C50 Safety Modification of Rear Seats and Restraint Systems in Vans and Utility Vehicles to Improve Occupant Protection

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The goal of this presentation is to present objective, scientific testing and prototype development of Van and Utility Vehicle rear seats and restraint systems. This is a companion study to "Rear Seat Safety Hazards: Collapsing Seats, Cargo Shift, Restraint Failure, and Loss of Occupant Survival Space." The present research will show how static testing reveals seat defects and also demonstrates how designs can be improved with simple, cost effective methods. Static testing is validated by dynamic crash testing.

The presentation will impact the forensic science community by iden- tifying an emerging safety defect trend that has serious implications for occupant safety, especially children. Attendees should obtain a clear understanding of increasing risks to rear seat occupants *of* Vans and Utility Vehicles in frontal and rear impacts, as well as the reasons for those risks. Anyone who rides in the rear seats of these vehicles is at risk from hazards posed by seat and restraint system design, as well as cargo shifting. There are addi- tional hazards posed by "Third Row Seating" in these vehicles which place occupants, often children, within the crush zone at the rear of a vehicle.

The goal of this paper is to present case studies and testing depicting various hazards to rear seat occupants in Vans and Utility Vehicles subjected to various impact vectors. There are emerging safety risks to children and adults from collapsing rear seats and inadequate restraint systems in vans and utility vehicles, which are capturing an ever-larger share of the vehicle market. This study will inform other researchers about why rear seats and restraint system failures are occurring in Vans and Utility vehicles, and how injury is being imparted to rear seat occupants despite use of available and how injury is being imparted to rear seat occupants. restraint systems.

Occupants of rear seats in vans and utility vehicles, and some hatch- back-type passenger cars, are subjected to increased hazards caused by the fact that there is no bulkhead or structural separation between cargo areas and occupant seating areas, combined with weak seat structures and attach- ment hardware. Significant loss of occupant survival space has been seen in both front and rear impacts that are well below human tolerance levels. Because of rear seat failure, occupants can be severely injured due to direct contact by other occupants, seat structures, shifting cargo, and intruding rear vehicle structures. Restrained occupants can be trapped between seat belts and the failed rear seats pushed forward by intruding cargo. Additional haz- ards are created to restrained occupants when rear seats fail, even without cargo shift, because seat movement can lead to submarining under lap belts, as well as misalignment of the upper torso relative to shoulder belts. Many rear seats in vans and utility vehicles utilize lap-only seat belts, which fail to protect the upper torso, and which also are more likely to lead to abdominal and spinal trauma than an effective lap-shoulder harness. In addition, many rear seats in vans and utility vehicles are designed with no or inadequate head restraints, inadequate seatback height, and lack of structural integrity com- pared with a conventional passenger car rear seat, in order to accommodate fold-and-tumble features, and/or easy removal of seats from the vehicle. There is a lack of dynamic testing of rear seat areas by safety agencies and auto manufacturers to validate the actual safety of these designated seating positions. These combined rear seat safety issues create risk factors for var- ious size occupants that are not foreseeable to typical users of vehicles, and which are not typically warned about in owner's manuals. Reasonably sim- ilar failures have been seen in a wide variety of vehicles from various man- ufacturers. This is especially significant considering that since 1996, NHTSA and the auto industry have advocated placing children in the back seat to avoid airbag hazards.

"Third Row Seating" in Sport Utility Vehicles, etc., where the rearmost seat is in very close proximity to a liftgate and rear window, as well as being in close proximity to open rear cargo areas, exacerbates these hazards because the "Third Row Seats" are often located within the rear crush zone of a typical vehicle. Alternative designs will be shown that address some of these hazards.

Utility Vehicles, Rear Seats, Restraint Systems

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