National Highway Traffic Safety Administration
Motorcoach Tests

GRSG - 94th Session
Nha Nguyen
Background

• NHTSA started to conduct a series of analysis and research to obtain a comprehensive review of motorcoach safety issues and the course of action that NHTSA will pursue to address them.

• www.regulations.gov; NHTSA Docket 2007-28793
Full Frontal Crash Test

• Obtain crash pulse from severe frontal crash event
• Obtain dummy readings for
  – Different dummy sizes
  – Different seat types
    • No belts
    • Lap and shoulder belts (3 – point belts)
    • Lap belts (2 – point belts)
    • Different seat manufacturers
• Study seat and seat attachment strength for different dummy sizes and rear occupant loading
• The test was conducted at the Vehicle Research and Test Center in December 2007.
Motorcoach Details

- 2000 MCI 102EL3 Renaissance
- Series 60 diesel engine
- B500 Allison Automatic transmission
- 54 seats
- 45 ft long, 12 ft 6 inches tall
Seats on the Motorcoach

• Baseline seats
  – No belts
  – American Seating

• Seats with Belts
  – MCI/Amaya
    • 3 point belts – 4 rows (dual seats)
    • 2 point belts – 1 row (dual seats)
  – Freedman Seating
    • 3 point belts – 1 row (dual seats)
Seats (Continued)

- Baseline (No belts)
- MCI/Amaya/FAINSA
  - 3 – point
  - 2 – point
- Freedman 3 – point
Seat Attachments

• 9 occupied, 13 unoccupied rows using OEM equipment

• 2 occupied rows reinforced
Test Conditions

- Speed: 30 mph (48.3 kph)
- Frontal impact: 0 degrees; full overlap
- Fixed Rigid Barrier
- Data channels: 355 dummy; 26 vehicle channels @ 12500 samples/sec
Occupants

- Hybrid III 50\textsuperscript{th} percentile male – 17 dummies
  - 175 cm (5 ft 9 in) tall and 77 kg (170 lb)
- Hybrid III 5\textsuperscript{th} percentile female – 3 dummies
  - 150 cm (5 ft) tall and 50 kg (110 lb)
- Hybrid III 95\textsuperscript{th} percentile male\textsuperscript{**} – 2 dummies
  - 188 cm (6 ft 2 in) and 100 kg (220 lb)
- Each dummy has
  - Accelerometers in head and chest
  - Load cells in upper neck and femur
  - Chest displacement potentiometer

\textsuperscript{**} The 95\textsuperscript{th} percentile male dummy is not in FMVSS
## Dummy Seating Locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1L</td>
<td></td>
</tr>
<tr>
<td>2L</td>
<td></td>
</tr>
<tr>
<td>3L</td>
<td></td>
</tr>
<tr>
<td>4L</td>
<td></td>
</tr>
<tr>
<td>5L (MCI)</td>
<td></td>
</tr>
<tr>
<td>6L</td>
<td></td>
</tr>
<tr>
<td>7L</td>
<td></td>
</tr>
<tr>
<td>8L</td>
<td></td>
</tr>
<tr>
<td>9L</td>
<td></td>
</tr>
<tr>
<td>10L</td>
<td></td>
</tr>
<tr>
<td>11L</td>
<td></td>
</tr>
<tr>
<td>12L</td>
<td></td>
</tr>
<tr>
<td>13L</td>
<td></td>
</tr>
<tr>
<td>14L</td>
<td></td>
</tr>
</tbody>
</table>

### Accel Locations
- 95th Unbelted
- 50th Unbelted
- 5th Unbelted
- 50th Lap Belt Only
- 5th Lap Belt Only
- 95th 3-Point Belted
- 50th 3-Point Belted
- 5th 3-Point Belted
- Reinforced Attachment
- OEM Attachment
Frontal Crash Videos
Crash Data

- Speed: 30.36 mph
- Dynamic Crush: 6.5 ft
- Peak deceleration: 10g at 125msec
Head Accelerations
50th Male – Front Seats

HIC's for III Mid-Sized Adult Male Dummies in Rows 4R, 5R, 6R and 7R

- Unbelted (Dotted Line)
- Belted (Solid Line)

Filter Class: CFC_1000

Dummy #055 Seat 4R Aisle
3-Point Belt
T0 (ms) T1 (ms) T2 (ms) Avg of T1 & T2
HIC[15] = 439.05 290.56 295.04 327.68

Dummy #280 Seat 4R Window
3-Point Belt
T0 (ms) T1 (ms) T2 (ms) Avg of T1 & T2
HIC[15] = 77.26 169.04 181.44 33.07

Dummy #168 Seat 5R Aisle
Unbelted
T0 (ms) T1 (ms) T2 (ms) Avg of T1 & T2
HIC[15] = 1308.49 152.29 169.69 290.60

Dummy #169 Seat 5R Window
Unbelted
T0 (ms) T1 (ms) T2 (ms) Avg of T1 & T2
HIC[15] = 843.77 162.48 156.20 159.67

Dummy #313 Seat 6R Aisle
3-Point Belt
T0 (ms) T1 (ms) T2 (ms) Avg of T1 & T2
HIC[15] = 203.77 321.44 323.52 94.09

Dummy #945 Seat 7R Aisle
Unbelted
T0 (ms) T1 (ms) T2 (ms) Avg of T1 & T2
HIC[15] = 612.81 171.76 174.88 132.94

Dummy #043 Seat 7R Window
Unbelted
T0 (ms) T1 (ms) T2 (ms) Avg of T1 & T2
HIC[15] = 728.31 159.04 167.36 95.33
Observation - Restraints

- Unbelted dummies:
  - High head and neck accelerations
- Dummies with 2-pt belts:
  - High head and neck accelerations
- Dummies with 3-pt belts:
  - Low head and neck accelerations
- All dummies have low chest accelerations and chest displacements and femur loads
Observation - Unbelted Dummies

- Unbelted dummies typically made head contact with the backseat in front within 150-180 ms
- Dummies on the aisle seats ended up on the floor and dummies on the window seats ended up on the front seats or on the floor
Observation - Belted Dummies

- Dummies stayed in seats
- Head/Knee contact with front backseat for 95th male dummies
Observation - Seat Hardware

- All seat attachments including baseline stayed intact
- Baseline seats and Freeman seatback broke/bent when impacted by unbelted dummies from behind
Rollover Tests

- Tests were done on 2 motorcoach models: MCI and Prevost
- ECE-R66 test procedures
- Data is being analyzed
Roof Crush Tests

• Tests were done on 2 motorcoach models: MCI and Prevost
• FMVSS 220 test procedures
• Data is being analyzed
Future Plans

• Conduct evacuation and flammability tests
• Evaluate research data for rulemaking recommendations
• Complete information can be found at www.regulations.gov; docket # NHTSA-2007-28793