WorldSID Status Report

October 2011
Background

• 2009-2011: Seating Evaluation
  – FMVSS 214 (WS & ES2-re)
  – WS Version 5.1 - 5.4 (WS)
  – UMTRI (WS)
  – FMVSS 214 (-20mm midtrack) (WS)

• Differences between the WS seating procedures and FMVSS 214
  – Initial seat setup
    • WS 5.4: midtrack - 20mm
    • WS 5.4 lowers the seat to lowest, taking out pitch of seat in some cases
  – OSCAR tolerance
    • WS H-point: Add 20mm +/-5mm
    • ES2-re H-point: (+/-) 10 mm
Observations from Seating Evaluation

- Head CG differences
- Similar final target H-points
- **Issues with leg lengths at FMVSS 214 (midtrack position)**
- Recommendations for WS seating procedure
  - Use FMVSS 214 seat cushion setup (mid angle / lowest height) with seat track at midtrack-20mm
  - Use WS5.4 in setting the dummy (tilt sensors) + Oscar H-point tolerance
Fleet Testing
Injury Criteria

- **Current regulation FMVSS 214**
  - ES2-re injury limits based on AIS 3 with 50% risk of injury except for pelvic criterion
    - HIC36: 1000
    - Chest: 44mm
    - Abdominal Force: 2500 N
    - Pubic Force: 6000N
    - Lower Spine: 82 g’s (monitored)

- **WorldSID (not approved)**
  - Using similar reasoning as the ES2-re (AIS 3 with 50% risk of injury except for pelvic and shoulder*)
    - HIC36: 1000
    - Thoracic Rib Def.: 57mm
    - Abdomen Def.: 57mm
    - Pubic Force: 2780 N
    - Lower Spine: 105 g’s
    - Shoulder Def: 65mm
    - Shoulder Force: 2560N

*Injury Risk Curves from 2009 & 2010 Stapp Papers on Injury Criterion by Audrey Petijean
<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Dummy</th>
<th>HIC36</th>
<th>Shoulder Deflection (mm)</th>
<th>Max Thorax Rib Deflection (mm)</th>
<th>Max Abdomen Rib Deflection (mm)</th>
<th>Lower Spine (G's)</th>
<th>Pubic Force (N)</th>
<th>Pelvis Resultant Acceleration (G's)</th>
<th>Abdominal Force (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury Values</td>
<td>WS</td>
<td>1000</td>
<td>65</td>
<td>57</td>
<td>57</td>
<td>75</td>
<td>2780</td>
<td>105</td>
<td>n/a</td>
</tr>
<tr>
<td>(AIS3)</td>
<td>ES2-re</td>
<td>1000</td>
<td>n/a</td>
<td>44</td>
<td>n/a</td>
<td>82 (monitored)</td>
<td>6000N</td>
<td>n/a</td>
<td>2500</td>
</tr>
<tr>
<td>Compact</td>
<td>WS</td>
<td>195</td>
<td>25</td>
<td>35</td>
<td>42</td>
<td>53</td>
<td>1107</td>
<td>69</td>
<td>n/a</td>
</tr>
<tr>
<td>PC1</td>
<td>ES2-re</td>
<td>183</td>
<td>n/a</td>
<td>29</td>
<td>not instrumented</td>
<td></td>
<td>2265</td>
<td>not instrumented</td>
<td>1765</td>
</tr>
<tr>
<td>Compact</td>
<td>WS</td>
<td>491</td>
<td>55</td>
<td>25</td>
<td>34</td>
<td>46</td>
<td>1151</td>
<td>79</td>
<td>n/a</td>
</tr>
<tr>
<td>PC2</td>
<td>ES2-re</td>
<td>545</td>
<td>n/a</td>
<td>26</td>
<td>not instrumented</td>
<td></td>
<td>2570</td>
<td>not instrumented</td>
<td>1410</td>
</tr>
<tr>
<td>MID Size</td>
<td>WS</td>
<td>250</td>
<td>57</td>
<td>32</td>
<td>44</td>
<td>73</td>
<td>1433</td>
<td>72</td>
<td>n/a</td>
</tr>
<tr>
<td>PC1</td>
<td>ES2-re</td>
<td>354</td>
<td>n/a</td>
<td>24</td>
<td>not instrumented</td>
<td></td>
<td>2182</td>
<td>not instrumented</td>
<td>1305</td>
</tr>
<tr>
<td>MID Size</td>
<td>WS</td>
<td>577</td>
<td>54</td>
<td>43</td>
<td>26</td>
<td>61</td>
<td>1201</td>
<td>87</td>
<td>n/a</td>
</tr>
<tr>
<td>PC2</td>
<td>ES2-re</td>
<td>402</td>
<td>n/a</td>
<td>23</td>
<td>not instrumented</td>
<td></td>
<td>2752</td>
<td>not instrumented</td>
<td>1051</td>
</tr>
<tr>
<td>Large PC</td>
<td>WS</td>
<td>514</td>
<td>51</td>
<td>56</td>
<td>40</td>
<td>57</td>
<td>925</td>
<td>47</td>
<td>n/a</td>
</tr>
<tr>
<td>Compact</td>
<td>WS</td>
<td>452</td>
<td>55</td>
<td>35</td>
<td>42</td>
<td>57</td>
<td>936</td>
<td>54</td>
<td>n/a</td>
</tr>
<tr>
<td>SUV</td>
<td>ES2-re</td>
<td>351</td>
<td>n/a</td>
<td>34</td>
<td>not instrumented</td>
<td></td>
<td>2093</td>
<td>not instrumented</td>
<td>1523</td>
</tr>
<tr>
<td>Mid Size</td>
<td>WS</td>
<td>470</td>
<td>62</td>
<td>29</td>
<td>42</td>
<td>54</td>
<td>812</td>
<td>52</td>
<td>n/a</td>
</tr>
<tr>
<td>SUV1</td>
<td>ES2-re</td>
<td>527</td>
<td>n/a</td>
<td>38</td>
<td>not instrumented</td>
<td></td>
<td>1614</td>
<td>not instrumented</td>
<td>not calculated</td>
</tr>
<tr>
<td>MID Size</td>
<td>WS</td>
<td>439</td>
<td>66</td>
<td>46</td>
<td>36</td>
<td>54</td>
<td>1557</td>
<td>71</td>
<td>n/a</td>
</tr>
<tr>
<td>SUV2</td>
<td>ES2-re</td>
<td>262</td>
<td>n/a</td>
<td>37</td>
<td>not instrumented</td>
<td></td>
<td>2697</td>
<td>not instrumented</td>
<td>1248</td>
</tr>
<tr>
<td>Large</td>
<td>WS</td>
<td>332</td>
<td>51</td>
<td>30</td>
<td>23</td>
<td>36</td>
<td>1227</td>
<td>58</td>
<td>n/a</td>
</tr>
<tr>
<td>SUV1</td>
<td>ES2-re</td>
<td>497</td>
<td>n/a</td>
<td>32</td>
<td>not instrumented</td>
<td></td>
<td>1248</td>
<td>not instrumented</td>
<td>1545</td>
</tr>
<tr>
<td>Large</td>
<td>WS</td>
<td>393</td>
<td>60</td>
<td>43</td>
<td>39</td>
<td>81</td>
<td>912</td>
<td>81</td>
<td>n/a</td>
</tr>
<tr>
<td>SUV2</td>
<td>ES2-re</td>
<td>311</td>
<td>n/a</td>
<td>25</td>
<td>not instrumented</td>
<td></td>
<td>2969</td>
<td>not instrumented</td>
<td>818</td>
</tr>
<tr>
<td>Mid Size</td>
<td>WS</td>
<td>367</td>
<td>38</td>
<td>41</td>
<td>33</td>
<td>57</td>
<td>1110</td>
<td>44</td>
<td>n/a</td>
</tr>
<tr>
<td>Truck</td>
<td>ES2-re</td>
<td>516</td>
<td>n/a</td>
<td>31</td>
<td>not instrumented</td>
<td></td>
<td>2575</td>
<td>not instrumented</td>
<td>1349</td>
</tr>
<tr>
<td>Van</td>
<td>WS</td>
<td>413</td>
<td>51</td>
<td>40</td>
<td>41</td>
<td>49</td>
<td>1013</td>
<td>58</td>
<td>n/a</td>
</tr>
</tbody>
</table>
MID Size SUV
ES2-re

SHOULDER

THORAX

ABDOMEN

PELVIS

WorldSID
ES2-re without jacket

WorldSID without jacket
Maximum Thorax Rib Deflection

Deflection (mm)

- Mid Size Truck
- MID Size PC2
- MID Size PC1
- MID Size SUV1
- MID Size SUV2
- Compact PC1
- Compact PC2
- Compact SUV1
- Large PC
- Large SUV1
- Large SUV2
- Van

Deflection (mm)

Deflection (mm)
MID Size SUV

Max Rib Deflection
ES2re Rib 1

Max Rib Deflection
WS Rib 3
WorldSID Shoulder and Thorax Ribs

Deflection (mm)

WS Shoulder Rib
WS Thorax Rib 1
WS Thorax Rib 2
WS Thorax Rib 3
Large SUV

ES2-re

WorldSID
Observations

- WorldSID overall kinematics very similar to ES2-re
- All vehicles ‘passed’ certification with both dummies
  - Some rib responses were elevated (over 80% IARV) for each dummy
  - Abdominal loading was generally higher for the WS than for the ES2-re, although all were below 80% IARV
  - All HICs and pubic forces were below 60% IARV for both dummies
- Several shoulder deflections, lower spine accelerations, and pelvic accelerations were elevated in the WS
  - These were not measured in the ES2-re
- WorldSID dummy: very durable
  - Broke shoulder IRTRAC swivel in 2/12 vehicles