Lower Interior Impacts to Seat Backs and B-Pillars

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Presentation Outline

• Target Population
  – Rear seat injuries
• Current standards
  – FMVSS 201/ FMVSS 201U
• Test Procedure Development
  – Headform selection
  – Test locations
  – Test speeds
• Initial Vehicle Testing
• Ongoing Research
Rear Seat Exposure

Inclusion Data Criteria
• NASS CDS- 1997 - 2013
• Model Year 1985 + (≤ 10,000 lbs)
• No age restrictions
• Rear seat occupants
• Restrained and unrestrained occupants
• All crash modes

<table>
<thead>
<tr>
<th>Rear Seat Injured Occupant Exposure</th>
<th>Annual Average Occupant Count (Weighted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Rear Seat Occupants (Exposure) (from NASS-CDS)</td>
<td>451,213 (100%)</td>
</tr>
<tr>
<td>Total Injured Occupants (MAIS 2+)</td>
<td>17,203 (3.8%)</td>
</tr>
<tr>
<td>Total Injured Occupants (MAIS 3+)</td>
<td>7,418 (1.6%)</td>
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</tbody>
</table>

Annual Average Rear Seat Fatalities: 2,569
• 6.6% of all traffic fatalities in ages 0-98
• FARS 2000-2013
48% of all AIS 2+ Injuries are to Head and Chest
65% of all AIS 3+ Injuries are to Head and Chest
Head Injury by Contact Source

MAIS\textsubscript{head} 2+

- Seatback: 815 (13+) + 576 (0-12)
- B-Pillar: 757 (13+) + 158 (0-12)

MAIS\textsubscript{head} 3+

- Seatback: 217 (13+) + 121 (0-12)
- B-Pillar: 226 (13+) + 93 (0-12)

Fatalities

- Seatback: 35 (13+) + 32 (0-12)
- B-Pillar: 79 (13+) + 22 (0-12)

Fatalities estimate scaled to the FARS data
Current Standards

- **FMVSS 201- Seat Back**
  - 15 lbs (6.8 kg), 165 mm diameter hemi-spherical headform at 15 mph (24 kph)
  - Impact location within the head impact area (center of head rest)
  - 80 g’s/3 ms criterion

- **FMVSS 201U**
  - 10 lbs (4.5 kg), free-motion headform (FMH) at 15 mph (24 kph)
  - Impacts at various upper interior locations above the window sill
  - HIC(d) ≤ 1000
Test Procedure Development

- Goal: Develop a repeatable testing method to assess the injury potential from head contact on seat backs and lower B-pillars

- Test Parameter Decisions
  - Type of headform/impactor
    - Current FMVSS 201 FMH (modified 50th male Hybrid-III head)
    - Pedestrian child headform (hemi-spherical)
      - Specified in GTR9/R127/EuroNCAP
  - Specific impact locations
  - Test speeds
Test Procedure Development

Headforms

- Child-size free-motion
  - 6 YO (7.7 lbs, 3.5 kg), hemispherical, 165 mm diameter
  - Instrumentation:
    - 3 accelerometers (XYZ)

- FMVSS 201 FMH
  - Adult size (10 lbs, 4.5 kg),
  - Instrumentation:
    - 3 accelerometers (XYZ)
Test Procedure Development Impact Locations

• Seat back and headrest locations were chosen based on different surfaces under the seat fabric with the focus on the upper quadrant of the vehicle seats
  – Hard structures such as frames and airbag mounting locations
  – Headrest post locations
  – Advanced head rest equipment
Test Procedure Development
Impact Locations: Positions of Rear Occupants
Test Procedure Development Impact Locations

• B-pillar impact sites were chosen based on window sill line and where the upper and lower B-pillars overlap
  – BP4 is approximately the lowest position in the current standard (FMVSS 201)
  – LBP1 & LBP2 (shown) are where upper and lower pillars overlap
  – Lower B-pillar trim do not have all of the ribbing that is currently in the upper interior trim
Test Procedure Development

Test Speeds

- Initial test speeds
  - 15 mph (24.1 kph) & 20 mph (32.2 kph)
- Supporting analysis
  - 15 mph FMH impact speed in FMVSS 201
  - NASS delta-v’s - frontal impacts
  - Child dummy head speeds from frontal NCAP tests
- Analysis shows that higher test speeds (above 20 mph) for seat back/head restraint impacts could be justified

<table>
<thead>
<tr>
<th>Program</th>
<th>Measurement</th>
<th>Velocity (mph)</th>
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<tbody>
<tr>
<td>FMVSS 201U Current Standard</td>
<td>FMH impact speed</td>
<td>15</td>
</tr>
<tr>
<td>NASS Data- Frontal Impacts</td>
<td>Vehicle Delta-V</td>
<td>11-25</td>
</tr>
<tr>
<td>Frontal NCAP Tests</td>
<td>Maximum head velocity</td>
<td>20-27</td>
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</table>
Initial Vehicle Testing
Child Headform

• Baseline testing
  – 12 vehicles (MY 2004-08)
  – 15 and 20 mph

• Countermeasure testing
  – Several types of EA materials tested on 3 vehicle platforms
    • Seat backs, B-pillars, and head restraints
  – Lowered the air curtain
    • B-pillar
Initial Vehicle Testing
Child Headform Results

• At 15 mph, only the B-pillars produced HIC15 over 700 (10 of 12)
• At 20 mph, B-pillars produced HIC15 results of over 700 in all tests (6 of 6)
  – Lowered air curtain reduced results by 26% (2692 to 1990)
  – 2 inches of EA material reduced HIC15 by 43% (2692 to 1521)
• At 20 mph, some seatbacks produced HIC15 over 700 (8 of 48)
  – Higher HIC responses would be expected if test speed was increased
  – Countermeasures reduced HIC15 responses (average = 33%)
    • Of the 8 baseline tests with HIC15 over 700, 5 were reduced below that level
    • 2 of those 5 required just 1 inch of EA material
Ongoing Research

- Evaluate seat backs/head restraints and B-pillars from more recent vehicles with the two headforms
- Select the headform
- Select test parameters
  - Specific impact locations
  - Test speeds
- Assess countermeasure effectiveness
THANKS FOR YOUR ATTENTION

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