NHTSA Side Crash Protection Program

Randa Radwan Samaha
NHTSA Vehicle Safety Research

Crashworthiness III: Side/Compatibility
SAE Government/Industry Meeting
May 12, 2004
Outline

• Synopsis of current safety problem
• Research goals
• Side impact pole test development
• Crash test results for 50\textsuperscript{th} male and 5\textsuperscript{th} female dummies
• Side impact safety problem
2001 FARS Nearsdie Nonrollover Fatalities, MY 1995+ Struck Vehicle

- Rigid narrow object: 21%
- Rigid non-narrow object: 4%
- Small car: 2%
- Large SUV or P/U: 17%
- Compact SUV or P/U: 15%
- Large van: 3%
- Minivan: 4%
- Heavy vehicle: 13%
- Other vehicle: 1%
- Other event or object: 3%

n = 2,312
Fatalities and Injuries by Crash Partner

1995-2001 Weighted NASS/CDS Nearside Impacts
Struck Vehicle MY 95+

- Occupants Involved - 120,492
- Equivalent Fatalities - 2,361
- AIS 3+ Occupants - 4,315

![Bar chart showing fatalities and injuries by crash partner.]
Nearside Seriously Injured Belted Occupants

1995-2001 Weighted NASS/CDS Nearsdie Impacts

- MY <=94 (83,043 total)
- MY >= 95 (19,453 total)

Percent (%) by body region:
- Head/face
- Neck
- Chest/back
- Abdomen
- Pelvis
1995-2001 Weighted NASS/CDS Nearside Impacts

- **Nearside Belted Occupants Fatalities**

- **Graph Description**
  - **Percent (%)** on the y-axis.
  - Categories: 'head/face', 'chest', 'abdomen*', 'other*', 'multiple**'

- **Legend**
  - MY <=94 (1877)
  - MY >= 95 (377)

- **Note**
  - * sample < 20 for all MY
  - ** sample < 20 for MY >= 95
• 59% of fatalities in side impact had a brain injury* (5,617 of 9,452 annual estimates)

*either alone or in combination with another injury
Nearside seriously injured occupants by height

1995-2001 Weighted NASS/CDS Nearside Impacts

- Struck by PC
- Struck by LTV
- Narrow object

MY 95+
The small size occupant is more at risk of serious injury in side impacts irrespective of crash partners.

- **Struck by a Passenger Car**
  - Occupants Involved
  - MAIS3+

- **Struck by an LTV**
  - Occupants Involved
  - MAIS3+

- **Narrow Object Crashes**
  - Occupants Involved
  - MAIS3+
Side Impact Research Goals

• Existing FMVSS 214 established minimum requirements for thoracic and pelvic protection for occupants in car-to-car side crashes

• **Research Goals**: Promote head protection & improve protection for other body regions for all light vehicles; provide protection for a wider segment of population using advanced side impact dummies (both 50\textsuperscript{th} male and 5\textsuperscript{th} female)
• Side impact pole test development
Motivation: Representative pole test will promote head protection for all vehicle classes (including heavier and high-hooded LTVs); will also improve structure and provide self-protection when side struck by LTVs
Weighted 1990-2001 NASS/CDS Near Side Impacts, All MY Belted Occupants With MAIS 3+ injuries
Weighted 1990-2001 NASS/CDS Near Side Impacts, All MY Belted Occupants With MAIS 3+ injuries
Oblique Pole Test

20 mph closing speed and 75° anticlockwise angle of approach

Optional 201P: 18 mph closing speed and 90° angle of approach
• Crash test results for 50\textsuperscript{th} male and 5\textsuperscript{th} female dummies
<table>
<thead>
<tr>
<th></th>
<th>HIC36</th>
<th>Rib Defl (mm)</th>
<th>Lower Spine (Gs)</th>
<th>Abd Force (N)</th>
<th>Pubic Force (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>99 Maxima*</td>
<td>5,254</td>
<td>35.7</td>
<td>45.1</td>
<td>1,196</td>
<td>2,368</td>
</tr>
<tr>
<td>00 Saab 9-5*</td>
<td>243</td>
<td>49.9</td>
<td>58.3</td>
<td>1,382</td>
<td>2,673</td>
</tr>
<tr>
<td>99 Volvo S80</td>
<td>329</td>
<td>48.6</td>
<td>51.2</td>
<td>1,547</td>
<td>1,127</td>
</tr>
<tr>
<td>00 Saab 9-5</td>
<td>171</td>
<td>49.4</td>
<td>49.0</td>
<td>1,366</td>
<td>1,733</td>
</tr>
<tr>
<td>04 Honda Accord</td>
<td>446</td>
<td>30.7</td>
<td>49.9</td>
<td>1,437</td>
<td>2463</td>
</tr>
<tr>
<td>04 Camry</td>
<td>405</td>
<td>43.4</td>
<td>50.6</td>
<td>1,165</td>
<td>1,849</td>
</tr>
</tbody>
</table>

Note: dummy driver seated per 201P otherwise mid-track
### Oblique Pole Test – 5th female

<table>
<thead>
<tr>
<th>Model</th>
<th>System Description</th>
<th>HIC36</th>
<th>Rib Defl (mm)</th>
<th>Lower Spine (Gs)</th>
<th>Abd. Defl (mm)</th>
<th>Pelvis Force(^\text{**}) (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>03 Camry</td>
<td>curtain + thorax(^*)</td>
<td>512</td>
<td>33.8</td>
<td>78</td>
<td>42.3</td>
<td>4,580</td>
</tr>
<tr>
<td>00 Saab</td>
<td>head/chest combo</td>
<td>2,233</td>
<td>31.7</td>
<td>67</td>
<td>29.5</td>
<td>6,045</td>
</tr>
<tr>
<td>02 Explorer</td>
<td>curtain(^*)</td>
<td>4,595</td>
<td>37.4</td>
<td>101</td>
<td>46.8</td>
<td>7,141</td>
</tr>
<tr>
<td>04 Honda</td>
<td>curtain + thorax</td>
<td>397</td>
<td>25.8</td>
<td>56</td>
<td>23.8</td>
<td>6128</td>
</tr>
</tbody>
</table>

*Air bags deployed remotely 11-13 ms*

\(^*\) Dummy driver seated full forward in seat

\(^\text{**}\) Sum of Iliac and Acetabular loads
### FMVSS 214 Tests – 50th male

<table>
<thead>
<tr>
<th>Side NCAP Tests – Driver Data</th>
<th>HIC36</th>
<th>Rib Defl (mm)</th>
<th>Lower Spine (Gs)</th>
<th>Abd Force (N)</th>
<th>Pubic Force (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Focus</td>
<td>None</td>
<td>272</td>
<td>47.6</td>
<td>81.5</td>
<td>1858</td>
</tr>
<tr>
<td>02 Impala</td>
<td>head/chest combo</td>
<td>138</td>
<td>50.8</td>
<td>67.0</td>
<td>1364</td>
</tr>
<tr>
<td>03 Corolla</td>
<td>None</td>
<td>350</td>
<td>44.3</td>
<td>70.8</td>
<td>1986</td>
</tr>
<tr>
<td>FMVSS 214 Tests – Driver Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01 Focus</td>
<td>None</td>
<td>137</td>
<td>36.3</td>
<td>59.7</td>
<td>1648</td>
</tr>
<tr>
<td>02 Impala</td>
<td>head/chest combo</td>
<td>69</td>
<td>45.7</td>
<td>49.3</td>
<td>1225</td>
</tr>
<tr>
<td>04 Honda</td>
<td>curtain + thorax</td>
<td>109</td>
<td>36.9</td>
<td>37.5</td>
<td>557</td>
</tr>
</tbody>
</table>

Data extracted from the FMVSS 214 tests for 50th male dummy. The table shows the HIC36, Rib Deflection (mm), Lower Spine (Gs), Abd Force (N), and Pubic Force (N) for the specified tests.
<table>
<thead>
<tr>
<th></th>
<th>HIC36</th>
<th>Rib Defl (mm)</th>
<th>Lower Spine (Gs)</th>
<th>Abd. Defl (mm)</th>
<th>Pelvis Force* (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Side NCAP Tests – Driver Data</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01 Focus</td>
<td>None</td>
<td>570</td>
<td>42.5</td>
<td>95</td>
<td>43.7</td>
</tr>
<tr>
<td>02 Impala</td>
<td>Head/Chest Combo</td>
<td>164</td>
<td>42.9</td>
<td>63</td>
<td>49.6</td>
</tr>
<tr>
<td><strong>FMVSS 214 Tests – Driver Data</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01 Focus</td>
<td>None</td>
<td>181</td>
<td>30.4</td>
<td>72</td>
<td>37.9</td>
</tr>
<tr>
<td>02 Impala</td>
<td>Head/Chest Combo</td>
<td>76</td>
<td>26.0</td>
<td>52</td>
<td>35.1</td>
</tr>
<tr>
<td>01 Buick Le Sabre</td>
<td>Thorax</td>
<td>130</td>
<td>41.2</td>
<td>67</td>
<td>39.8</td>
</tr>
<tr>
<td>04 Honda Accord</td>
<td>Curtain + Thorax</td>
<td>103</td>
<td>44</td>
<td>51</td>
<td>44</td>
</tr>
</tbody>
</table>

*Sum of Iliac and Acetabular loads