C11 Experimental Study of Seat-Back Recliner Sudden Failure and Effect on Rear Child Injury in Rear Impacts

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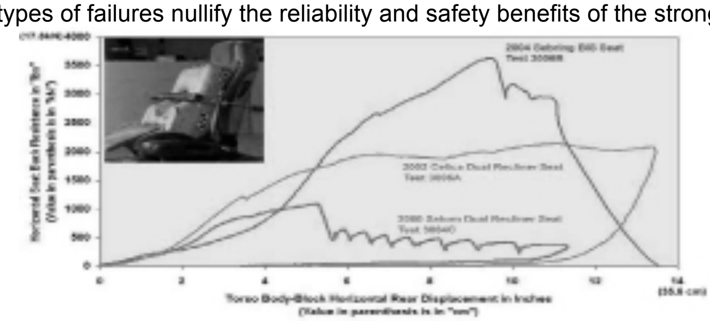
After attending this presentation, attendees will learn about an efficient “quasi-static” test method for measuring vehicle front seat ultimate rearward force resistance, deformation levels, and “reliability” of seat support regarding a rear child in rear impacts.

This presentation will impact the forensic science community by demonstrating a method that provides a simplified means for evaluating seat safety reliability in rear impacts.

Similar to the shoulder belt in a frontal impact, the seat back is the primary restraint device available to protect both the front adult and children seated behind in rear impacts. “Rear impact” crash test multi-variable studies, discussed at previous Amercian Academy of Forensic Sciences (AAFS) meetings and published in engineering society proceedings have demonstrated that, among other factors, the stronger front seat systems, such as the dual recliner “non-belt-integrated” types and the “Belt-Integrated-Seat” (BIS) types, generally provide less penetration into the occupant space of children seated behind the weaker “single recliner” yielding seat, and as such result in a safer environment for both the front adult and the rear child.[1-3] Experimental results have been shown to be consistent with statistical accident database studies conducted independently by others, such as Jermakian et al. of the Childrens Hospital of Philadelphia, and Mango and Garthe.[4,5] However, crash tests and “Quasi-Static” (QS) ultimate seat strength and deformation tests have shown that, in some instances, the rear child safety value of a potentially stronger and less rearward yielding seat can be voided if seat components like the recliner seat back adjustment mechanisms suddenly fail or give way, such as when “recliner locking gear teeth” distort and slip over one another. These types of failures nullify the reliability and safety benefits of the stronger seat back restraint factors.



Unfortunately, there are no federal requirements to measure reliability of ultimate seat strength and deformation data, as has been done by the private sector since the early 1990s. One method uses a torso-body-block device, similar in weight to a 95th percentile male, to more realistically load the seat system QS and enable efficient duplication of sudden failure deficiencies not found by limited test approaches. This QS method data also enables estimates of torso “Peak G” dynamic loads and has been shown to correlate with actual crash test and “real world” accident case findings. The figure above shows a photo inset of the torso-body-block test setup and data from “ultimate seat strength and deformation” tests of three different seat systems; one seat is the much stronger 2004 BIS Sebring seat, and two are the less strong Dual Recliner (DR) types. The result for the 2000 Saturn DR-type seat illustrates a sudden load failure “drop-off” in seat load when recliner gear-teeth slipping occurs, making this system an unreliable safety device. More important, since the area under the load-deformation curve is proportional to energy absorption, the seat with the sudden load failure ultimately absorbs much less energy than the other two seats and, as a result, put both the front adult and rear child at risk of enhanced injury. In this study, the torso-body-block seat strength method is described and results of adjuster mechanism failures are shown and correlated with sled-body-buck crash tests to demonstrate consistency with actual cases involving rear-seated child injuries.

References:

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3. Saczalski, K., Pozzi, M., Burton, J., “Rear Seated Child Injury Risk Experimental Measures Related to Vehicle Front Seat Performance in Rear Impacts”, Paper IMECE2009-10390, ASME, 2009.
4. Jermakian, J., Arbogast, K., Durbin, D., Kallin, M., “Injury Risk for Children in Rear Impacts: Role of the Front Seat Occupant”, presented at the 57th AAAM Annual Conference, October 2008.
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Rear Impact, Seat Strength, Quasi-Static Testing

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