before coming to rest.

Figure 4. Overhead view showing rollover damage to Vehicle 1.

At final rest, Vehicle 1 was on its roof with the front of the vehicle facing south. Vehicle 2 also traversed the 2nd and 1st travel lanes before impacting the east retaining wall with its frontal plane. At final rest, Vehicle 2 was also facing south and was straddling the east road edge line.

During the rollover sequence, the unrestrained driver of Vehicle 1 was thrust rearward and was partially ejected through the backlight opening. The driver's head contacted the concrete roadway surface resulting in numerous severe head injuries. Driver 1 sustained a scalp laceration which measured 10 cm (3.9 in.) in length (AIS-2). He sustained a right parietal, temporal and occipital skull fracture with the brain and dura exposed (AIS-4), a cerebral laceration (AIS-4), subdural hematoma (AIS-4), a subarachnoid hemorrhage (AIS-3) and a cerebral contusion (AIS-3) all noted to the right side. Driver 1 was fatally injured and had succumbed to his injuries at the crash scene. It was later determined that he had a blood alcohol level of .31%. The driver of Vehicle 2 sustained a cervical strain (AIS-1) and a left shoulder abrasion (AIS-1) from the shoulder belt webbing.

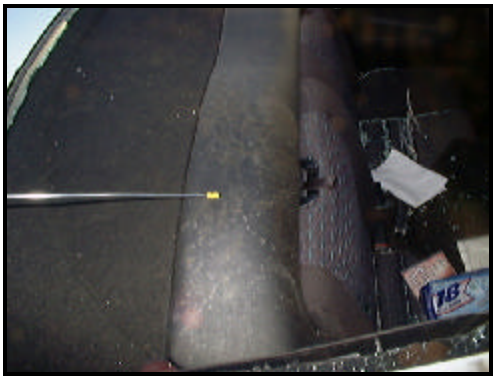

Figure 5. View showing area of driver 1's partial ejection.

Exterior of Case Vehicle

Table 1. Vehicle Information

Model year, make and model	1998 Ford Mustang GT
VIN	1FAFP42X0WF
CDC	12FRAS6 (Initial Impact) 00TDDAO4(Secondary Impact/Primary) 00RZES1(third impact)

Table 2. Crush Measurements

Plane of Impact	Field L cm/in.	C1 cm/in.	C2 cm/in.	C3 cm/in.	C4 cm/in.	C5 cm/in.	C6 cm/in.
Front Bumper	147	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
	57.9	0	0	0	0	0	0

Interior of Case Vehicle

The interior of the Mustang GT sustained severe damage due to the rollover and the roof structure deformation. The greenhouse area was compromised as integrity was lost through the windshield(holed) and all side tempered glazing disintegrated. In addition, the backlight glazing disintegrated and was the avenue for the driver's partial ejection. There were scuff marks noted to the center console area, roof panel, right C-pillar and the rear seatback cushion.

This vehicle is equipped with front bucket seats that have the folding seat back feature. The driver's seat was adjusted between the middle and rearmost track position. The front, left seat back was also deformed rearward and rotated slightly clockwise due to occupant (driver) loading. The front seats are equipped with adjustable head restraints which were not damaged during the impact.

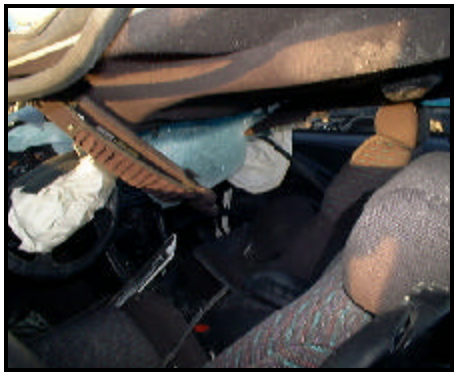

Figure 6. Front, Left view showing interior of case vehicle

Figure 7. Front, right showing case vehicle interior

Table 3. Intrusions

Intruded Component	Location of Intrusion	Intruded Value cm/in.		Dominant Crush Direction
Windshield Header	Front, left	21	8.3	Vertical
Windshield Header	Front, middle	21	8.3	Vertical
Windshield Header	Front, right	21	8.3	Vertical
Roof Panel	Front, right	19	7.5	Vertical
Roof Panel	Front, middle	19	7.5	Vertical
Roof Panel	Front, left	17	6.7	Vertical
Left A-Pillar	Front, left	14	5.5	Vertical
Right A-Pillar	Front, right	12	4.7	Vertical
Roof Panel	Second seat, right side	10	3.9	Vertical
Roof Panel	Second seat, middle	9	3.5	Vertical
Roof Panel	Second seat, left side	8	3.1	Vertical
Roof Side Rail	Front, left	8	3.1	Vertical
Roof Side Rail	Front, right	5	2.0	Vertical

Case Vehicle Occupant Protection Systems

The 1998 Ford Mustang was equipped with the redesigned air bag systems. This system consists of two frontal primary crash sensors located in the cowl and adjacent to the upper radiator support and a safing sensor located within the diagnostic monitor. The air bag diagnostic monitor is centrally located in the instrument panel at the consol level. The diagnostic monitor checks the system for readiness and continually monitors air bag system components and wiring connectors for possible faults when the ignition switch is on. The diagnostic monitor will illuminate the air bag indicator lamp when the ignition switch is turned on (approximately six seconds) and when a potential problem with the system is detected. The air bag diagnostic monitor is also equipped with an internal backup power supply. The backup power feature is sufficient to deploy the air bags in the event that the battery or battery cables are damaged in a collision before the crash sensors are activated. An air bag indicator lamp is located in the front, left instrument panel, below the tachometer. There is an air bag module located in the front, left steering wheel hub and front right instrument panel (top mount).

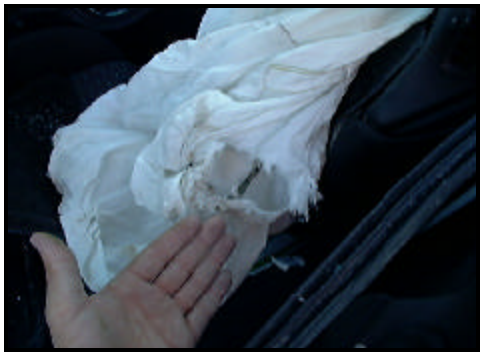

Figure 8. View showing hole in passenger air bag

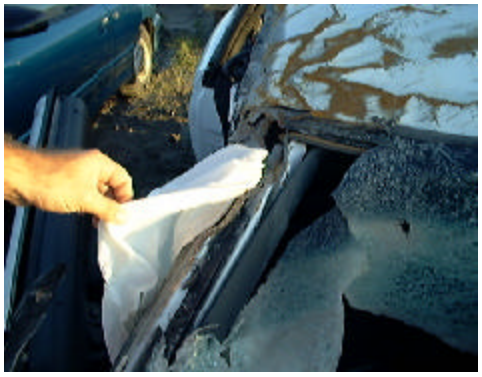

Figure 9. Passenger air bag melted to the right A-Pillar

The drivers air bag is housed in the steering wheel hub and encases the silicone-coated nylon air bag, inflator unit, air bag sliding contact and the mounting plate-retainer ring are concealed by the steering wheel trim cover which is equipped with the standard horizontal tear seams. The circular air bag is 67.3 cm in diameter and is tethered by two straps and two exhaust vent ports are present.

The lower instrument panel is equipped with a rigid plastic knee bolster. There were no detectable occupant contacts to either the knee bolster or the air bag fabric.

Figure 10. View showing deployed passenger (front, right) air bag

The front, right passenger air bag is located on the instrument panel (top mount). The module deployment door is rectangular in shape and constructed with molded-in tear seam that separates and hinges out of the way during the deployment. The air bag module consists of an inflator unit, air bag, reaction housing with mounting brackets and the trim cover module door. The air bag is constructed of ripstop nylon and inflates to a total volume of 8 cubic feet. There was considerable damage to the air bag due to contact with the concrete roadway surface. The air bag was pinned between the pavement and the right A-pillar as the vehicle slid on its roof panel.

Case Vehicle Occupant Demographics

	Occupant 1
Age/Sex:	21/Male
Seated Position:	Front Left
Seat Type:	Bucket with folding back(s)
Height (cm/in:):	183 72.05
Weight (kg/lbs).:	92 202.8
Pre-existing Medical Condition:	None Reported
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	None Used
Air bag:	Driver air bag deployed as a result of the initial front right impact

Occupant Injuries

Table 4. Injuries

Injury	Injury Severity (AIS)	Injury Mechanism
Scalp laceration that measures 10 cm with the brain and dura exposed	2	Ground (Concrete roadway surface)
Right Parietal, Temporal and Occipital skull fracture with brain and dura exposed (Vault fracture)	4	Ground (Concrete roadway surface)
Right, cerebrum laceration	4	Ground (Concrete roadway surface)
Right, cerebrum hematoma/hemorrhage	4	Ground (Concrete roadway surface)
Right, cerebrum subarachnoid hemorrhage	3	Ground (Concrete roadway surface)
Right cerebrum intracerebral contusion - multiple	3	Ground (Concrete roadway surface)

Occupant Kinematics

The 21 year-old-male unrestrained male driver of the 1998 Ford Mustang GT was situated in the front, left seated position (exact posture unknown). The driver was traveling at a high rate of speed and presumably had at least one hand on the steering wheel rim and his right foot on the accelerator pedal.

He responded to the frontal, right corner impact with Vehicle 2, by initially moving forward. As the case vehicle initiated a rapid clockwise rotation, the driver responded by moving forward and laterally to his right. He probably came into contact with the deploying drivers air bag, however, there were no occupant contact evidence to support this. As the Mustang pitched to its left side (still rotating clockwise), the driver was thrust rearward between the front

seatback supports. The case vehicle impacted its roof panel as it initiated an extended slide of approximately 182.9 m (600 ft.). The drivers head passed through the backlight opening impacting the concrete roadway surface with the right side of his head. His lower torso and legs were entangled between the seatback supports which probably prohibited a full ejection. As a result of his head vs. ground impact he sustained numerous severe head injuries which included; a scalp laceration which measured 10 cm (3.9 in.) in length (AIS-2), a right parietal /temporal and occipital skull fracture with the brain and dura exposed (AIS-4), a cerebral laceration (AIS-4), subdural hematoma (AIS-4), a subarachnoid hemorrhage (AIS-3) and multiple cerebral contusions (AIS-3). The driver was fatally injured and succumbed to his injuries at the crash location.

Scene Diagram