Side Impact Crash Testing with the 50th Percentile Male WorldSID

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NHTSA
Outline

- Background
- WorldSID Information
- Test Details
- Test Results
- Observations
- Future Research
Background

- FMVSS 214 final rule released in September 2007
- Updated the dummies and test configurations
  - Added ES2re (50th male) and SIDIIIs (5th female)
  - 20 mph oblique pole and MDB test configurations
- NHTSA states it will begin evaluations with the WorldSID dummy
- Dynamic pole tests have been conducted in 2007 and 2008 with the same fleet vehicles used to evaluate the ES2re.
50th Percentile Male WorldSID Dummy

- Development of dummy began in 1997
- Made available in 2004
- Represents a mid-sized adult male occupant
- More measurement capabilities (up to 200 channels)
  - IRTRAC rib (5) and shoulder deflections
  - Rotational head accels
  - Onboard data acq.
Comparison of ES2, WorldSID, and SID/H3

<table>
<thead>
<tr>
<th></th>
<th>WorldSID</th>
<th>ES2</th>
<th>SID/H3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder width</td>
<td>480</td>
<td>485</td>
<td>473</td>
</tr>
<tr>
<td>Thorax width (nipple)</td>
<td>371</td>
<td>337</td>
<td>NA</td>
</tr>
<tr>
<td>Pelvis width</td>
<td>410</td>
<td>355</td>
<td>372</td>
</tr>
<tr>
<td>Sitting height (neck/torso interface)</td>
<td>600</td>
<td>660</td>
<td>NA</td>
</tr>
<tr>
<td>Sitting height (erect)</td>
<td>870</td>
<td>920</td>
<td>919</td>
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</table>
Comparison of WorldSID and ES2

Erect Seating Posture

**WorldSID**

- Knee, top edge
- Knee, front edge
- Pelvis, back edge
- Shoe, top edge

**ES-2**

- Knee, top edge
- Knee, front edge
- Pelvis, back edge
- Shoe, top edge

Hartlieb, Siebert, Reischelt
WorldSID TC Meeting, San Diego, 2003-10-20
Test Setup
Test Vehicles

- 2004 Honda Accord
- 2005 Subaru Forester
- 2006 Toyota Sienna
- 2005 Ford 500
- 2006 VW Jetta
- 2005 Saturn Ion
- 2005 Ford Expedition
- 2005 VW Beetle Convertible
Test Setup

- Used draft WS seating procedure V. 1.0. with minor adjustments
- Aligned vehicle at 75 degrees
- Aligned head CG with the centerline of pole
- Test Speed: 32kph
- Dummy instrumented with 3 G5 units (~90 channels)
Seating Procedure
WorldSID Seating Procedure Draft 1.0

- Placed seat according to current FMVSS 214 procedure for 50th Male (S8.3.1 and S10.3.1)
  - At rearmost position find mid angle of cushion, keeping mid angle, adjust to lowest position, move seat to midtrack
  - Oscar the seat at this position

- Began with step #20 of seating procedure
  - “Draft Test Procedure V.1.0”, 6/6/06

- Adjusted dummy using the tilt sensors
  - Head, thorax and pelvis were adjusted to 0±2°
Test Results
Currently there are not IARV’s associated with WorldSID.

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<tbody>
<tr>
<td>2006 VW Jetta (C+T)</td>
<td>528</td>
<td>48.1</td>
<td>49.9</td>
<td>63.3</td>
<td>1001.9</td>
<td>56.6</td>
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<td>2005 Saturn Ion ( C )</td>
<td>612</td>
<td>49.0</td>
<td>70.1</td>
<td>79.8</td>
<td>1263.9</td>
<td>68.1</td>
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<td>2005 Honda Accord (C+T)</td>
<td>380</td>
<td>26.2</td>
<td>28.8</td>
<td>51.7</td>
<td>1304.5</td>
<td>53.0</td>
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<td>2005 Ford 500 (C+T)</td>
<td>1609</td>
<td>62.4</td>
<td>65.7</td>
<td>82.0</td>
<td>1208.6</td>
<td>66.0</td>
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<tr>
<td>2005 Subaru Forester (Combo)</td>
<td>1463</td>
<td>60.8</td>
<td>36.6</td>
<td>79.3</td>
<td>1227.4</td>
<td>77.0</td>
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<tr>
<td>2006 Toyoto Sienna (C+T)</td>
<td>418</td>
<td>38.0</td>
<td>52.3</td>
<td>67.9</td>
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<tr>
<td>2005 VW Beetle Convertible (Combo)</td>
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<td>36.3</td>
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<td>76.6</td>
<td>1269.9</td>
<td>85.9</td>
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WorldSID
VW Beetle and Toyota Sienna
Thorax Deflections

- 2005 Volkswagen Jetta
- 2004 Honda Accord
- 2005 Subaru Forester
- 2005 Ford 500
- 2005 VW Beetle Convertible
- 2005 Saturn Ion
- 2005 Ford Expedition
- 2005 Toyota Sienna

Graph showing Thorax Rib 1, 2, and 3 Deflections for different vehicles.
Abdomen Deflections

- 2005 Volkswagen Jetta
- 2004 Honda Accord
- 2005 Subaru Forester
- 2005 Ford 500
- 2005 Toyota Sienna
- 2005 Ford Expedition

Abdomen Rib Deflections

- Dummy Responses (mm)

Graph showing comparisons of abdomen rib deflections for different car models.
Lower Spine Resultant Accelerations (T12)

- 2005 Volkswagen Jetta
- 2004 Honda Accord
- 2005 Subaru Forester
- 2005 VW Beetle Convertible
- 2005 Saturn Ion
- 2005 Ford 500
- 2005 Ford Expedition
- 2005 Toyota Sienna

Dummy Responses (g's)
Pubic Symphysis Force

- 2005 Volkswagen Jetta
- 2004 Honda Accord
- 2005 Subaru Forester
- 2005 Volkswagen Beetle Convertible
- 2005 Saturn Ion
- 2005 Ford 500
- 2005 Ford Expedition
- 2005 Toyota Sienna
Pelvis Resultant Acceleration

- 2005 Volkswagen Jetta
- 2004 Honda Accord
- 2005 Subaru Forester
- 2005 VW Beetle Convertible
- 2005 Saturn Ion
- 2005 Ford 500
- 2005 Ford Expedition
- 2005 Toyota Sienna
Observations

- Overall dummy durability and dummy responses were good
  - Minor damage
    - IRTRAC
    - Rib delamination
  - Deflection responses
  - Head position
IRTRAC Damage
IRTRAC Damage
Shoulder rib delaminating
Deflection reached maximum?

Shoulder Y-Axis Displacement

- 2004 Honda Accord Max = 47.262 mm at 52 ms
- 2005 Subaru Forester Max = 64.699 mm at 30 ms
- 2006 Volkswagen Jetta Max = 63.761 mm at 49 ms
- 2005 Saturn Ion Max = 64.154 mm at 46 ms
- 2005 Ford 500 Max = 66.729 mm at 61 ms
- 2006 Toyota Sienna Max = 51.555 mm at 55 ms
- 2005 Volkswagen Beetle Max = 35.518 mm at 55 ms
- 2005 Ford Expedition Max = 28.597 mm at 63 ms
ES2re vs WorldSID
HIC 36

- 2005/2006 VW Jetta
- 2005 Saturn Ion
- 2004 Honda Accord
- 2005 Ford 500
- 2005 Subaru Forester
- 2006 Toyota Sienna
- 2005 VW Beetle Conv
- 2005 Ford Expedition

Dummy Responses (g's)

ES2re vs WorldSID

- 2054 g's
- 3680 g's
Why different?
Possible answers

- Ford 500-
  - Possible Sensor issue- airbags deployed at different times
    - WorldSID test- air bag deployed later in the event (22ms vs 37ms)
    - WorldSID sits differently in the seat
- VW Beetle and Subaru Forester-
  - Combination head and thorax bags
    - bags did not get between head and pole
2005 Ford 500

Minor differences in seating

ES2re

WorldSID
2005 VW Beetle
Airbag inflation issue

ES2re

WorldSID
Future NHTSA Research

- FMVSS 214 MDB tests with 2 WorldSID 50th male dummies
- Analyze data and compare with the ES2re dummy
- Bio-Mechanics Group:
  - R&R testing
  - Biofidelity testing
- Begin evaluation of the 5th female WorldSID dummy
Questions?

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