FMVSS 202a Dynamic Evaluation of the Volvo WHIPS Seat

Ford Presentation to NHTSA
FMVSS 202a Alternative Dynamic Test

- Examine field performance of Volvo WHIPS seats versus performance in NHTSA’s dynamic tests.
- Functional equivalency of the dynamic and static requirements.
- Suggested modifications of the dynamic requirements
Volvo WHIPS Seat: Real-World Performance

- Comparing Volvo seats with WHIPS to the previous-generation Volvo seats (Jakobsson and Norin, IRCOBI 2004).
  - There was an 18% reduction for initial soft tissue neck injuries.
  - For soft tissue neck injuries lasting more than 1 year, there was a 36% reduction.

- IIHS reported a 49% reduction in neck injury claim rates with WHIPS compared to previous generation seats (IIHS status report, 10/2002).
Volvo WHI PS Seat: Public Ratings

- **IIHS/IIWPG (2005)**
  - All tested models rated “Good”
    - S40, S60, S80, XC90

- **Folksam/SRA (2005)**
  - All tested models rated Green
    - S40, V50, S60, V70, S80, XC90
# FMVSS 202a Alternative Dynamic Sled Test: Volvo S80

<table>
<thead>
<tr>
<th></th>
<th>Test 1</th>
<th>Test 2</th>
<th>Average (n=15)</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Backset (mm)</td>
<td>--</td>
<td>--</td>
<td>13</td>
<td>55</td>
</tr>
<tr>
<td>Backset in Test (mm)</td>
<td>55</td>
<td>50</td>
<td>52.5</td>
<td></td>
</tr>
<tr>
<td>Head-Torso Angle (Deg)</td>
<td>15.9</td>
<td>16.6</td>
<td>16.3</td>
<td>12</td>
</tr>
<tr>
<td>C7/T1 – My (Nm)</td>
<td>50</td>
<td>41</td>
<td>45.5</td>
<td></td>
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</tbody>
</table>
The 12 degree head-torso rotation requirement may not be functionally equivalent to the static requirements.

- Minimum height
- Backset (Front outboard seating positions)
- Gaps
- Energy Absorption
- Height Retention
- Backset retention, displacement and strength

The 12 degree head-torso rotation requirement may be design/technology restrictive.
Based on paired tests of Saab seats with and without the Self Aligning Head Restraint (SAHR)

- The head-torso rotation was obtained via film analysis using “phantom” reference targets (Viano).

- Not the method required by FMVSS 202a where instrumentation error is +/- 1.5 deg compared to film analysis (Voo et al., SAE 2003-01-0174).

Viano 2002, “Role of the Seat in Rear Crash Safety”
Film Analysis: “Phantom” Reference Targets

- Viano, Role of the Seat in Rear Crash Safety, SAE 2002.
Dynamic Test Option: 12 Degree Injury Criterion

- Based on one type of seat: with SAHR (Saab 9-3) and without SAHR (Saab 9000)
  - At 16 km/hr $\Delta V$ (approximates Dynamic Test Alternative $\Delta V$ of 17.3 km/hr)
    - Two tests with Saab 9-3 (SAHR)
    - Two tests with Saab 9000 (w/o SAHR)

- 12 Degree injury criterion may not accurately represent other head restraints/ seats (including other active systems)

Ref: NHTSA 2004-19807-5
NHTSA Head to Torso Rotation
Risk of Injury Curve
Dynamic Test Proposal

- Increase the head-to-torso rotation limit to 20°
  - Approximately represents a 11% risk of whiplash injury (AIS 1) according to the NHTSA probability curve.
  - Significantly lower than the 18.8% injury risk level allowed for moderate head injuries (AIS 2) by the HIC requirement of 500.
  - Will be less design restrictive.