



Engineering Sciences Section – 2010

C33 Containment Potential of Laminated Glazing in High Speed Rollover Testing

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After attending this presentation, attendees will recognize the retention capabilities of laminated glass door windows for unrestrained occupants in a dynamic rollover event.

This presentation will impact the forensic science community by discussing how keeping occupants inside the vehicle during a rollover accident event is the first step to reducing occupant injury in this accident mode.

Keeping occupants inside the vehicle during a rollover accident event is the first step to reducing occupant injury in this accident mode. While increased restraint use, restraint performance and vehicle structural integrity have all been identified as being associated with occupant containment, vehicle glazing is known as the structural

component that is most likely to fail during this accident mode. Vehicle glazing failure usually creates large portals in the vehicle structure through which occupants can be ejected. In the presented automotive rollover testing, the original tempered door glazing was replaced with laminated glazing and unrestrained Anthropometric Test Devices (ATDs) were subjected to high rates of rotation. Under various configurations, ATD kinematics and glazing performance during rollover were recorded.

The performed study includes seven controlled, multi-revolution tests of a partial sport utility vehicle (SUV) occupant compartment test fixture rotating about a fixed, longitudinal axis. The front doors of the fixture were modified by replacing the original equipment manufacturer (OEM) glazing with a piece of 0.269" thick laminated glass manufactured by American Glass Products containing a 30 mil PVB inner layer. Although slightly thicker (from OEM thickness of 0.152" to 0.269" laminated thickness), the laminated glass was able to fit into the OEM window hardware by slightly expanding the window frame metal flanges. Additionally, the right front door window frame was reinforced with a 1.5 to 2.25" wide piece of sheet metal.

Unrestrained Hybrid III 50th percentile male ATDs were positioned in the driver's and/or passenger's seating positions with dummy kinematics and interaction with the front window glazing observed at roll rates of up to 644 degrees per second. The same driver's and passenger's doors, as well as their associated laminated glazing, were utilized in all of the seven tests conducted. At various points during the testing, the laminated glazing on each door was pre-damaged in order to note the effect of existing fractures. The observed results of the testing are summarized in the following Table.

Test	Description	Max. Roll Rate	Pre-test Substitution	Door Containment	Glazing Status
1	LF ATD, DGL, Med/High 30 Sp	200 deg/s	100 (plus door sub) 144 = ATD	Failure: Ejected through Large Structural Opening	Undamaged at initiation of testing; 6' roll out before door failure
2	RF ATD, PGL, Med/High 30 Door	200 deg/s	20	Migrated to seat, Full containment	Undamaged at initiation of testing; 6' roll out before door failure
3	RF ATD, PGL, Med/High 30 Door	644 deg/s	20	Failed against door glazing, Full containment	Undamaged at initiation of testing; 6' roll out before door failure
4	RF ATD, PGL, Med/High 30 Door	644 deg/s	40	Failed against door glazing, Full containment	Fractured, no seat propagation and minimal deformation
5	LF ATD, DGL, Med/High 30 Door	644 deg/s	40	Failed against door glazing, Full containment	Undamaged at initiation of testing; 6' roll out before door failure
6	LF ATD, DGL, Med/High 30 Door	644 deg/s	60	Failed against door glazing, Full containment	Fractured post-test with only slight propagation of cracks during testing
7	LF ATD, DGL, Med/High 30 Door	644 deg/s	40	Failed against door glazing, Full containment	Fractured post-test with only slight propagation of cracks during testing

No separation of the laminated glazing from the door window surround was noted as the ATDs migrated through the test fixture during the roll event. The undamaged as well as the fractured laminated door glazing was found to retain the ATDs with no ejection through this portal with no additional glazing fracture or minimal propagation of glazing cracks.

Rollover, Laminated Glazing, Containment