KOREA GTR No.7 2nd Phase Research Results

Dec. 8, 2009

Ministry of Land, Transport and Maritime Affairs,
Korea Automobile Testing and Research Institute
Headrest. KMVSS upgrade plan

- During GTR 7 discussion, KOREA considered harmonization with lead time, etc.
- All possible GTR options will be considered on KMVSS.
- Phase I GTR will be adopted as KMVSS in 2010.

Before GTR introduce in KMVSS, make the program (gov)

Adopting in KNCAP & Lead Good H/R Performance

Offer the advantage of design preceding, etc.

- GTR No.7 Publish (2008.3)
- Discuss with MLTM
- 2nd Phase start
- Actively research & Coop.
Objective of KOREA Research

- **Objective**
  - Harmonization of GTR No. 7 in KMVSS
  - Global cooperation for Head restraints GTR Phase II

- **Work Scop**
  - GTR No. 7 Phase II
    - Head restraints height: Effective height in KOREA
    - Dynamic Test
      - Evaluation of BioRIDII: Repeatability, Reproducibility
      - Evaluation injury indicator in BioRIDII
      - Check the BioRIDII calibration procedures

- **GTR 2nd Phase Terms of reference**
  - Head restraint Height
  - Whiplash Injury (MAIS1 or MAIS 2 more)
  - Define Test procedures
    - Test condition
    - Clarify the mechanism of whiplash injury
    - Evaluation of BioRIDII
    - Evaluation of Indicator
    - Feasibility studies etc.
Over all Research Schedule

Stage 1(2008)
- Harmonization GTR No.7
- GTR No.7 Review
- BioRID II

Stage 2(2009)
- Head Restraints Height
- Statistic review & Test
- Additional Test
- Reproducibility Test
- New Cal. system Test
- BioRID II propriety review

GTR No.7 Phase II
- Discuss with MLTM

2010 will be published.

GTR No. 7 2nd Amendment
Evaluation of BioRIDII performance

◆ Test Condition
  - Dummy & Number of tests
    - Denton 3 different BioRIDII-g (S1, S3, S4) [Dummy was calibrated before the test.]
    - 3 times Test in KATRI (engineer also KATRI persons)
  - Pulse : KNCAP (Same as the E-NCAP Medium pulse 16km/h)
  - Seat & Head restraints setting : KNAP (Same as the E-NCAP)
  - Neck injury indicator:
    - Head X acc, Nkm, NIC, HRC, T1 X acc, Upper-Fx –Fz -My, Lower-Fx, -Fz, -My

<table>
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<tr>
<th>Location</th>
<th>Target measure</th>
<th>Tolerance</th>
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<tbody>
<tr>
<td>H-point (X-axis)</td>
<td>+20mm Forward</td>
<td>±10mm</td>
</tr>
<tr>
<td>H-point (Z-axis)</td>
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<td>±10mm</td>
</tr>
<tr>
<td>Pelvis angle</td>
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<td>±2.5°</td>
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<tr>
<td>Head plane angle</td>
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<tr>
<td>Backset</td>
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</table>
Evaluation of BioRIDII

◆ Method of Evaluation

➢ Repeatability

\[ C.V = \frac{S_d}{\bar{X}} \times 100 \% \]

\[ \bar{X} = \text{Mean value of each dummy} \]

\[ S_d = \text{Standard deviation of each dummy} \]

➢ Reproducibility

\[ C.V = \frac{S_B}{\bar{X}_G} \times 100 \% \]

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

\[ \bar{X}_G = \text{Mean value of 3 dummies} \]

MSB : Mean square between groups (dummies)

MSW : Mean square in a group (each dummy)

n : Number of repetitions of test

<table>
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<tr>
<th>CV</th>
<th>Category</th>
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<td>3%</td>
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<tr>
<td>3% &lt; CV &lt; 7%</td>
<td>acceptable</td>
</tr>
<tr>
<td>7% &lt; CV &lt; 10%</td>
<td>marginal</td>
</tr>
<tr>
<td>CV &gt; 10</td>
<td>not acceptable</td>
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</table>

MLTM

Korea Transportation Safety Authority
Evaluation of BioRIDII

Seat condition & Dummy setting

HRMD Measurement

Measurement C.V
Evaluation of BioRIDII

- Results of Repeatability Evaluation

- Head X repeatability in all dummy is good.
- Among 3 dummies, each C.V. does not show consistency but graphs are pretty similar.
- Even though BioRID calibrated, repeatable variation has been depend on dummy.
Evaluation of BioRIDII

◆ Results of Reproducibility Evaluation

Upper Fx & My, Lower Fz, Nkm_Nfa are not acceptable indicators during the test.

ESV paper by Japan(09-0302)
Evaluation of BioRIDII – Test site variation

- **Test Condition**
  - Dummy: BioRIDII-g 1 test each site.
  - Test Site: 2 different site (Hyundai, Dymos)
  - Pulse: KNCAP (Same as the E-NCAP Medium pulse 16km/h)
  - Seat: same seat, other conditions same repeatability test
Evaluation of BioRID II – Test site variation

- Head X
- HRC
- T1 Acc
- Upper Fx
- Upper Fz: about 100N
- Upper My: about 7 Nm
Head Restraint Height – Non Active Seat

Review of KOREA Anthropometry statistics, the reasonable height of Head Restraint is 800mm

- Purpose
  - Neck Injury indicators analysis comparing 800 & 850mm H/R height

- Test condition
  - Pulse: K-NCAP (E-NCAP medium pulse)
  - Seat setting: K-NCAP
  - Dummy: Denon BioRID Iig (KATRI)
  - Head restraint height: 800, 850mm

- Headrest. height 800mm
- Headrest. height 850mm

Indicators on 800mm height H/R are slightly higher than 850mm height H/R
But not a big different.
Evaluation of BioRIDII Calibration procedures

- Current Version
- New Version

Changed Parts: Head Rest Jig, Foam block, Probe, Sliding guild.

Evaluation

- Repeatability Test: Graphs review
- Dummy: 4 ea Denton BioRIDII-g
- Test condition: Each dummy passed the current cal procedures and then 3 or 4 tests of each dummy were conducted on the new cal. system with H/R & not.
New sled without H/R Jig Cal. Result Graphs

Each dummy shows repeatable but there are some discrepancy with dummies.
New sled wit H/R Jig Cal. Result Graphs

Each dummy shows repeatable but there are some discrepancy with dummies.

(Upper Neck  Fx, My, Lower Neck Fx, Fz, My)
Other Issue

- Pendulum force on new sled system is much higher than the old version, so head & neck movement is too strong and too much. It’s cause of neck bumper separation during the calibration test.

- During the cal. test setup, sled keep moving, need fixing jig.
Evaluation of BioRIDII – Denton & FTSS

◆ Test Condition

- Dummy: BioRIDII-g Denton & BioRIDII FTSS.
- Test Site: KATRI, Test setup: same condition (repeatability test condition)
- Test number: 3 times
Head X repeatability in two dummies are good.

- Upper Fx is not acceptable with two dummies
- Upper Fz & My & Lower My in Denton BioRID and Upper Fz in FTSS BioRID is not acceptable for repeatability analysis.
Summary

- Result data for neck injury indicators on BioRIDII
  - Repeatability: S1 & S3 dummy is marginable but S4 dummy is not acceptable.
  - Reproducibility: Not acceptable for Upper Fx, Upper My, Lower Fz, & Nkm.
    Similar results submitted last ESV. (Japan & Europe)
  - Results of different site test are similar except upper Fz & My.
- With repeatability & reproducibility issues, we may suggest some robust indicator after full consideration for neck injury mechanism in stead of neck injury indicator.
  → In terms of the regulation, small variation of seat condition must be acceptable.
    (Seat is not rigid structure)
- Neck injury indicators on 800mm HR were slightly higher than 850mm HR but not a big different each other.
- New cal. system shows good repeatable but the results between dummies are different. (Need further study)
- Neck injury indicators on Denton & FTSS BioRIDII are similar with each other.