



C43 Wave-Out Airbag Fatality in a Minor Traffic Collision

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The goal of this presentation is to remind the viewer of the inherent dangers that can arise when a vehicle operator is in close proximity to a deploying airbag in a minor traffic collision.

This presentation will impact the forensic community and/or humanity by highlighting the explosive nature of supplemental inflatable restraints systems. This presentation will briefly describe the theory and design considerations that can be implemented to address airbag deployments where the risk of injury outweighs the anticipated mitigation of injury in minor traffic collisions.

Collision Overview: A two-vehicle, traffic collision occurred on South Highland in Madison County, Jackson, Tennessee. South Highland is a four-lane roadway with a center median turn lane and a speed limit of 45 mph. Just minutes before 12 noon, the female driver of a 1997 Mazda 626 4-door sedan was exiting a parking lot and was attempting a left turn to travel north on South Highland. To complete the left turn, the Mazda had to first cross two southbound traffic lanes.

While the Mazda waited to enter the roadway, a vehicle in southbound lane #2 stopped. The driver of this southbound vehicle motioned with his hand to the Mazda driver, a signal offering her the right-of-way. The Mazda driver proceeded cautiously, leaning forward to look around the left A-pillar to better see approaching traffic from her left. After slowly entering the southbound lane #2, the Mazda driver started her left turn and began to enter lane #1.

Traffic in southbound lane #1 did not slow for the Mazda as the vehicles in lane #2 had. A 1987 Ford Mustang was in southbound lane #2, and this female driver was gazing to her left searching for a furniture store. When she turned back to the traffic ahead, the Mazda had entered her lane. The Ford driver quickly steered left to avoid the impact, but it was too late.

The right front corner of the Ford impacted near the center of the Mazda's front bumper. Upon impact, the Mazda rotated clockwise in yaw. Collision damage to the Ford extended from the right front fender back to the right door, with some cosmetic damage to the right headlight assembly area. The Mazda's collision damage was most significant to the right front corner. As the Ford swept past the Mazda's front bumper, the Mazda's forward structures were pulled to the right as well as thrust rearward.

The magnitude of the longitudinal crash pulse of the Mazda was severe enough to deploy the airbags. Eyewitnesses observed the head position of the Mazda driver relative to the steering wheel. The inflating airbag thrust the driver back into her seat while the vehicle interior filled with what appeared to be smoke. The driver sat motionless.

Injuries: The inflating airbag caught the Mazda driver under her chin, as evidenced by significant abrasions and contusions to her chin and upper neck. An autopsy was performed and revealed a severe hinge-type basilar skull fracture. The skull fracture propagated through the level of the middle ear, and extended on the left and right sides to such an extent that the fracture lines nearly touched at the back of the head. The fracture was extensive enough to lift the front part of the skull. The Mazda driver also suffered a subdural hematoma in the cervical spine, a subarachnoid hemorrhage of the cerebellum, and an intraventricular hemorrhage in the fourth ventricle. The associated hemorrhages around the cervical spinal cord, brain stem, and cerebellum caused close to immediate death. Blood loss through her nose and ears, by witness accounts, was remarkable, yet witnesses still attempted to revive her. Their efforts were gallant, but were unable to restore her life.

Analysis: A thorough reconstruction was conducted to determine collision parameters using input from many sources. The point-of-impact and vehicle rest positions were documented on-site by investigating officers. A range of vehicle headings and subsequent impact angles were determined through scene geometry. A range of pre-impact speeds for the Ford was obtained through witness statements. And a range of pre-impact speeds for the Mazda was calculated using an acceleration versus distance analysis of the encroachment into the roadway from the exit driveway. Using Engineering Dynamics Corporation HVE-2D EDSMAC software, vehicle alignment, point of contact, and impact speeds were input and adjusted until the post-impact rotation of the Mazda closely matched what was measured at the collision scene.

This iterative reconstruction analysis determined the pre-impact speed of the Ford was between 32 and 40 mph, and the pre-impact speed of the Mazda was between 5 and 7 mph. The included angle between the vehicle centerlines of this oblique collision was between 115 and 123 degrees. The Mazda sustained a velocity change of 11 to 12 mph, with a PDOF of between 24 and 28 degrees. The longitudinal velocity change of the Mazda was therefore 10 to 11 mph. Post-impact rotation of the Mazda was approximately 60 to 70 degrees.

Further Study: The 3-point lap and shoulder belt was worn by the Mazda driver at the time of collision. This fact was confirmed by observing heavy blood stains in an area of the webbing that would not be exposed if the seat belt had been stowed. While load marks typically found on the latch plate or D-ring were not



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observed, the lack of this physical evidence in this vehicle is not an indication that the seat belt was not worn. A collision of relatively low severity and the resulting occupant restraining forces involved do not typically leave evidence of loading. In a collision of this magnitude, the risk of a severe injury would be extremely low, even for an unbelted occupant, but the driver was killed by the deploying airbag.

Conclusion: The deployment threshold of the Mazda was too low for this impact. The Mazda's airbag deployment range is 8 mph (no-fire) to 14 mph (all-fire). That is, the airbag system is designed to always deploy when the vehicle's rate of deceleration is equivalent to the longitudinal deceleration experienced by the vehicle during a frontal barrier impact at 14 mph. Furthermore, the airbag system must not

deploy if the vehicle's rate of deceleration is less than that experienced in a barrier impact at 8 mph. In the impact with the Ford, the Mazda's impact severity of 10 - 11 mph longitudinal velocity change resulted in the deployment of the Mazda airbags.

Raising the deployment threshold of the Mazda may have reduced the likelihood of a deployment in this collision. In fact, other vehicles of the same model year use a higher deployment threshold. And, dual-threshold systems were in use at that time, such that higher deployment criteria is used for belted occupants.

Tank tests performed on the driver's airbag inflator showed that it is significantly more aggressive than other vehicles in its class category. Reducing inflator output, and therefore, reducing the aggressivity of the airbag may have helped lower the risk of deployment-type injuries in this case.

Studies have been shown that short statured drivers often position their seat based primarily on their ability to reach the foot pedals. What is often ignored is the location of the steering wheel. Short statured drivers can be expected to adjust their seat to the forward end of the adjustment range, thus increasing their proximity to the airbag. Pedal extenders may have resulted in increased distance from the deploying airbag.

The airbag deployment in the Mazda was unnecessary and unreasonably dangerous. A belted driver in this collision was exposed to little risk of serious injury. But for the airbag deployment, the driver of the Mazda would not have died in this collision.

Airbag Fatality, Basilar Skull Fracture, Minor Traffic Collision