Evaluation of the side impact test procedure proposed by IHRA/CIWG

SP1: Car Accidents
WP1.1: Advanced side impact and compatibility
Task 1.1.4: Side Out of Position

Luis Martinez - INSIA-UPM
SP1 Car accidents. 1.1 Lateral impacts
IHRA/SIWG proposed test suite

- Advanced protection in multi-vehicle lateral crashes
- Protection in single crashes involving narrow objects
- Improved head protection in lateral impacts
- Evaluating risk from deploying side airbags

• All WP1.1 partners:
  - BAST
  - CRF
  - IDIADA
  - Takata-Petri
  - Toyota
  - TNO
  - TRL
  - TUG
  - VW

GRSP informal group on CRS - May 13, 2008
Side Out of Position.

Objectives

• Review appropriateness of and evaluate the IHRA / TWG proposal for Europe.
TWG Report
Recommended Procedures For Evaluating Occupant Injury Risk From Deploying Side Airbags

ISO TR 14933
Road vehicles — Test procedures for Evaluating occupant interactions with Deploying side impact airbags
## Side Out of Position Target positions.TWG (ISO 14933).

- **3-year-child**
- **6-year-child**
- **5%-female**

<table>
<thead>
<tr>
<th>Not Critical =&gt; skip</th>
<th>Seat-mounted</th>
<th>Door-mounted</th>
<th>Roof-rail-mounted</th>
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</thead>
<tbody>
<tr>
<td><img src="image" alt="3-year-child" /></td>
<td><img src="image" alt="3-year-child" /></td>
<td><img src="image" alt="3-year-child" /></td>
<td><img src="image" alt="3-year-child" /></td>
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<td><img src="image" alt="6-year-child" /></td>
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<td><img src="image" alt="5%-female" /></td>
<td><img src="image" alt="5%-female" /></td>
<td><img src="image" alt="5%-female" /></td>
</tr>
</tbody>
</table>

- Maybe critical => investigate
Side Out of Position Approach

- Limited evaluation of IHRA protocol:
  - Focus on EU situation.
    - Forward facing: Hybrid-III 3yo, 6yo, SID-IIs.
    - Rearward facing: Hybrid-III 3yo.
  - Only curtain and seat mounted side airbags.
  - Including repeatability & reproducibility.

- Effects of CRS:
  - Fair and good group II&III seats.
  - Seat mounted side airbags and head thorax bags.
  - Forward facing: Hybrid-III 3yo, 6yo.
Side Out of Position
Effect of the CRS

- Test laboratories:
  - IDIADA  Hybrid III 3y dummy.
  - TNOHybrid III 6y dummy.
- Test vehicle / airbag:
  - Toyota Corolla / seat mounted airbags.
- Test period:
### Test program

<table>
<thead>
<tr>
<th>Code</th>
<th>Age</th>
<th>Type</th>
<th>Description</th>
<th>CRS</th>
<th>Age Group</th>
<th>Model</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>D-1</td>
<td>3yr old</td>
<td>3.3.3.1 Forward facing</td>
<td>Simple (WH Vario-Kid)</td>
<td>no</td>
<td>Hybrid III 3yr</td>
<td>1</td>
<td>Toyota 2</td>
</tr>
<tr>
<td>D-2</td>
<td>3yr old</td>
<td>3.3.3.1 Forward facing</td>
<td>Contoured (Romer Kid with backrest)</td>
<td>CRS 1</td>
<td>Hybrid III 3yr</td>
<td>1</td>
<td>Toyota 2</td>
</tr>
<tr>
<td>D-3</td>
<td>3yr old</td>
<td>3.3.3.1 Forward facing</td>
<td>Contoured (Romer Kid with backrest)</td>
<td>CRS 2</td>
<td>Hybrid III 3yr</td>
<td>1</td>
<td>Toyota 2</td>
</tr>
<tr>
<td>E-1</td>
<td>6yr old</td>
<td>3.3.3.5 Forward facing</td>
<td>no</td>
<td>Hybrid III 6yr</td>
<td>1</td>
<td>Toyota 2</td>
<td>2</td>
</tr>
<tr>
<td>E-2</td>
<td>6yr old</td>
<td>3.3.3.5 Forward facing</td>
<td>Simple booster cushion (Sunny)</td>
<td>CRS 3</td>
<td>Hybrid III 6yr</td>
<td>1</td>
<td>Toyota 3</td>
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<tr>
<td>E-3</td>
<td>6yr old</td>
<td>3.3.3.5 Forward facing</td>
<td>Simple (WH Vario-Kid)</td>
<td>CRS 1</td>
<td>Hybrid III 6yr</td>
<td>1</td>
<td>Toyota 3</td>
</tr>
<tr>
<td>E-4</td>
<td>6yr old</td>
<td>3.3.3.5 Forward facing</td>
<td>Contoured (Romer Kid with backrest)</td>
<td>CRS 2</td>
<td>Hybrid III 6yr</td>
<td>1</td>
<td>Toyota 3</td>
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<tr>
<td>E-5</td>
<td>6yr old</td>
<td>3.3.3.5 Forward facing</td>
<td>Contoured (Romer Kid without backrest)</td>
<td>CRS 4</td>
<td>Hybrid III 6yr</td>
<td>1</td>
<td>Toyota 3</td>
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<tr>
<td>Total</td>
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<td></td>
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</tr>
</tbody>
</table>
Side Out of Position Test specifications

- IHRA SIWG protocol / 3yo/6yo Forward facing.
- CRS installation according to manual.
- CRS OOP positions according “APROSYs workshop”
- Dummy instrumentation:
  - Focussed on draft injury criteria.
    - Head acceleration.
    - Upper/lower neck forces and moments.
    - Chest acceleration.
    - Sternum deflection.
Side Out of Position
CRS selection

- All CRS ECR R44 approved.
- Selection based on ADAC results.
- “Good” seat:
  - Römer KID / with & without back rest.
- “Poor” seats:
  - Simple booster (“supermarket”).
  - IWH variokid.
## Side Out of Position

### Test results / Injury criteria limits

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Unit</th>
<th>HIII 3yo</th>
<th>HIII 6yo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• HIC 15</td>
<td></td>
<td>570</td>
<td>723</td>
</tr>
<tr>
<td>Upper neck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Nij</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>• Tension force (+Fz)</td>
<td>kN</td>
<td>1.13</td>
<td>1.49</td>
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<tr>
<td>• Compression force (-Fz)</td>
<td>kN</td>
<td>1.38</td>
<td>1.82</td>
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<tr>
<td>Thorax</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Sternum deflection</td>
<td>mm</td>
<td>36</td>
<td>40</td>
</tr>
<tr>
<td>• Deflection rate</td>
<td>m/s</td>
<td>8</td>
<td>8.5</td>
</tr>
</tbody>
</table>
Side Out of Position
Test results / Hybrid III 3yo
## Test results / Hybrid III 6yo

<table>
<thead>
<tr>
<th></th>
<th>No backrest</th>
<th>with backrest</th>
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</thead>
<tbody>
<tr>
<td>HIC 15</td>
<td>723</td>
<td>1.6</td>
</tr>
<tr>
<td>Nij</td>
<td>1</td>
<td>0.33</td>
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<tr>
<td>Tension</td>
<td>1.49</td>
<td>0.14</td>
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<tr>
<td>Compression</td>
<td>1.82</td>
<td>0.18</td>
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<tr>
<td>Deflection</td>
<td>40</td>
<td>0.3</td>
</tr>
<tr>
<td>Deflection rate</td>
<td>8.5</td>
<td>1.54</td>
</tr>
</tbody>
</table>

![Graph showing test results](image)

**Graph**
- **HIC 15**
- **Nij**
- **Tension**
- **Compression**
- **Deflection**
- **Deflection rate**
Side Out of Position
Test results / Hybrid III 3yo
Side Out of Position
Test results / Hybrid III 3yo
Side Out of Position
Test results / Hybrid III 6yo
Side Out of Position
Test CRS conclusions

• No serious airbag interaction (loading < 15%) between airbag and child in CRS.
• Most injury values lower than “standard” IHRA scenarios.
• Neck tension force higher with CRS but still very low <10%.
• OOP in case of use of group I CRS not an issue, results with booster comparable with “standard” IHRA.
• No significant difference between “good” and “poor” CRS.
Side Out of Position

Main findings

- IHRA/TWG reproducibility very difficult, repeatability is possible.

- TWG interpretation needs clarification (a.o. seat foremost/rearmost position).

- Tests with CRS show that to cover the EU situation, the TWG proposal covers the worst case situation.

- From accident studies: side OOP is not (yet?) an issue in Europe.

- Any new tendency to (re)introduction of door mounted airbags in Europe should carefully be monitored because of the potential higher injury risk in case of out-of-position.
THANKS FOR YOUR ATTENTION!!!