

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

September '05
JAPAN MLIT



Purpose

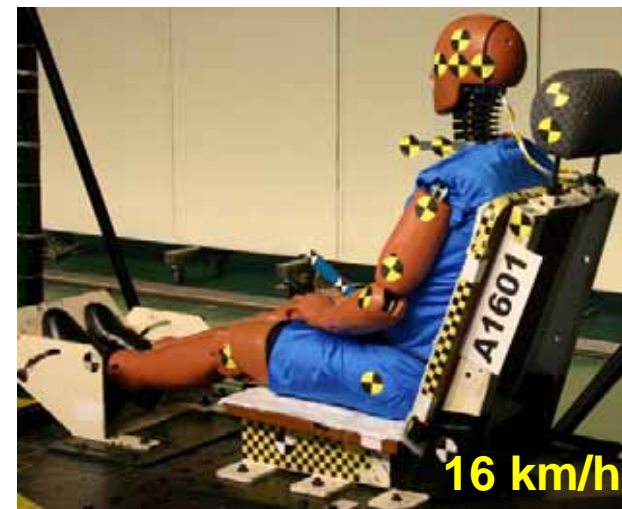
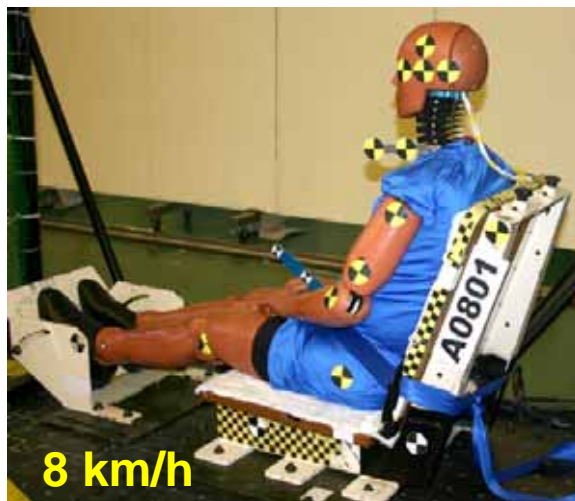
To evaluate and verify repeatability and reproducibility, the challenges of BioRID-II dummy.



Test Matrix

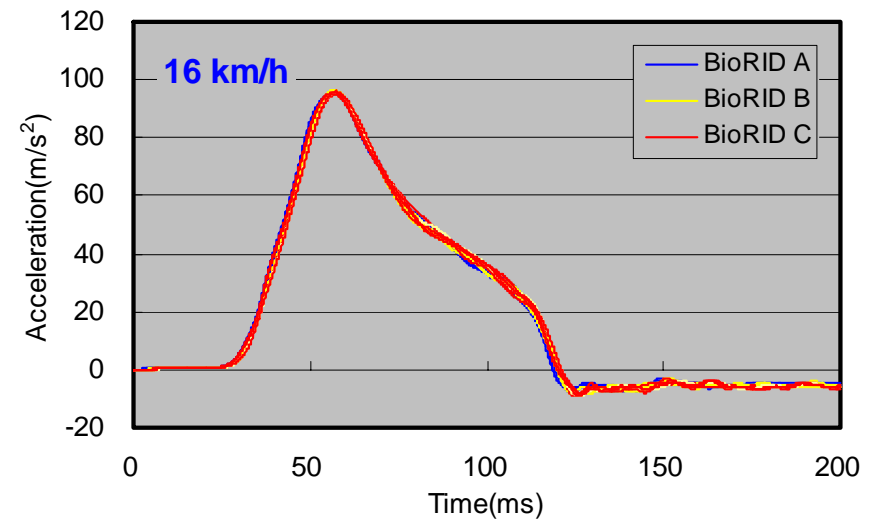
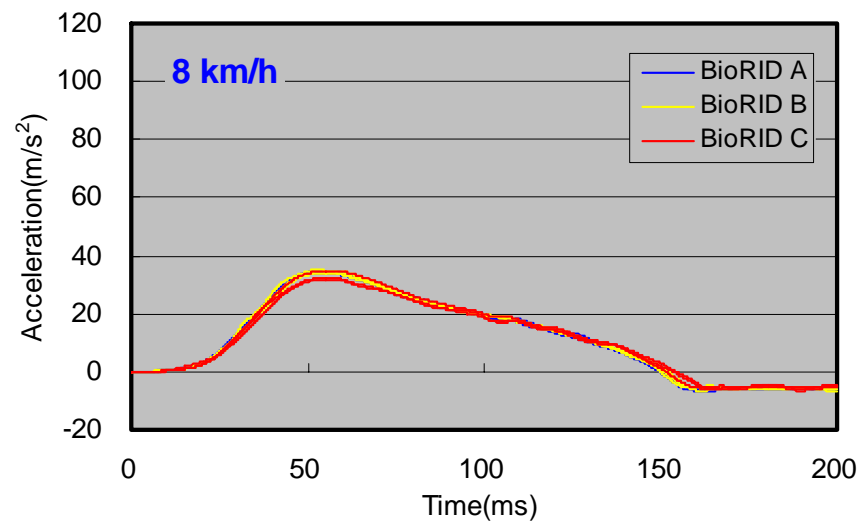
Use rigid seats to evaluate exclusively the characteristics of dummies.
Seating positions are set within a tolerance of ± 5 mm.

Dummy	Target Velocity (km/h)	Test Number						Head Restraint
BioRID A		A801	A802	A803	(n=3)			Without
BioRID B	8	B801	B802	B803	(n=3)			Without
BioRID C		C801	C802	C803	(n=3)			Without
BioRID A		A1601	A1602	A1603	A1604	A1605	(n=5)	With
BioRID B	16	B1601	B1602	B1603	B1604	B1605	(n=5)	With
BioRID C		C1601	C1602	C1603	C1604	C1605	(n=5)	With



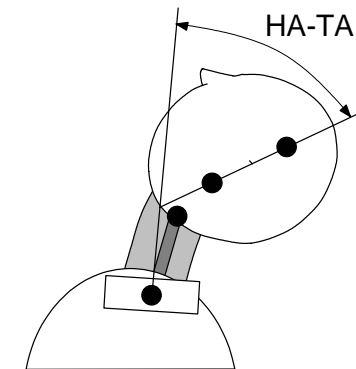
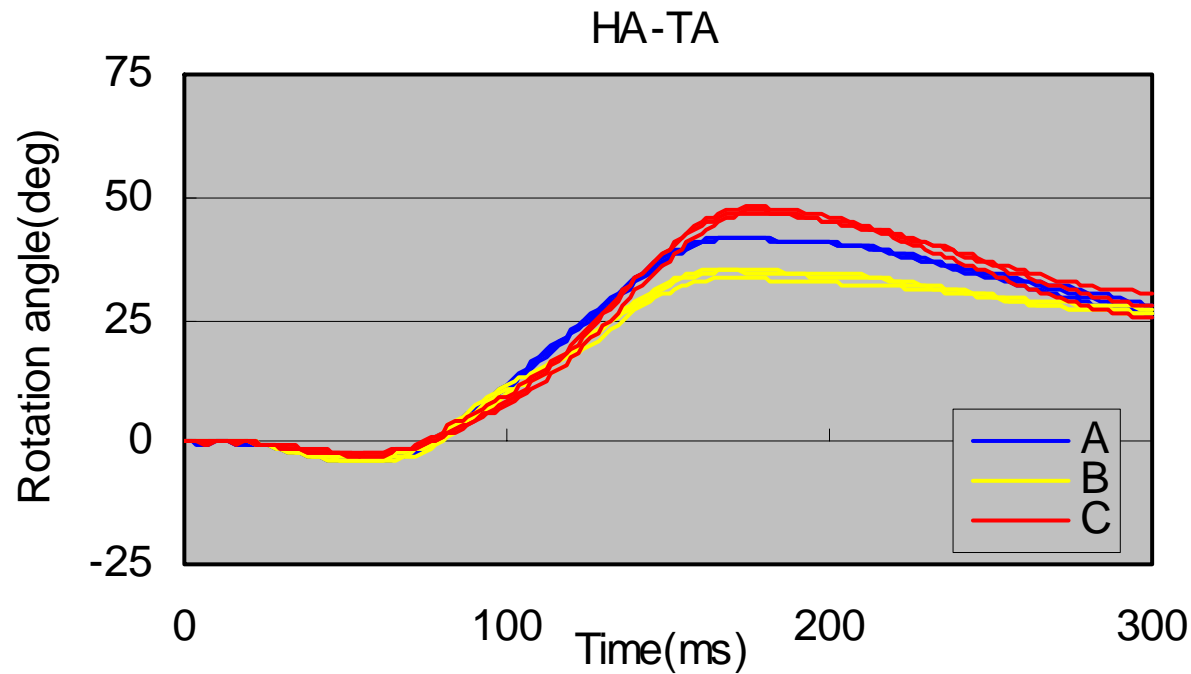
Sled Acceleration

Reproducibility of the sled acceleration (input condition at impact) was favorable.



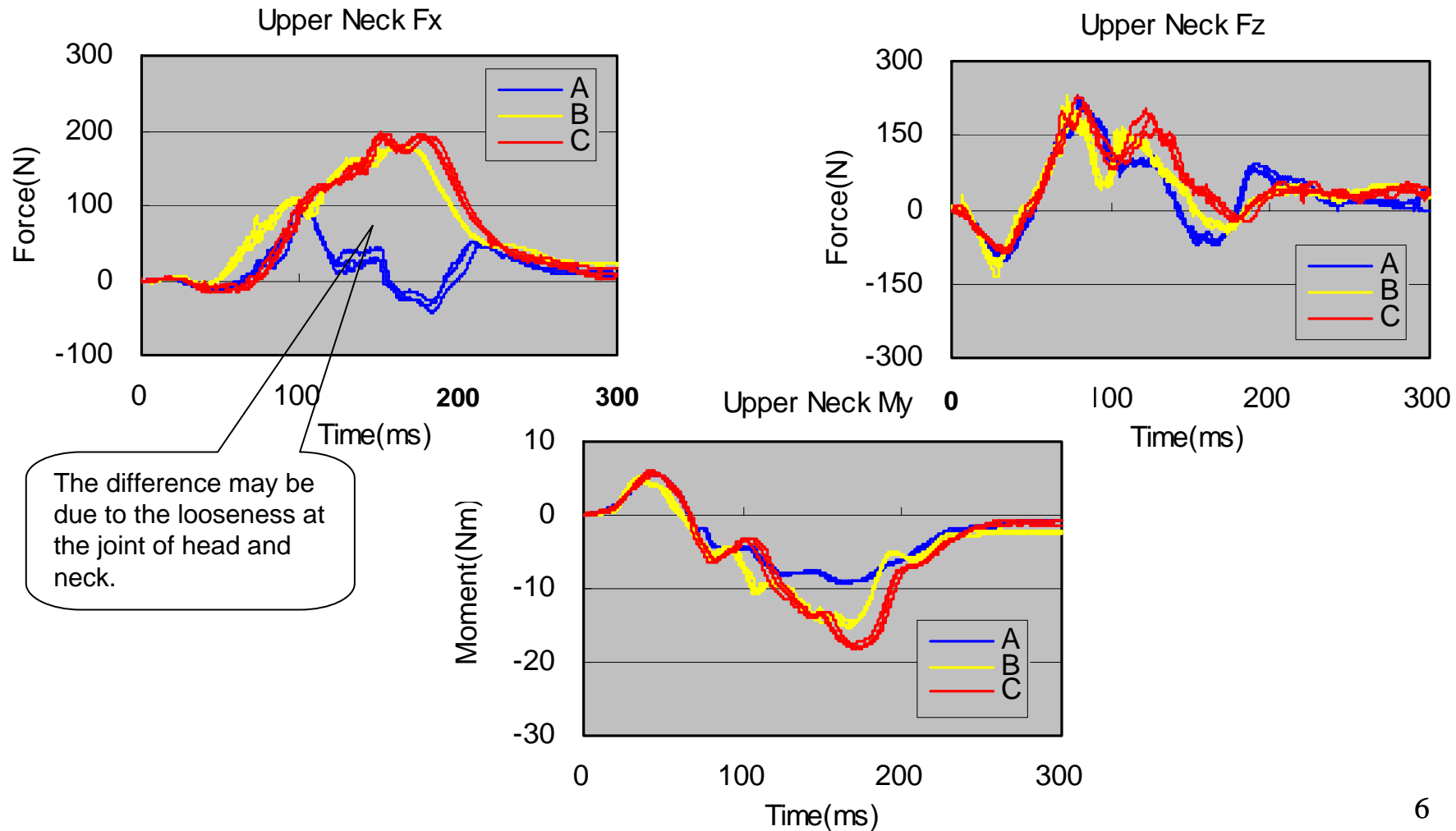
Head Rotation Angle Relative to T1(8 km/h)

**Repeatability of each dummy was favorable.
However, there are some variations between dummies.**



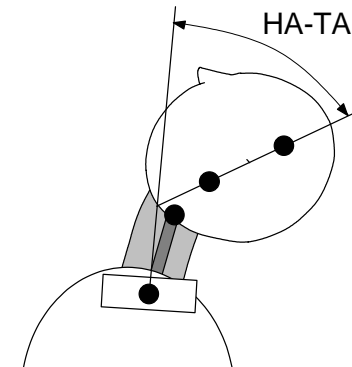
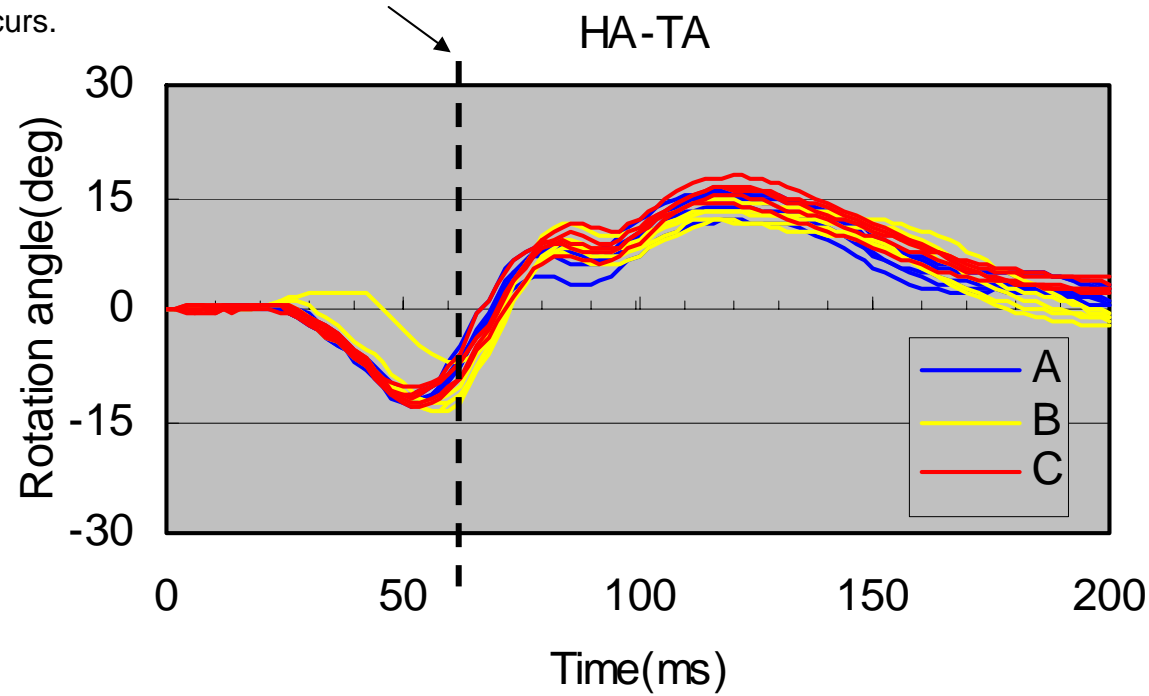
Upper Neck (8 km/h)

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.

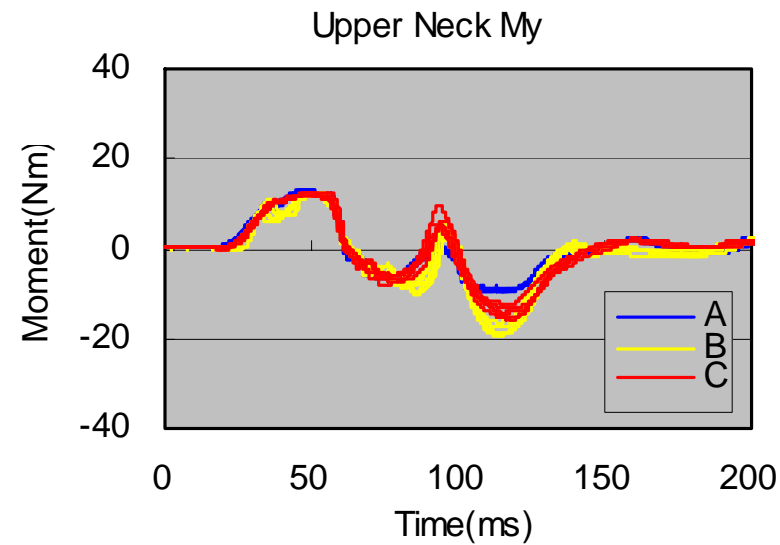
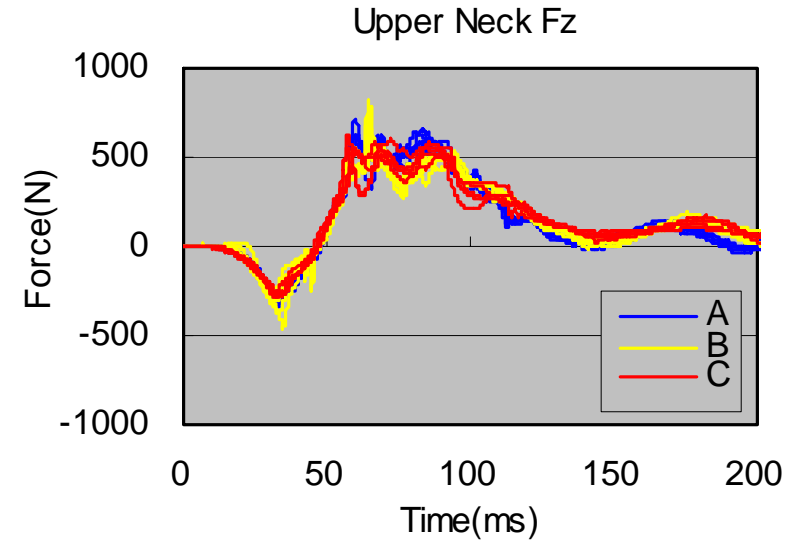
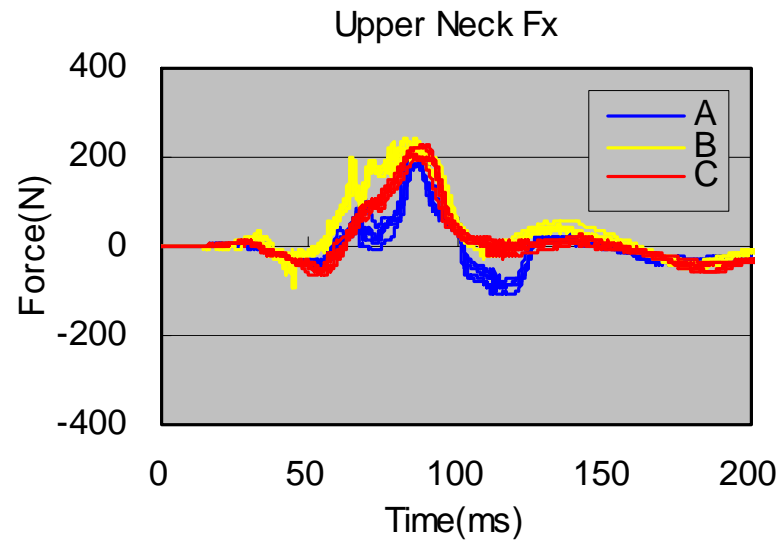


Head Rotation Angle Relative to T1 (16 km/h)

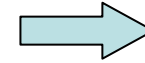
Moment in time at which contact with head restraint occurs.



Upper Neck (16 km/h)



Repeatability and Reproducibility



Under analysis

CV: coefficients of variation

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.

$$\text{Repeatability } C.V = \left[\frac{S_p}{\bar{X}_G} \right] 100 (\%) \quad \text{Reproducibility } C.V = \left[\frac{S_B}{\bar{X}_G} \right] 100 (\%)$$

$\bar{X}_G =$ Mean of all three BioRID-II dummies.

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

$S_p =$ Estimated pooled (average) standard deviation of all three BioRID-II

$k =$ Number of BioRID-II dummies compared (in this case $k = 3$).

$S_i =$ Estimated standard deviation of the i -th BioRID-II dummy.

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

$S_B =$ Estimated standard deviation of the difference between the three BioRID-II dummy. It is derived from the mean square between treatments (MSB) and the mean square within treatments (MSW) of the Analysis of Variance, as follows:

$n =$ Number of tests.

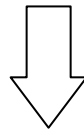


Comparison of Dummies Used for This Evaluation

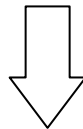
A: Level:F JARI dummy (5 months after calibration)

B: Level:F Just purchased

C: Level:F 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.**



Other Challenges (Reference for Dummy Set-up)

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.

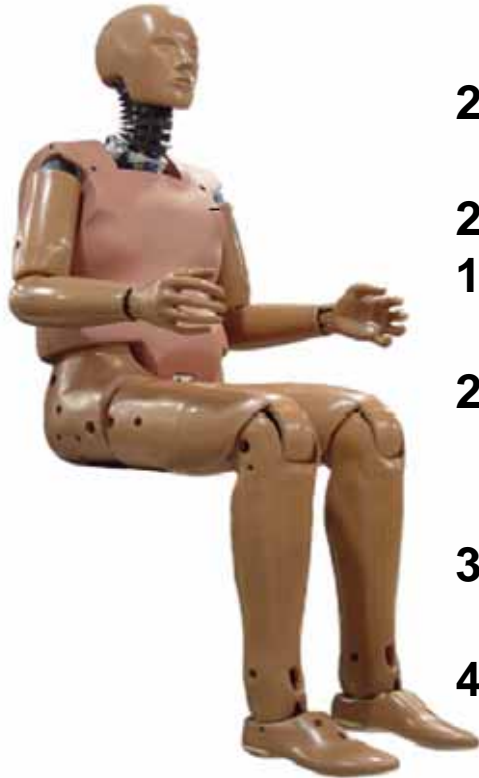
In order to reduce variation, the seat should be positioned at the manufacturer's design reference point, as we requested for the backset requirements.

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.