Test of force controlled yielding seats to draft GTR head restraint dynamic test

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GTR Draft

Either 55 mm* backset

or

< 12 degree Hybrid III head-torso rotation in dynamic test

*IIWPG 70 mm
Two basic concepts of dynamic neck protection

Reduce elastic force by force controlled yielding (cf belt force limiter)

Reduce time of head-to-headrest contact by reduced backset or active headrest (cf belt pretensioner)
Force controlled yielding recliner, named Whips-R

Whips-R in Volvo seats
Force controlled yielding recliner
Whips-R

Whips-R in Volvo seats
Real-life and rating facts
Whips-R

Volvo seats with force controlled yielding recliners reduce risk of short and long term soft tissue neck injuries in real life*
Volvo seats with force controlled yielding recliners are on the top of all consumer rating lists**

**Folksam/SRA (criteria based on scientific facts) and IIWPG (IIHS/Thatcham/ADAC) (criteria based on best practice)
Combined IIWPG and Folksam&SNRA evaluation

Normalized values for the 16 kph pulse

V70 w/o Whips-R

V70 with Whips-R

NIC
Nkm
Rebound
T1
Fx
Fz
HT
Autoliv draft GTR dynamic test evaluation

Hybrid III (draft GTR)
V70 w/o Whips-R
V70 with Whips-R

BioRID (sole deviation from draft GTR)
V70 with Whips-R
## Test results draft GTR (Hybrid III)

<table>
<thead>
<tr>
<th></th>
<th>Volvo w/o Whips-R</th>
<th>Volvo with Whips-R</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Head-torso angle [deg]</strong></td>
<td>24,8</td>
<td>19,6</td>
</tr>
<tr>
<td><strong>NIJ</strong></td>
<td>0,14</td>
<td>0,11</td>
</tr>
<tr>
<td><strong>T1 peak acc</strong></td>
<td>13,6</td>
<td>7,1</td>
</tr>
<tr>
<td><strong>Head angular velocity</strong></td>
<td>1010</td>
<td>642</td>
</tr>
<tr>
<td><strong>Head peak angle</strong></td>
<td>29,7</td>
<td>32,7</td>
</tr>
<tr>
<td><strong>Torso peak angle</strong></td>
<td>8,2</td>
<td>20,7</td>
</tr>
<tr>
<td><strong>Upper seat back disp.</strong></td>
<td>74,7</td>
<td>172</td>
</tr>
</tbody>
</table>
Head-torso rotation and T1 acceleration normalized results

![Bar chart showing head-torso rotation and T1 acceleration results](chart.png)
## Test results BioRID instead of HIII

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Results</th>
<th>&quot;Good Rating&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIC</td>
<td>10.4m/s^2</td>
<td>15m/s^2</td>
</tr>
<tr>
<td>Nkm</td>
<td>0.17</td>
<td>0.3</td>
</tr>
<tr>
<td>T1 acc</td>
<td>7.3g</td>
<td>9.5g</td>
</tr>
<tr>
<td>Head contact time</td>
<td>52ms</td>
<td>70ms</td>
</tr>
<tr>
<td>Upper neck Fx</td>
<td>32.4N</td>
<td>130N</td>
</tr>
<tr>
<td>Upper neck Fz</td>
<td>304N</td>
<td>600N</td>
</tr>
</tbody>
</table>

Remark: reflects highest possible rating ([Folksam/SRA](#) and [IIWPG](#))
Summary test results

Volvo Whips-R test results are excellent when BioRID and BioRID performance criteria are used.

When tested with Hybrid III, the head-torso rotation is reduced, but exceeds 12 degrees.

Remark: Volvo seats meet backset requirement of less than 55 mm, irrespective of Whips-R.
Head-torso rotation risk curve

The FMVSS202 risk curve is based on two (2) observations. No force controlled yielding systems were taken into account.

<table>
<thead>
<tr>
<th>Seat</th>
<th>Field Data</th>
<th>Sled Tests (16 km/h) weighted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of occupants</td>
<td>No. with MT and LT whiplash injuries</td>
</tr>
<tr>
<td>Saab 900</td>
<td>160</td>
<td>25</td>
</tr>
<tr>
<td>Saab 9-3</td>
<td>122</td>
<td>9</td>
</tr>
</tbody>
</table>
Discussion

Proposed GTR head-torso rotation risk curve is based on only two observations of claim frequency where sample data-Δv median is only 10 km/h
Conclusion

Proposed GTR dynamic test does not acknowledge force controlled yielding seats