WorldSID 50th Update

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on behalf of the WorldSID Task Group

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Outline

► Retrospective
► ISO - WorldSID 50th Evaluation
► NHTSA - WorldSID 50th Evaluation
► Further Activities
► Summary
Retrospective

- Last WorldSID Update at 42\textsuperscript{nd} session in December 2007
- Release of WorldSID 50\textsuperscript{th} production version on March 9\textsuperscript{th}, 2004
  - Developed by over 45 organizations from around the world
    - Governmental agencies, research institutes, automotive manufacturers
  - Full vehicle tests covering all side impact test procedures
  - Extensive sled-, component- and certification test series
- Fully evaluated in more than 1000 tests worldwide
  - WorldSID meets the ISO specifications
- WorldSID International Standard - ISO 15830
  - Documentation available since 2005
- Start of NHTSA WorldSID evaluation in 2004
ISO - WorldSID 50th Evaluation

- WorldSID Biofidelity rating according to ISO TR9790
- WorldSID Testing conducted by OSRP, Transport Canada, and NHTSA
- WorldSID Task Group and NHTSA conducted similar sled tests
  - Data is similar between the two organizations
  - Calculated ISO biofidelity rating using ISO data and NHTSA data
- ISO evaluation finalized in 2007
# ISO - WorldSID 50th Evaluation

- Biofidelity Rating according to ISO TR9790
  - Comparison of ES-2re vs WorldSID

<table>
<thead>
<tr>
<th>Body Region</th>
<th>ES-2re</th>
<th>WorldSID Ford (OSRP)</th>
<th>WorldSID NHTSA/VRTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>5</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Neck</td>
<td>4.2</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Shoulder</td>
<td>4.5</td>
<td>8.3</td>
<td>8.3</td>
</tr>
<tr>
<td>Thorax</td>
<td>4.0</td>
<td>7.4</td>
<td>7.5</td>
</tr>
<tr>
<td>Abdomen</td>
<td>4.1</td>
<td>7.5</td>
<td>7.3</td>
</tr>
<tr>
<td>Pelvis</td>
<td>3.2</td>
<td>4.4</td>
<td>4.8</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td><strong>4.2</strong></td>
<td><strong>7.1</strong></td>
<td><strong>7.2</strong></td>
</tr>
</tbody>
</table>

Unacceptable: 0  
Marginal: 2.6  
Fair: 4.4  
Good: 6.5  
Excellent: 8.6  

ISO - WorldSID 50th Evaluation

Comparison of ES-2re vs WorldSID

X Biofidelity Rating according to ISO TR9790

**“GOOD”**
NHTSA - WorldSID 50th Evaluation

- Two instrumented WorldSID 50th provided by OSRP
- Evaluation tests conducted at NHTSA/VRTC laboratory
  - Tests focused on:
    - Biofidelity
      - NHTSA rating (Rhule 2002)
    - Anthropometry
    - WorldSID full scale evaluation under FMVSS 214 test conditions
- NHTSA - WorldSID 50th evaluation finalized in mid 2008
NHTSA - WorldSID 50th Evaluation

- NHTSA Biofidelity Rating (Rhule 2002)
  - External biofidelity:
    - Ability to replicate human loading of its environment in a crash
    - Measurements made externally to human and dummy
  - Internal biofidelity:
    - Ability to replicate human internal response in a crash
    - Internal measurements used for injury criteria
### NHTSA - WorldSID 50th Evaluation

**NHTSA Biofidelity Rating (Rhule 2002)**

**Test matrix**

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Test Name</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 mm Rigid Lateral Head Drop</td>
<td>Head Test 1</td>
<td>ISO 9790 - Head Test 1</td>
</tr>
<tr>
<td>7.2 g Restrained Occupant Sled</td>
<td>Neck Test 1</td>
<td>ISO 9790 - Neck Test 1 &amp; Shoulder Test 3</td>
</tr>
<tr>
<td>12.2 g Restrained Occupant Sled</td>
<td>Neck Test 3</td>
<td>ISO 9790 - Neck Test 3 &amp; Shoulder Test 3</td>
</tr>
<tr>
<td>4.3 m/s Rigid Pendulum Lateral and Oblique Thorax Impact</td>
<td>Thorax Test 1</td>
<td>ISO 9790 - Thorax Test 1</td>
</tr>
<tr>
<td>6.8 m/s Rigid Wall Sled</td>
<td>Heidelberg Sled Test</td>
<td>ISO 9790 - Thorax Test 5 &amp; Pelvis Test 7</td>
</tr>
<tr>
<td>6.8 m/s Rigid Wall Sled</td>
<td>Wayne State Sled Test</td>
<td>ISO 9790 - Abdomen Test 3 &amp; Pelvis Test 10</td>
</tr>
<tr>
<td>6 m/s Rigid Pendulum Pelvis Impact</td>
<td>Pelvis Test 1</td>
<td>ISO 9790 - Pelvis Test 1</td>
</tr>
<tr>
<td>10 m/s Rigid Pendulum Pelvis Impact</td>
<td>Pelvis Test 2</td>
<td>ISO 9790 - Pelvis Test 2</td>
</tr>
<tr>
<td>4.4 m/s Padded Pendulum Lateral and Oblique Shoulder Impact</td>
<td>NHTSA Shoulder Test</td>
<td>Bolte et al. 2003</td>
</tr>
<tr>
<td>2.5 m/s Rigid Pendulum Lateral and Oblique Thorax Impact</td>
<td>NHTSA Thorax Test</td>
<td>Shaw et al. 2006</td>
</tr>
<tr>
<td>6.7 m/s Flat Rigid Wall Sled</td>
<td>NHTSA LS FR</td>
<td>Maltese et al. 2002</td>
</tr>
<tr>
<td>6.7 m/s Flat Padded Wall Sled</td>
<td>NHTSA LS FP</td>
<td>Maltese et al. 2002</td>
</tr>
<tr>
<td>6.7 m/s Rigid Abdomen Offset Sled</td>
<td>NHTSA LS RAO</td>
<td>Maltese et al. 2002</td>
</tr>
<tr>
<td>6.7 m/s Rigid Pelvis Offset Sled</td>
<td>NHTSA LS RPO</td>
<td>Maltese et al. 2002</td>
</tr>
<tr>
<td>8.9 m/s Flat Padded Wall Sled</td>
<td>NHTSA HS FP</td>
<td>Maltese et al. 2002</td>
</tr>
</tbody>
</table>
NHTSA - WorldSID 50th Evaluation

- NHTSA Biofidelity Rating (Rhule 2002)
  - External biofidelity - Comparison of ES-2re vs WorldSID

![Bar chart showing biofidelity ratings for different body parts (Neck, Shoulder, Thorax, Abdomen, Pelvis, Overall) for WorldSID and ES-2re. The chart indicates good biofidelity with average values for each body part highlighted in green and yellow bars.]

- WorldSID
- ES-2re

- Average VR

- Neck: WorldSID 0.8, ES-2re 1.9
- Shoulder: WorldSID 0.8, ES-2re 1.9
- Thorax: WorldSID 3.0, ES-2re 2.9
- Abdomen: WorldSID 1.9, ES-2re 2.7
- Pelvis: WorldSID 2.8, ES-2re 4.8
- Overall: WorldSID 1.9, ES-2re 3.2

Good Biofidelity
NHTSA - WorldSID 50th Evaluation

NHTSA Biofidelity Rating (Rhule 2002)
- Internal biofidelity - Comparison of ES-2re vs WorldSID

- **WorldSID**  
  - Average, N\(R\)
  - Head: 1.0  
  - Shoulder: 1.9  
  - Thorax: 2.0  
  - Abdomen: 2.4  
  - Pelvis: 1.8

- **ES-2re**
  - No measurement of abdomen deflection available.

- **Overall (w/o Abdomen)**
  - WorldSID: 1.6  
  - ES-2re: 1.7

**Good Biofidelity**
NHTSA - WorldSID 50th Evaluation

NHTSA Biofidelity Results:
- Good repeatability
- Good reproducibility
- Good durability
- Good handling
- Good biofidelity rating according to ISO TR9790
- Good biofidelity rating based on NHTSA rating scheme

The WorldSID 50th male dummy is an improved side impact test dummy
NHTSA - WorldSID 50th Evaluation

- Anthropometry study
  - UMTRI Manikin as reference
NHTSA - WorldSID 50th Evaluation

- Anthropometry study
  - ES-2re versus UMTRI seating

![Anthropometry study diagram with ES-2re versus UMTRI seating](image)

- Head CG
- Shoulder Joint
- Thorax Rib 1
- Thorax Rib 2
- Thorax Rib 3
- Abdomen Force
- H-Point
NHTSA - WorldSID 50th Evaluation

► Anthropometry study
  ● WorldSID versus UMTRI seating

WorldSID

- Head CG
- Shoulder Joint
- Thorax Rib 1
- Thorax Rib 2
- Thorax Rib 3
- Abdomen Rib 1
- Abdomen Rib 2
- H-Point
NHTSA - WorldSID 50th Evaluation

- Anthropometry study
- WorldSID versus ES-2re in UMTRI seating

WorldSID
- Head CG
- Shoulder Joint
- Thorax Rib 1
- Thorax Rib 2
- Thorax Rib 3
- Abdomen Rib 1
- Abdomen Rib 2
- H-Point

ES-2re
- Head CG
- Shoulder Joint
- Thorax Rib 1
- Thorax Rib 2
- Thorax Rib 3
- Abdomen Force
- H-Point
Results of anthropometry study:

- WorldSID anthropometry based on UMTRI
- ES-2re anthropometry based on Hybrid-III

<table>
<thead>
<tr>
<th></th>
<th>WorldSID</th>
<th>ES-2re</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder width</td>
<td>480</td>
<td>485</td>
</tr>
<tr>
<td>Thorax width (nipple)</td>
<td>371</td>
<td>337</td>
</tr>
<tr>
<td>Pelvis width</td>
<td>410</td>
<td>355</td>
</tr>
<tr>
<td>Sitting height (neck/torso interface)</td>
<td>600</td>
<td>660</td>
</tr>
<tr>
<td>Sitting height (erect)</td>
<td>870</td>
<td>920</td>
</tr>
<tr>
<td>Leg Length</td>
<td>555</td>
<td>452</td>
</tr>
</tbody>
</table>

- WorldSID has a more “slouched” position

The WorldSID anthropometry is more realistic
NHTSA - WorldSID 50th Evaluation

- NHTSA full scale evaluation under FMVSS 214 test conditions
  - Pole & MDB
  - Same fleet vehicles used to evaluate the ES-2re

**FMVSS 214 Pole Test**
- 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)

**FMVSS 214 MDB Test**
- 2005 Subaru Forester
- 2005 Ford 500
- 2006 VW Jetta
- 2005 Saturn Ion
- 2005 Honda CRV

- WorldSID IARVs proposed by WorldSID TG
- WorldSID seating procedure (Draft 1.0) provided by dummy positioning sub-committee
NHTSA - WorldSID 50th Evaluation

Results of NHTSA full scale evaluation

- Good durability
  - MDB tests - no damages on WorldSID
  - Pole tests - minor damages reported

MDB Test Summary
(Currently no detailed analyses available)

- All vehicles passed IARVs for both ES-2re and WorldSID
- WorldSID tests produced more marginal responses
- Differences are more pronounced in the pole testing

Pole Test Summary
(CURRENTLY no detailed analyses available)

- 5 out of 8 vehicles exceeded IARVs for both ES-2re and WorldSID
Results of NHTSA full scale evaluation (cont.)

- Due to different anthropometry, body regions of ES-2re and WorldSID are in different locations.
- Different head positions produce different impact locations in pole tests.
- Thorax and abdomens are aligned differently with the vehicle interior.

Test data available at NHTSA webpage:

Further Activities

**NHTSA:**

- Preparation of documentation needed to Federalize the WorldSID 50th Male
- Injury criteria development
- Evaluation of seating procedure
- Evaluation of WorldSID 5th Female

**EU:**

- Request to EEVC-SC for WorldSID 50th Male evaluation according to the EEVC requirements
Further Activities

TRANSPORT CANADA:

► Comparison of WorldSID 50th Male response to ES2re response in FMVSS 214 barrier tests

► Finalization of the harmonized seating procedure for WorldSID 50th in mid of 2009

► Evaluation of multipoint sensing (RibEye) in WorldSID 50th (March 2009)

► Biofidelity evaluation of updated WorldSID 5th Female

► Evaluation of updated WorldSID 5th Female in full scale reconstruction of a pole crash.
Further Activities

ISO:

- Upgrade of ISO 15830 documents will be finalized early 2009
- Development of Injury Risk Curves for WorldSID 50th Male by ISO TC22/SC12/WG6 working group (ISO TR12350)
  - Completion expected by May 2009
Summary

► NHTSA WorldSID 50th evaluation is completed successfully
► WorldSID 50th biofidelity is better than ES-2re in both rating schemes (NHTSA & ISO)
► Good durability, repeatability, reproducibility and usability
► WorldSID 50th anthropometry is more realistic

The WorldSID 50th male dummy is an improved side impact test dummy
Thank you!

www.worldsid.org