JAPAN Research Status for Bio-RID II Dummy Repeatability and Reproducibility on Head Restraints GTR

September '05

JAPAN MLIT
To evaluate and verify repeatability and reproducibility, the challenges of BioRID-II dummy.
Use rigid seats to evaluate exclusively the characteristics of dummies. Seating positions are set within a tolerance of ±5 mm.

<table>
<thead>
<tr>
<th>Dummy</th>
<th>Target Velocity (km/h)</th>
<th>Test Number</th>
<th>Head Restraint</th>
</tr>
</thead>
<tbody>
<tr>
<td>BioRID A</td>
<td>A801 A802 A803</td>
<td></td>
<td>Without</td>
</tr>
<tr>
<td>BioRID B</td>
<td>8 B801 B802 B803</td>
<td></td>
<td>Without</td>
</tr>
<tr>
<td>BioRID C</td>
<td>C801 C802 C803</td>
<td></td>
<td>Without</td>
</tr>
<tr>
<td>BioRID A</td>
<td>A1601 A1602 A1603 A1604 A1605</td>
<td>(_encoding)</td>
<td>With</td>
</tr>
<tr>
<td>BioRID B</td>
<td>16 B1601 B1602 B1603 B1604 B1605</td>
<td>(_encoding)</td>
<td>With</td>
</tr>
<tr>
<td>BioRID C</td>
<td>C1601 C1602 C1603 C1604 C1605</td>
<td>(_encoding)</td>
<td>With</td>
</tr>
</tbody>
</table>
Reproducibility of the sled acceleration (input condition at impact) was favorable.
Head Rotation Angle Relative to T1(8 km/h)

Repeatability of each dummy was favorable. However, there are some variations between dummies.
Upper Neck (8 km/h)

Repeatability of each dummy was favorable. However, there are some variations between dummies. Fx of Dummy A is different from those of B and C.

The difference may be due to the looseness at the joint of head and neck.
Head Rotation Angle Relative to T1 (16 km/h)

Moment in time at which contact with head restraint occurs.

![Graph showing head rotation angle over time](graph.png)
Upper Neck (16 km/h)

Upper Neck Fx

Upper Neck Fz

Upper Neck My
Repeatability and Reproducibility

Repeatability is defined as the similarity of results expected to be obtained in repeated testing of a single dummy under identical conditions.

Reproducibility is defined as the smallness of variability expected to be obtained between dummies tested under identical conditions.

\[
\text{Repeatability CV} = \left( \frac{S_p}{X_G} \right) \times 100 \%
\]

\[
\text{Reproducibility CV} = \left( \frac{S_B}{X_G} \right) \times 100 \%
\]

\[X_G = \text{Mean of all three BioRID-II dummies.}\]

\[S_p = \sqrt{\frac{k}{\sum_{i=1}^{k} S_i^2/k}}\]

\[S_B = \sqrt{\frac{\text{MSB-MSW}}{n}}\]

\[n = \text{Number of tests.}\]
Comparison of Dummies Used for This Evaluation

A: Level ₿ JARI dummy (5 months after calibration)
B: Level ₿ Just purchased
C: Level ₿ Frequently calibrated

Each dummy (A, B, C) has favorable repeatability. However, as for reproducibility, there are some variations.

Since the reproducibility was improved after removing the looseness at the joint of head and neck, the variations may be caused by factors related to calibration. We are going to analyze the cause of variations.
Since Bio-RID dummies are set up with reference to 3DM+HRMD, the variation of its installation has a significant influence on the performance of dummies.

In order to reduce variation, the seat should be positioned at the manufacturer’s design reference point, as we requested for the backset requirements.

When the optional dynamic test is applied to rear seats, the seatback angle can not be set to 25° if it is fixed (non-adjustable).

Procedures to set-up the dummy when the seatback angle is set to a degree other than 25° should be clarified.
Conclusion

1. Repeatability
   1) It will be possible to obtain practical repeatability when the dummy is maintained as required and its set-up position is clarified.
   2) Quantification of repeatability is in process.

2. Reproducibility
   1) It was found that dummies from different production lot show different impact response.
   2) However, it was also found the possibilities of eliminating such variations by countermeasures such as a standard calibration test.
   3) It was found that the performance of dummies change depend on their set-up posture.
   4) In order to secure reproducibility, the following should be clarified;
      • Calibration for maintaining product performance
      • Design reference point for reducing the variations in the set-up posture.

we will report additional result of consideration, along with the repeatability of HY-III dummy at the next meeting.