Proposal for ECE R17-08
Dynamic Backset Option with BioRID II

JASIC/Japan
Dec. 2008
Head Restraint gtr, WP29/2008/54 and /55, was agreed at #144 WP29 in March. 08,

**Static**

- H-point with Backset \( \leq 55\text{mm} \)
- R-point with Backset \( \leq 45\text{mm} \)

**Dynamic Option**

**Contracting Parties choice**

- HY-III
  - Head rotation \( \leq 12\text{ deg} \)
  - HIC \( \leq 500 \)

**OR**

Some criteria with BioRID II

Until BioRID II requirements are included in this gtr or adopted in the national regulation of a Contracting Party, head restraints shall comply with any or all static requirements.

*: Manufacture’s choice
Motivation of this Amendment proposal

The number of permanent disabilities due to rear-end collisions have been significantly increasing in Japan. The countermeasure should be effective and quick.
Motivation of this Amendment proposal

ECE R17-08 series amendment, GRSP/2008/11 has been proposed as follows.

BioRID II requirement
[Reserved for future use when dummy and criteria are agreed.]

Japan would like to propose Bio RID II requirement because of following reasons.

- to assure active or reactive head restraints performance.
- to avoid active, reactive and pre-active definition trouble and design restriction.
- to provide equal dynamic option opportunity for all seat types.

*: Manufacture’s choice

Active or reactive head restraints are not required to comply with Backset requirements.
Motivation of this Amendment proposal

Performance level of reactive head restraints are not always GOOD according to IIHS test results. Poor ranking seats are out of static backset requirement.

Static backset: 58mm - 152mm
Dynamic test for Head restraint gtr Phase1 should be an alternative test for static Backset, and had better to equivalent to static backset. It is considered to evaluate following phase I stage of whiplash phenomenon.
Condition of Dynamic Test for gtr phase 1

- BioRID II is promising with its high biofidelity to the human body, but still need to study injury criteria indicators, reference values, test pulse, etc. for appropriate dynamic test as we propose as in phase 2 activity.
- EEVC WG20 and Japan have recognized that a Geometrical indicator of BioRID II is feasible now.
The head O.C. (Occipital Condyle) x-axis displacement with respect to T1 was proposed as a candidate of geometric indicator from the result of EEVC WG12 and Japan (JARI) joint assessment of Rear Impact Dummy Biofidelity.
Proposal for Dynamic Test for ECE R17-08

Definition of Dynamic Backset

Dynamic backset, maximum OC-T1 relative displacement, shall be calculated as the maximum absolute value of \( D'_{OC-T1(t)} \), whichever is larger between both seat sides.

\[
D'_{OC-T1(t)} = D_{OC-T1(t)} - D_{OC-T1(0)}
\]

Note: The measurements data shall be considered for evaluation until the point in time at which the head rebounds from the head restraint or at 300 ms after T-zero, whichever occurs first.
Proposal for Dynamic Test for ECE R17-08

- Set BioRID II head with $+15^{\pm}/-2\text{mm}$ distance to static backset

- Measure "Dynamic backset $\Delta V = 16\text{km/h}$ sled test"

- Head O.C. (Occipital Condyle)
- Head C.G. (Centre of Gravity)
Coefficient of determination Relation between static backset and various BioRID II indicators

Dynamic backset shows the highest coefficient rate ($R^2$) among all indicators by MADYMO simulation study.
Sensitivity analysis by MADYMO simulation

Dynamic backset has a potential to show the effect of passive, active and WHIPS type anti-whiplash seats.
Repeatability, Reproducibility and Threshold Evaluation Tests

33 seats were tested at 6 different laboratories in cooperation with EEVC WG20.

<table>
<thead>
<tr>
<th>IIHS Ranking</th>
<th>Seat Type</th>
<th>Number (*:EEVC data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Normal</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Reactive</td>
<td>2(3*)</td>
</tr>
<tr>
<td></td>
<td>Passive</td>
<td>2</td>
</tr>
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<td></td>
<td>WHIPS</td>
<td>(1*)</td>
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<tr>
<td>Acceptable</td>
<td>Normal</td>
<td>1</td>
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<tr>
<td></td>
<td>Reactive</td>
<td>(1*)</td>
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<tr>
<td></td>
<td>Passive</td>
<td>2</td>
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<tr>
<td>Marginal</td>
<td>Normal</td>
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</tr>
<tr>
<td>Total</td>
<td></td>
<td>33</td>
</tr>
</tbody>
</table>
Repeatability Evaluation

◆ Test method

The repeatability of following indicators were evaluated by 3 seats about 3 seat types.

・Dynamic backset (Head O.C. –T1), Fx, My, etc.

◆ Method of evaluation

Comparison of coefficient of variation (CV)

\[
\text{Repeatability } \quad \text{C.V} = \frac{S_d}{X} \times 100 \%
\]

\[X = \text{Mean value of each indicator maximum value}\]

\[S_d = \text{Standard deviation of each indicator maximum value}\]

◆ Criteria

Admissible level: CV ≤ 10
Repeatability Evaluation
Dynamic backset shows good repeatability.

Upper neck MY show slight variation.
Reproducibility Evaluation

◆Test method

The reproducibility of following indicators were evaluated by 3 dummies about 3 seat types.

・Dynamic backset (Head O.C. –T1), Fx, My, etc.

◆Method of evaluation

Comparison of coefficient of variation (CV)

Reproducibility C.V = \( \frac{S_B}{X} \) 100 (%) \( X \) = Mean value of each indicator maximum value

\( S_B = \left( \frac{MSB - MSW}{n} \right)^{1/2} \)

MSB = Square average of Maximum value and Minimum value
MSW = Square average of All value
n = number of tests

◆Criteria Admissible level: CV ≤ 10
Reproducibility Evaluation
Dynamic backset shows good reproducibility.

Fx and Upper neck MY show large variation.
Threshold study for Static Backset

- Dynamic Backset shows correlation between normal seat static backset, and show the effect of reactive, passive and WHIPS type seats.
- About [48mm] dynamic backset is equal to achieve 55 mm HRMD static backset requirement.
Threshold study for IIWPG Ranking

About [48mm] Dynamic backset is equivalent to achieve minimum performance level of IIWPG “GOOD” rating.
Threshold study for Hybrid III head rotation

[48mm] Dynamic backset is equivalent to achieve 12 degree head rotation angle with Hybrid III.
Proposal for ECE R17-08

Japan has proposed following manufacturer’s option for all type of seats. Dynamic backset threshold is proposed [52mm] (=48mm + 4mm variation).

Static

H-point with Backset ≤ 55mm

R-point with Backset ≤ 45mm

Dynamic Option

Bio RID II
Dynamic backset ≤ [52mm]

*: Manufacture’s choice

OR*

OR*
This proposed threshold could be excluding lower performance reactive type head restraints.
Conclusion

Dynamic backset (Maximum x displacement of Head O.C.- T1) is considered as a reasonable dynamic geometric indicator for BioRID II for following reasons.

✓ Reasonable repeatability and reproducibility
✓ Correlation with static backset, IIWPG ranking and field long term injury evaluations.
✓ Reflection of passive, reactive and WHIPS type seats effect.

Dynamic backset threshold is proposed as a equivalent level for static backset, IIWG GOOD ranking and Hybrid III head rotation requirements with 4mm measurement variation, and excluding lower performance active HR.

Dynamic backset ≤ [52]mm
Thank You