Crash Test Evaluation of Rear Seat Occupant Protection

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Objectives

1. Monitor existing regulations and provide the necessary scientific evidence for the development of new or amended regulations;

2. Provide scientific evidence to advance crash test dummy technology.
I. Protection of adult/child occupants

1) Frontal Crash
   - Interactions with the vehicle interior
   - Influence of restraint system

2) Side Impact Crash
   - Interactions with the vehicle interior
   - Influence of restraint system
   - Interactions with non-struck side occupants

II. ATD development
Information sharing

1. Shared with the NHTSA
2. Industry
3. Safety Organizations
Outline

1) Full frontal rigid barrier
   - Comparison of front and rear seat responses
   - Head & neck response in rear seats
   - Child restraint securement

2) Moving-car to moving-car 40% frontal offset crash tests
   - struck side curtain interaction
   - Non-struck side containment
Methods:

High-speed videos are recorded at 1000 frames/second
- lateral views of the front seat occupants;
- lateral and a frontal view of the rear seat occupants.

Impact speeds: 48 km/h   56 km/h
CHEST DEFLECTION RESPONSE OF THE HIII 5th

![Diagram showing chest deflection response for different speeds and occupant types.]

- **Drivers**
- **Front Passenger**
- **Rear Occupant**

**X-axis:**
- 40 km/h
- 48 km/h
- 56 km/h

**Y-axis:**
- Chest Deflection [mm]

**Legend:**
- Blue bars represent drivers.
- Green bars represent front passengers.
- Orange bars represent rear occupants.

**Note:**
- The graph shows the deflection in millimeters for each occupant group at different speeds.

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Head & NECK RESPONSE OF THE HIII 5th

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Motion in the front seat is more controlled, ATD remains upright;

Motion of rear seat ATDs varies as a function of seat characteristics & belt anchorage geometry
Hybrid III dummies have a rigid spine box and a seated pelvis.

Observations

1. Seat location in the vehicle, including proximity to the airbags and knee bolsters, in front row seats was found to influence the kinematic responses of the Hybrid III 5th percentile ATD.

2. ATDs restrained in rear seat locations exhibited much greater forward displacements relative to the seat cushion and lap and shoulder belt.

3. Chest deflection is greater and is dependant on impact velocity.

4. The rigid spine and moulded seated pelvis of the ATD interferes with flexion and prevent head contact with the interior.
In 56 km/h rigid barrier tests excursion for combined attachments was less.
Importance of Top Tethers
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Excursion is greater for ATD in harness without the top tether than for ATD in low back booster seat
Multiple Occupancy

Large excursions observed for all three ATDs
Observations

1. Excursion for belt + top tether installation is greater than for belt + LATCH installations.

2. Head/face contact with front seatback can be problematic when trim is present.

3. Top tether attachment should play a critical role in retention of the CRS.

4. Beyond fitment, multiple occupancy presents important safety challenges.
Frontal Offset Curtain Interaction
Frontal Offset Curtain Interaction
Frontal Offset Ejection
Frontal Offset Roll-Out of Hybrid III
Frontal Offset Neck Interaction of Q6
Conclusion

The environment in the rear seat is completely different from the front seat.

Improvements will require:

1. Increased awareness
2. Advances in ATD designs
3. Development of appropriate criteria
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