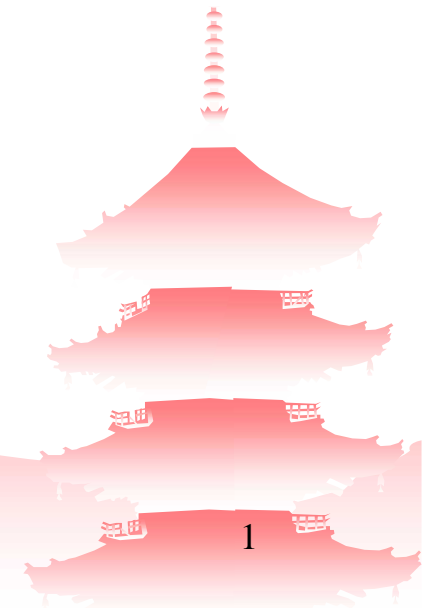


Informal document No. GRSP-44-24  
(44th GRSP, 10-12 Dec 2008,  
agenda item 12b))

# 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  $\leq 55\text{mm}$



Contracting Parties may allow manufacturers to choose

R-point with Backset  $\leq 45\text{mm}$



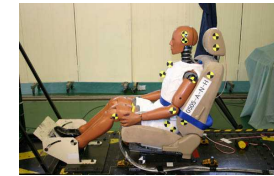
## Dynamic Option

Contracting Parties choice

HY-III

Head rotation  $\leq 12\text{ deg}$

HIC  $\leq 500$



OR\*

OR

Some criteria with BioRID II

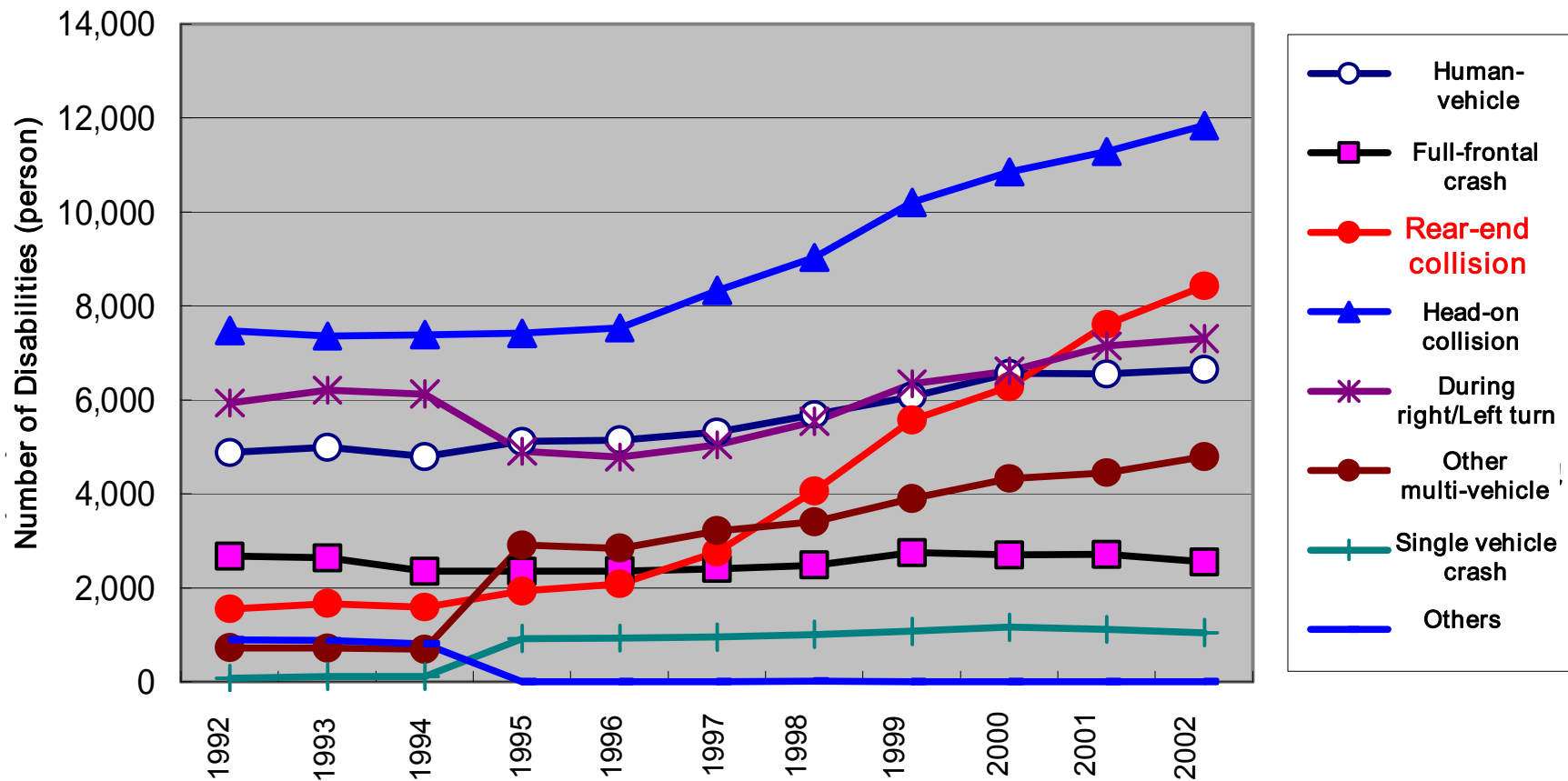
Until BioRID II requirements are included in this gtr or adopted in the national regulation of a Contracting Party, head restraints shall comply with any or all static requirements.



\*: Manufacture's choice

# Motivation of this Amendment proposal

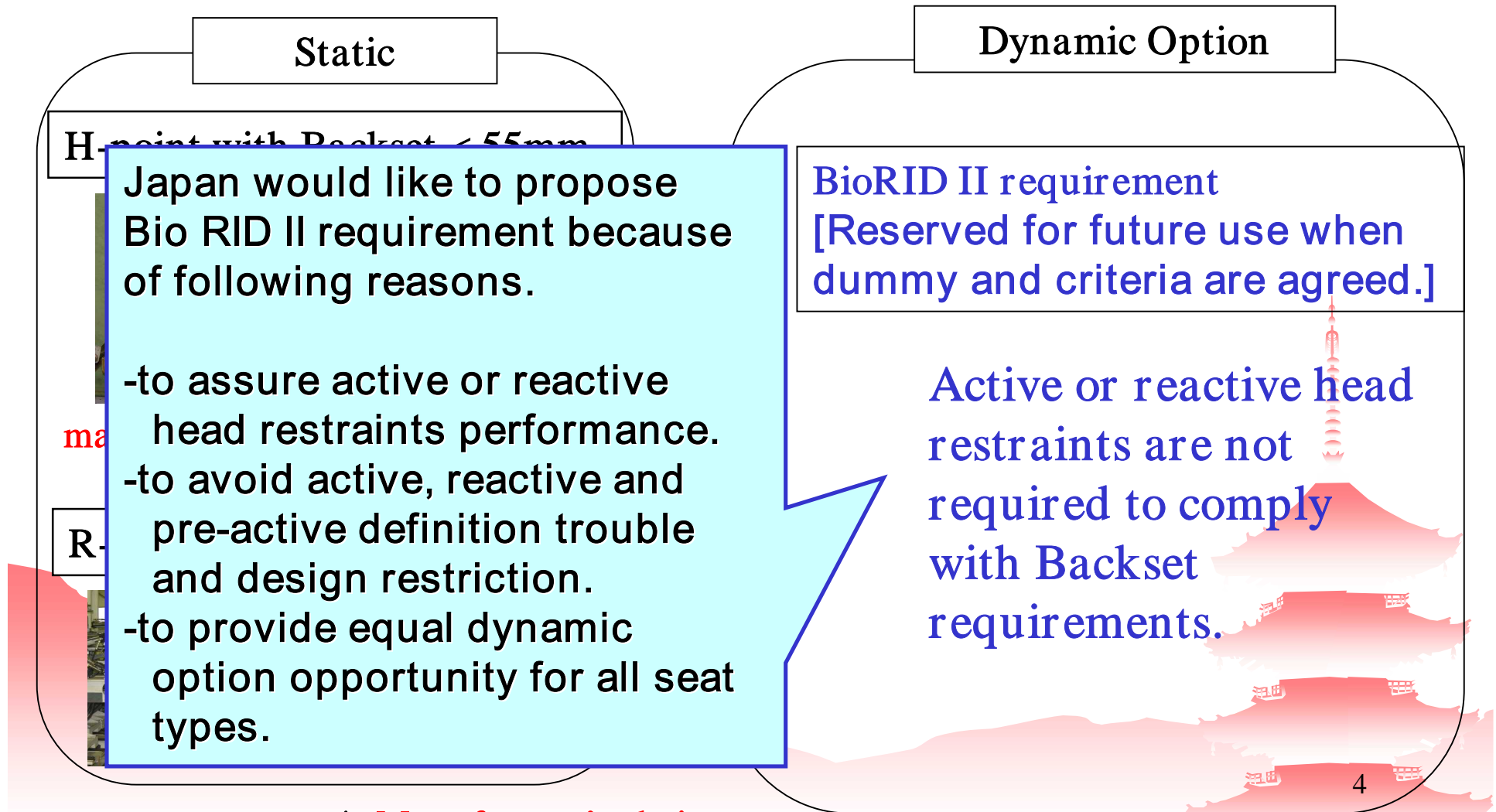
The number of permanent disabilities due to rear-end collisions have been significantly increasing in Japan.  
 The countermeasure should be effective and quick.



Yearly Change in the Number of permanent Disabilities by Accident Type in Japan (Total Disabilities in 1992-2002)

# Motivation of this Amendment proposal

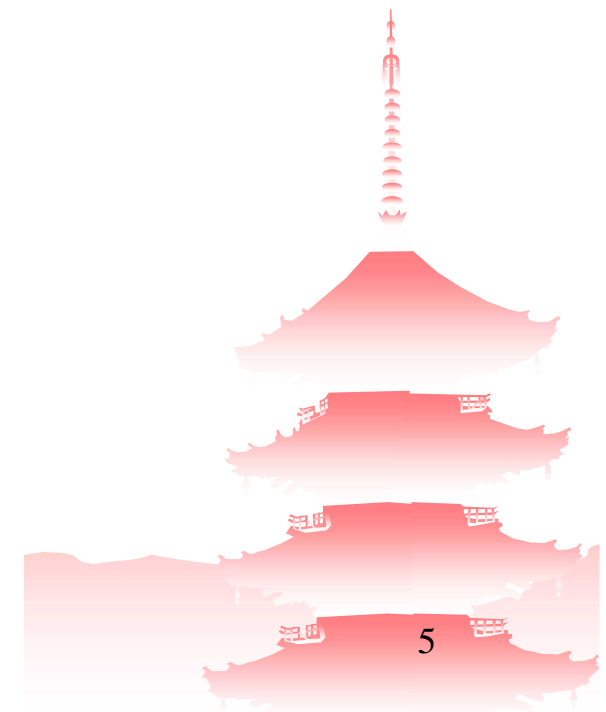
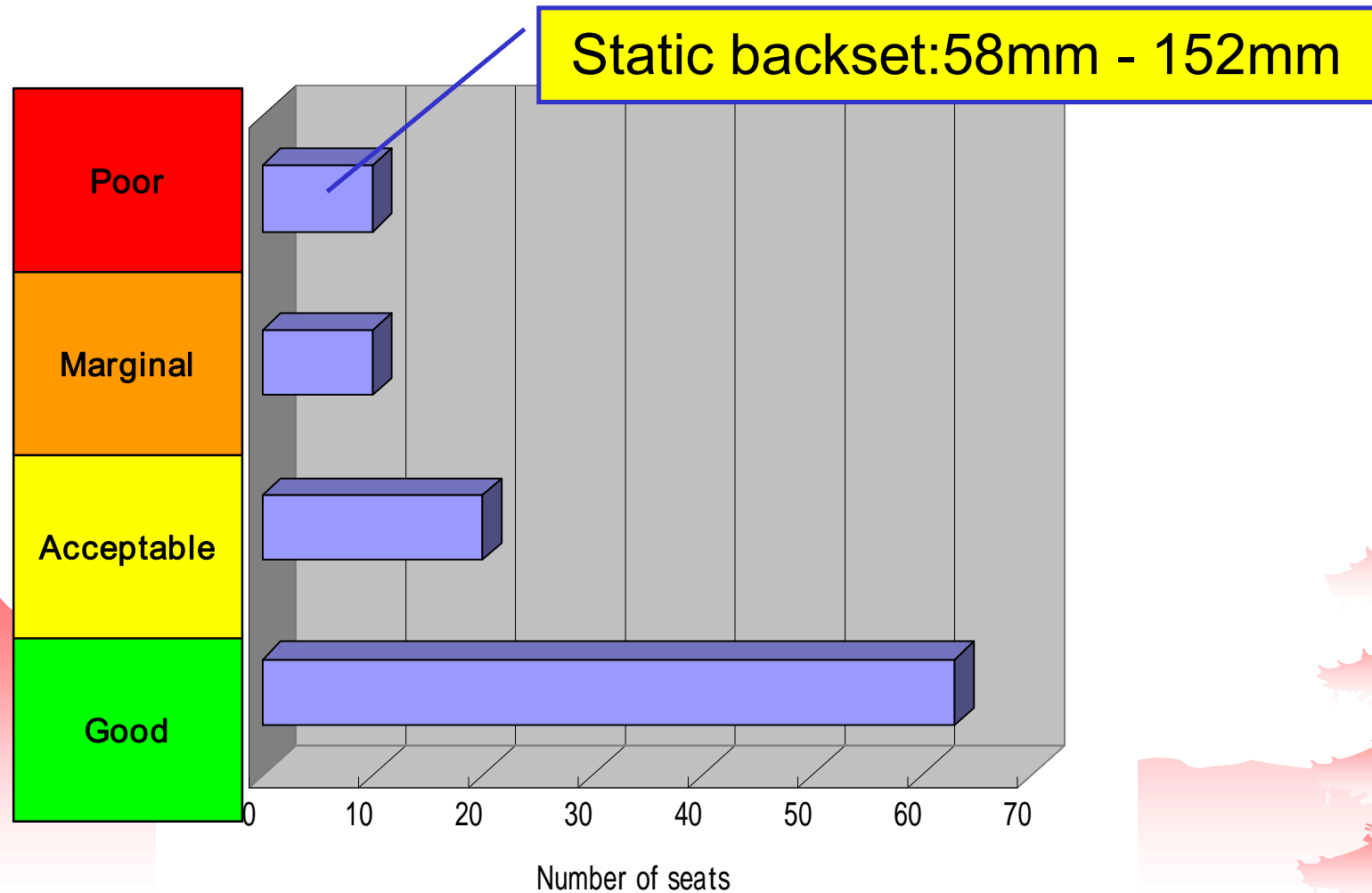
ECE R17-08 series amendment, GRSP/2008/11 has been proposed as follows.



\*: **Manufacture's choice**

## Motivation of this Amendment proposal

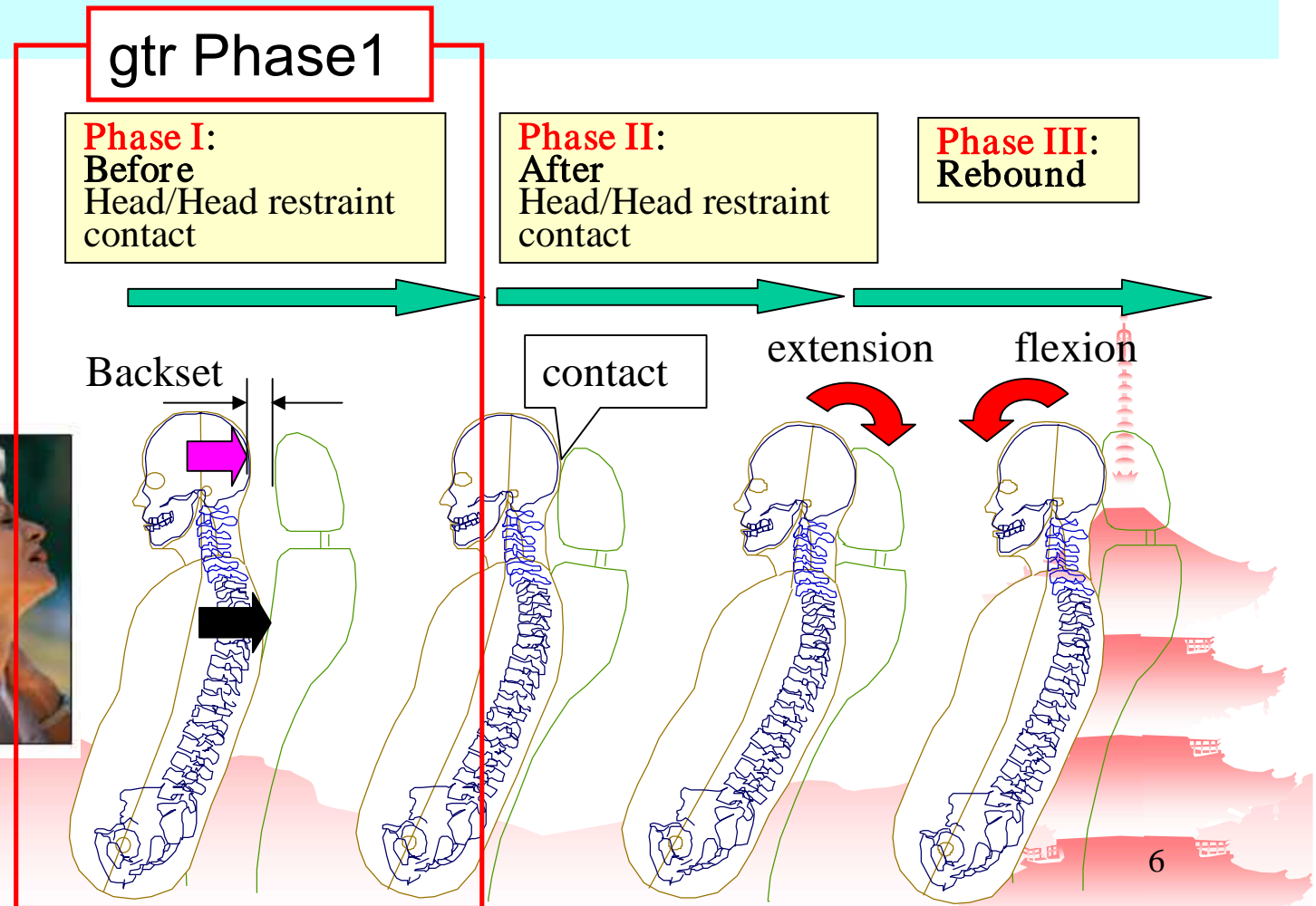
Performance level of reactive head restraints are not always GOOD according to IIHS test results. “Poor” ranking seats are out of static backset requirement.



# Condition of Dynamic Test for gtr phase1

- 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.

## Whiplash Phenomenon

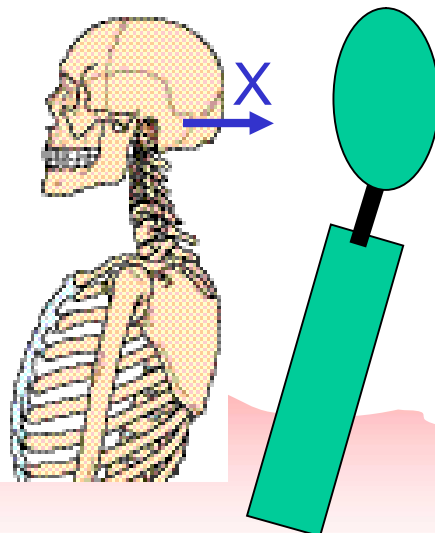


## Condition of Dynamic Test for gtr phase 1

- 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.

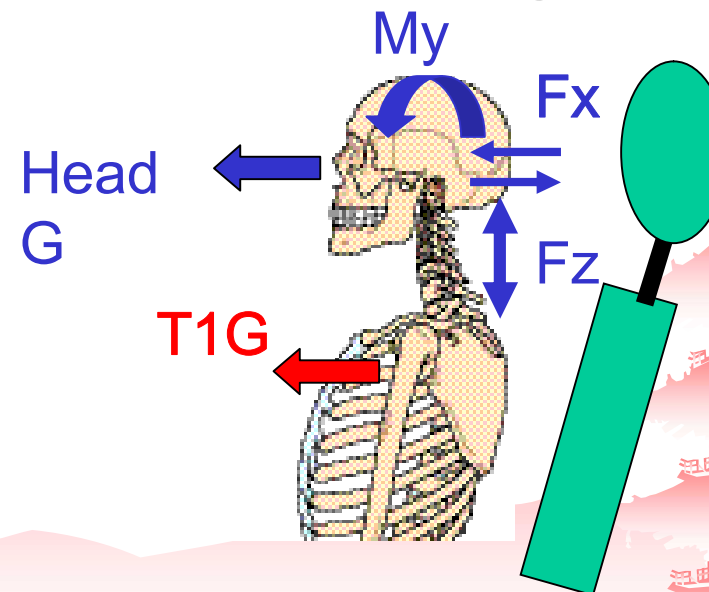
### Phase1

Geometric indicator



### Phase2

NIC, Nkm, Nij, LNL, NDC....



# Proposal for Dynamic Test for ECE R17-08

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.

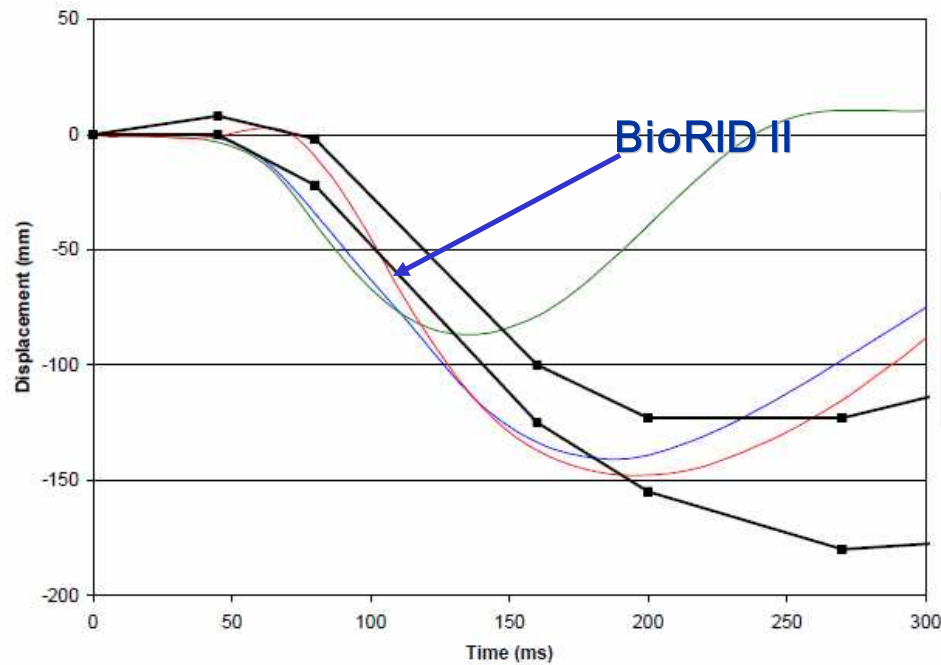
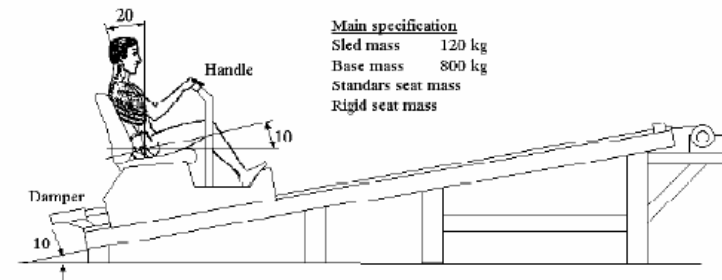


Figure 3.18: Head x-axis displacement with respect to T1 (JARI Testing)



Hybrid-III BioRID II RID3D

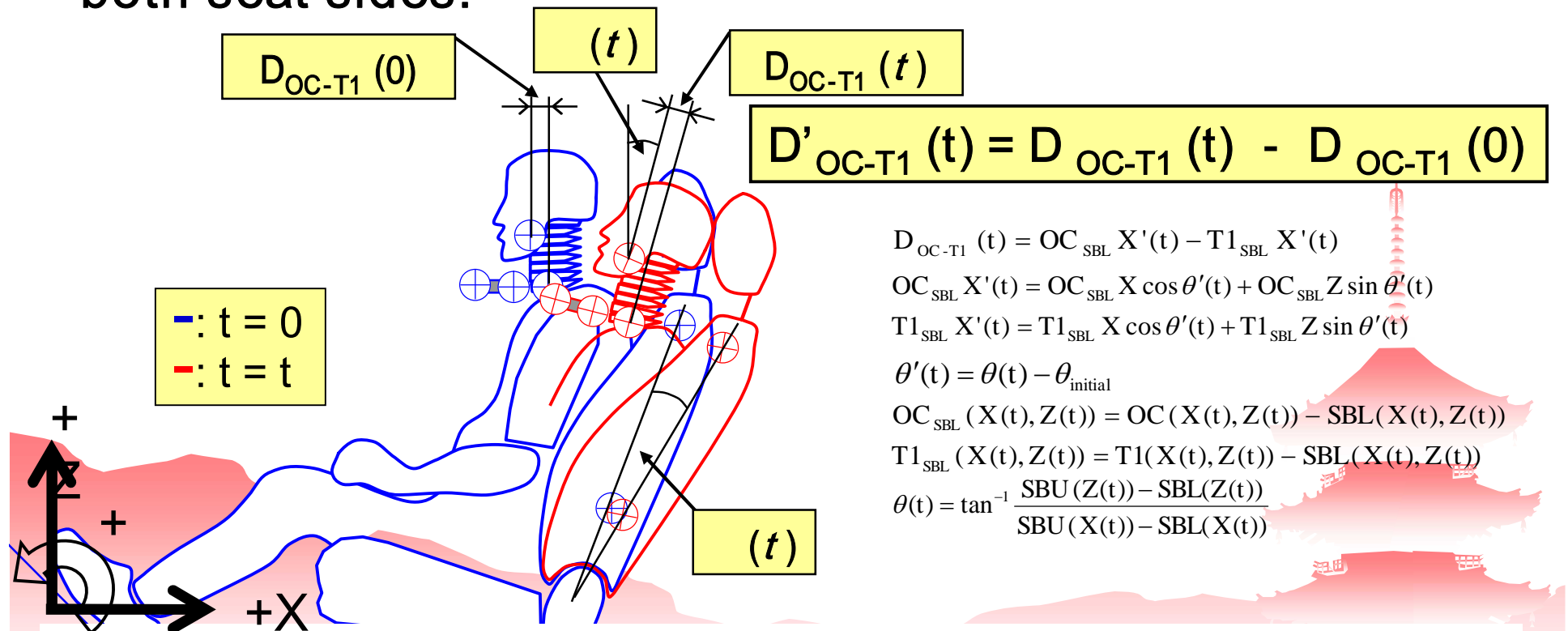




# Proposal for Dynamic Test for ECE R17-08

## 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.

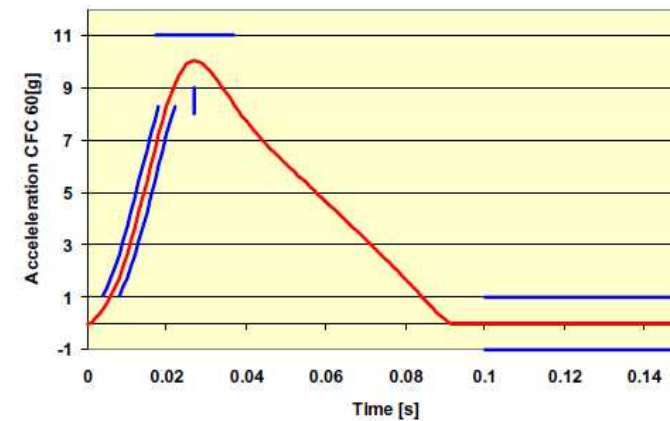
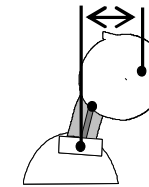
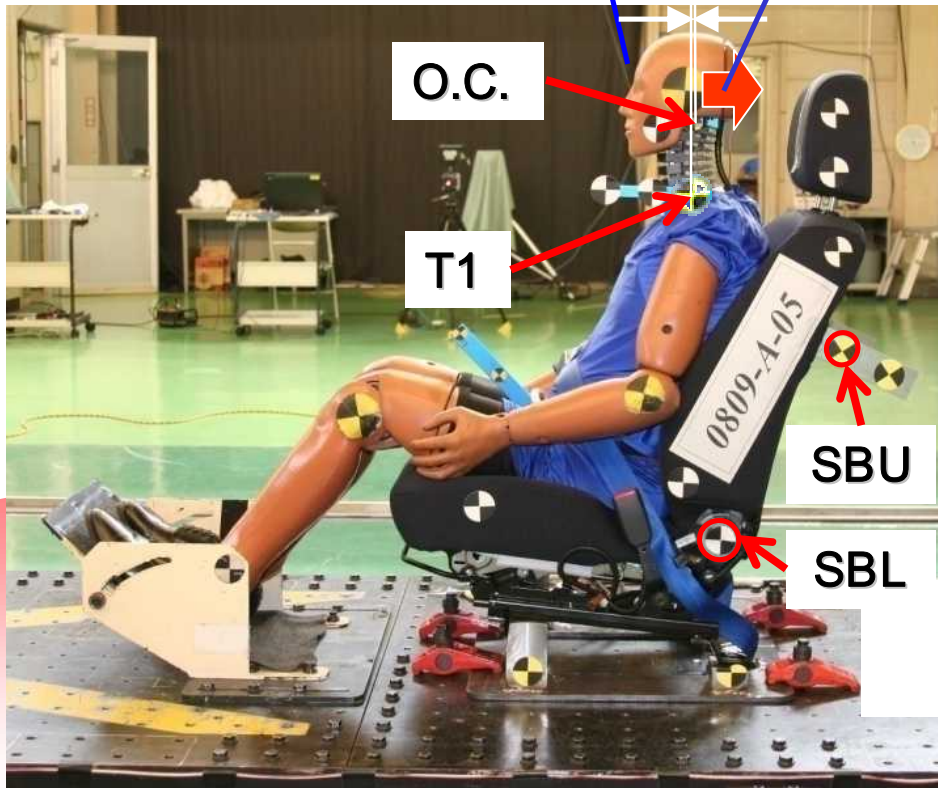


Note: The measurements data shall be considered for evaluation until the point in time at which the head rebounds from the head restraint or at 300 ms after T-zero, whichever occurs first.

# Proposal for Dynamic Test for ECE R17-08

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

:Measure “Dynamic backset” at  $V = 16\text{km/h}$  sled test

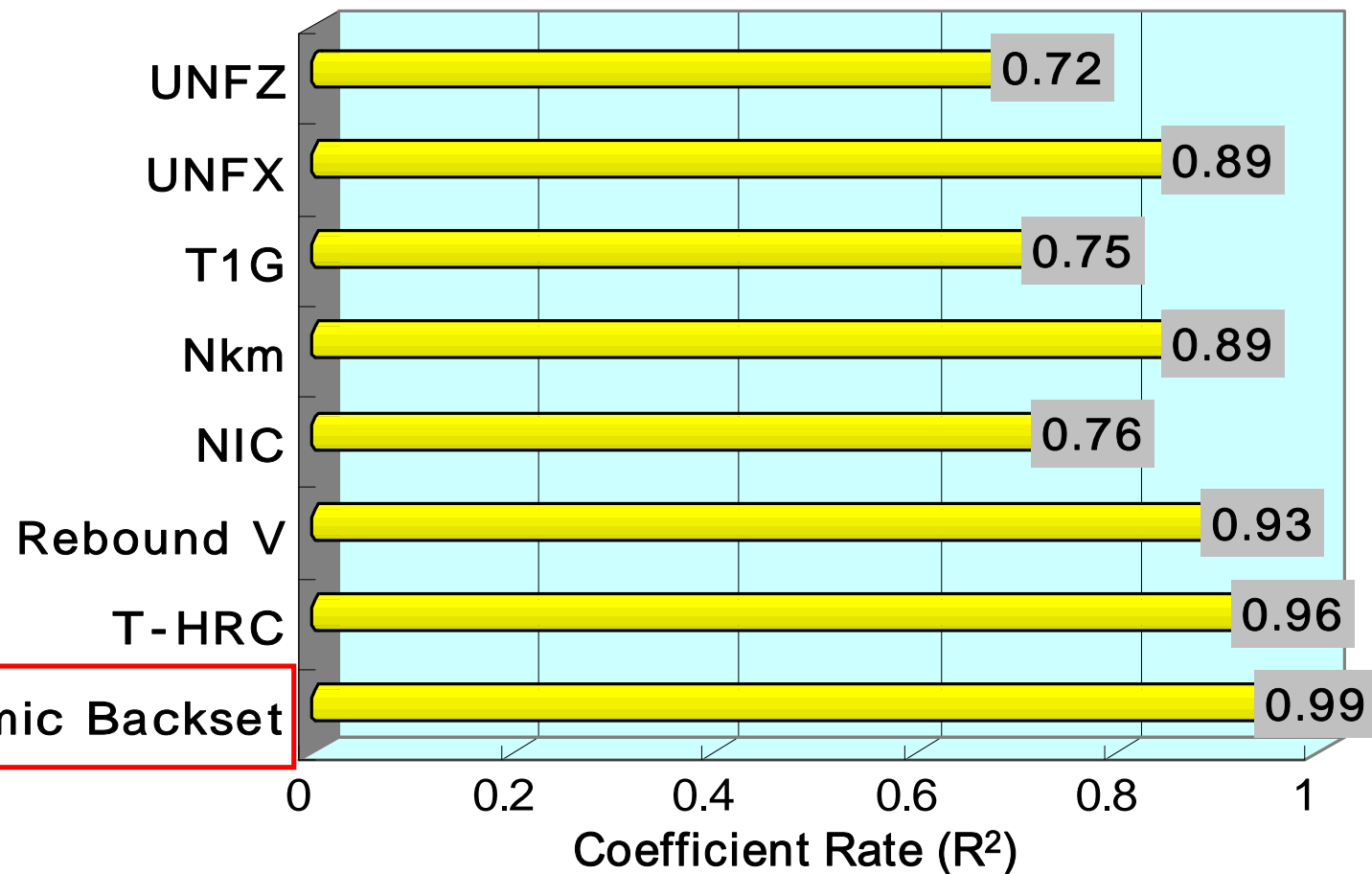


Sled Pulse

- Head O.C. (Occipital Condyle)
- Head C.G. (Centre of Gravity)

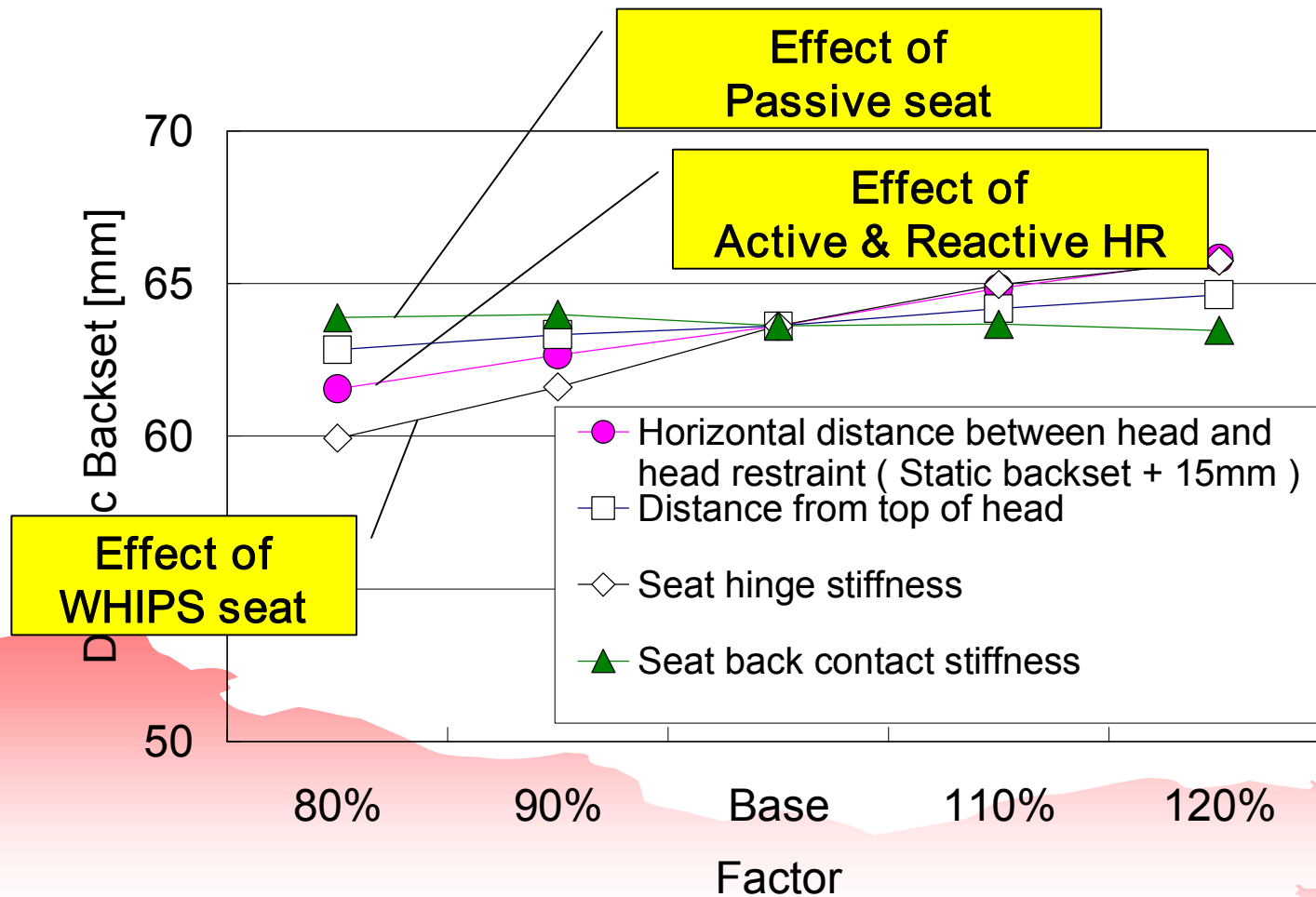
## Coefficient of determination Relation between static backset and various BioRID II indicators

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



# Sensitivity analysis by MADYMO simulation

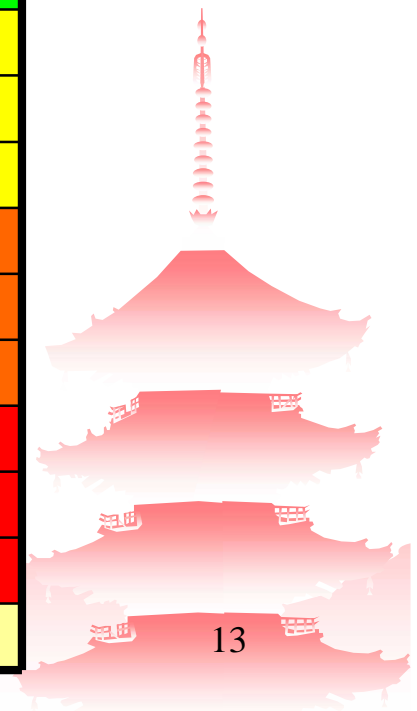
Dynamic backset has a potential to show the effect of passive, active and WHIPS type anti-whiplash seats.



# Repeatability, Reproducibility and Threshold Evaluation Tests

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

IIHS Ranking	Seat Type	Number (*:EEVC data)
Good	Normal	4
	Reactive	2(3*)
	Passive	2
	WHIPS	(1*)
Acceptable	Normal	1
	Reactive	(1*)
	Passive	2
Marginal	Normal	1
	Reactive	1
	Passive	4
Poor	Normal	5
	Reactive	5
	Passive	1
Total		33



# 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)

$$\text{Repeatability} \quad C.V = \frac{S_d}{\bar{X}} \quad 100 (\%)$$

$\bar{X}$  = Mean value of each indicator maximum value

$S_d$  = Standard deviation of each indicator maximum value

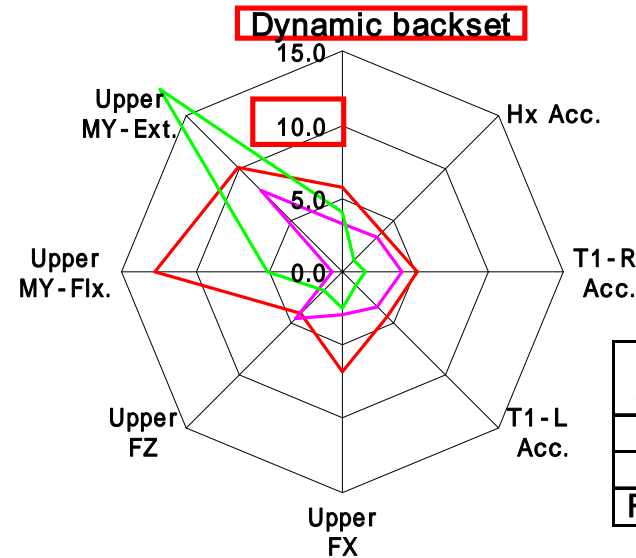
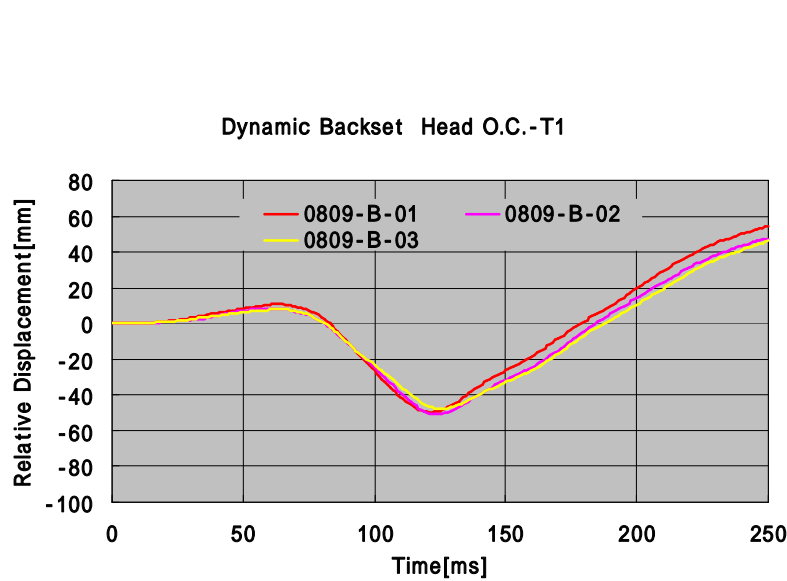
◆ Criteria Admissible level: CV 10



BioRID-II

# Repeatability Evaluation

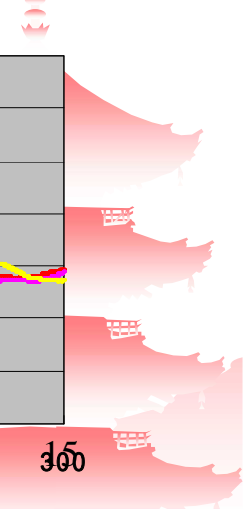
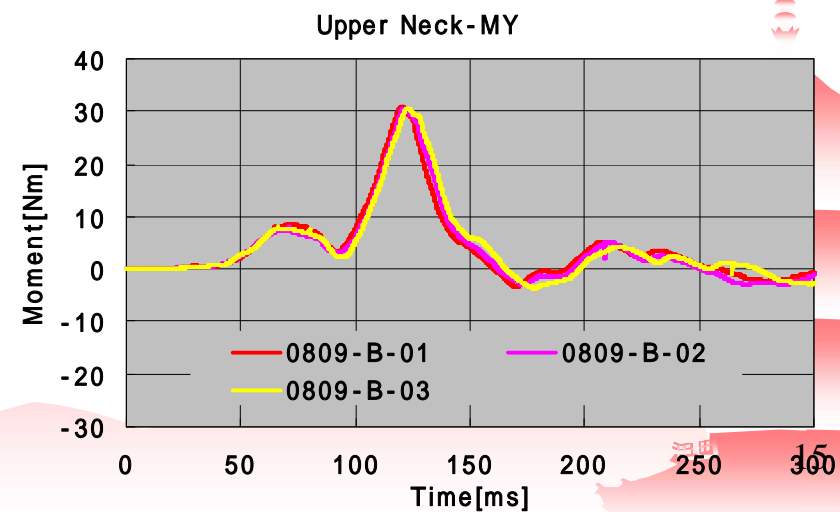
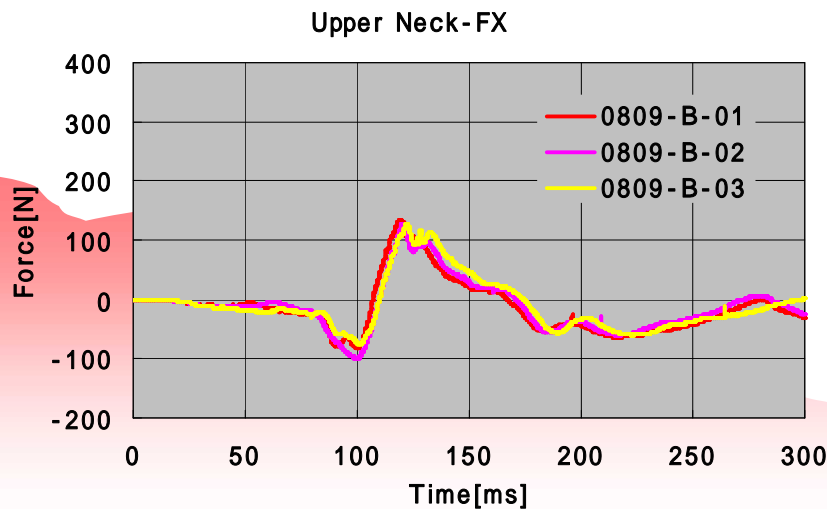
Dynamic backset shows good repeatability.



OC-T1 (mm)	
Standard Deviation	
Normal	4.3
Passive	1.6
Re-Active	2.5

— Normal — Passive — Re-Active

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)

$$\text{Reproducibility C.V} = \frac{S_B}{\bar{X}} \quad 100 (\%)$$

$\bar{X}$  = Mean value of each indicator maximum value

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

MSB = Square average of Maximum value and Minimum value

MSW = Square average of All value

n = number of tests



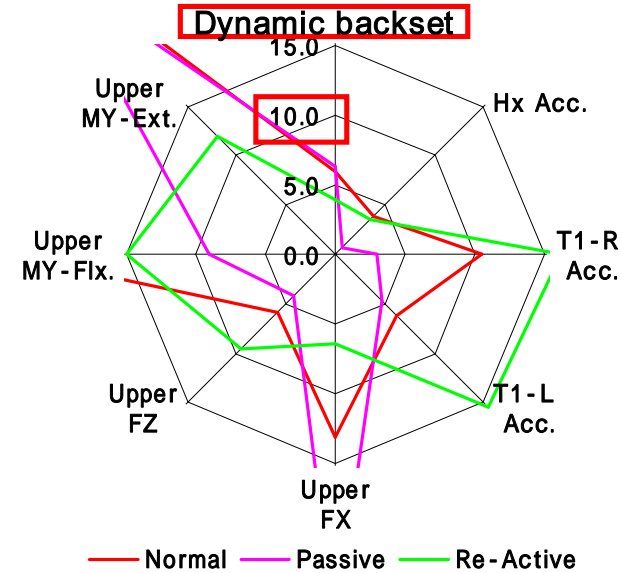
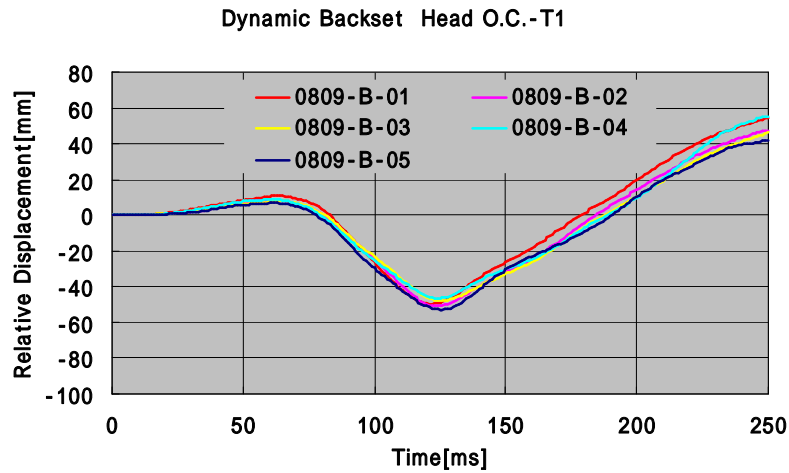
BioRID-II

## ◆ Criteria Admissible level: CV 10

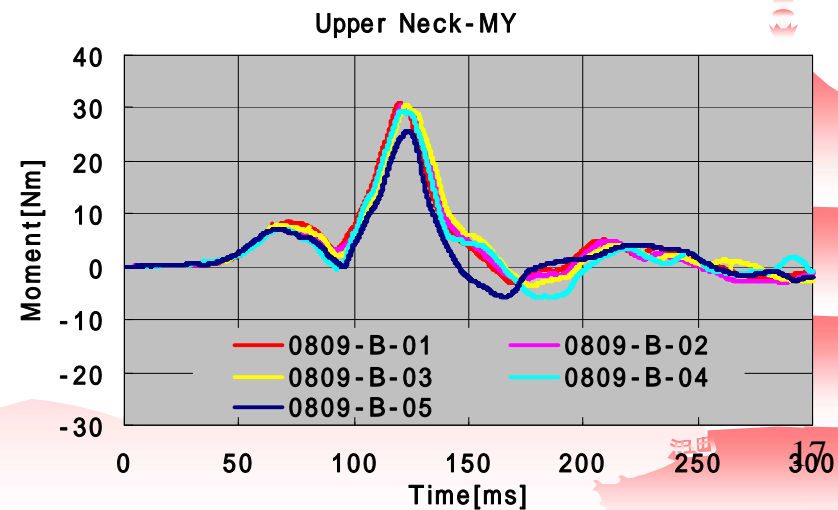
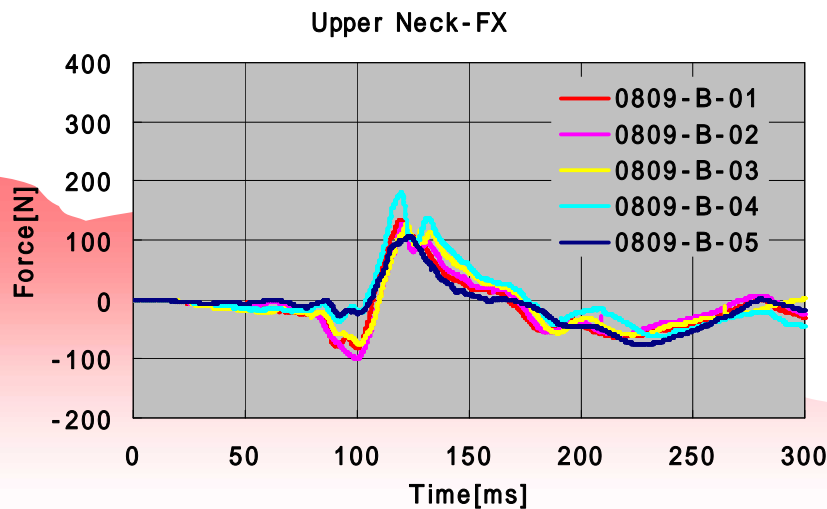


# Reproducibility Evaluation

Dynamic backset shows good reproducibility.

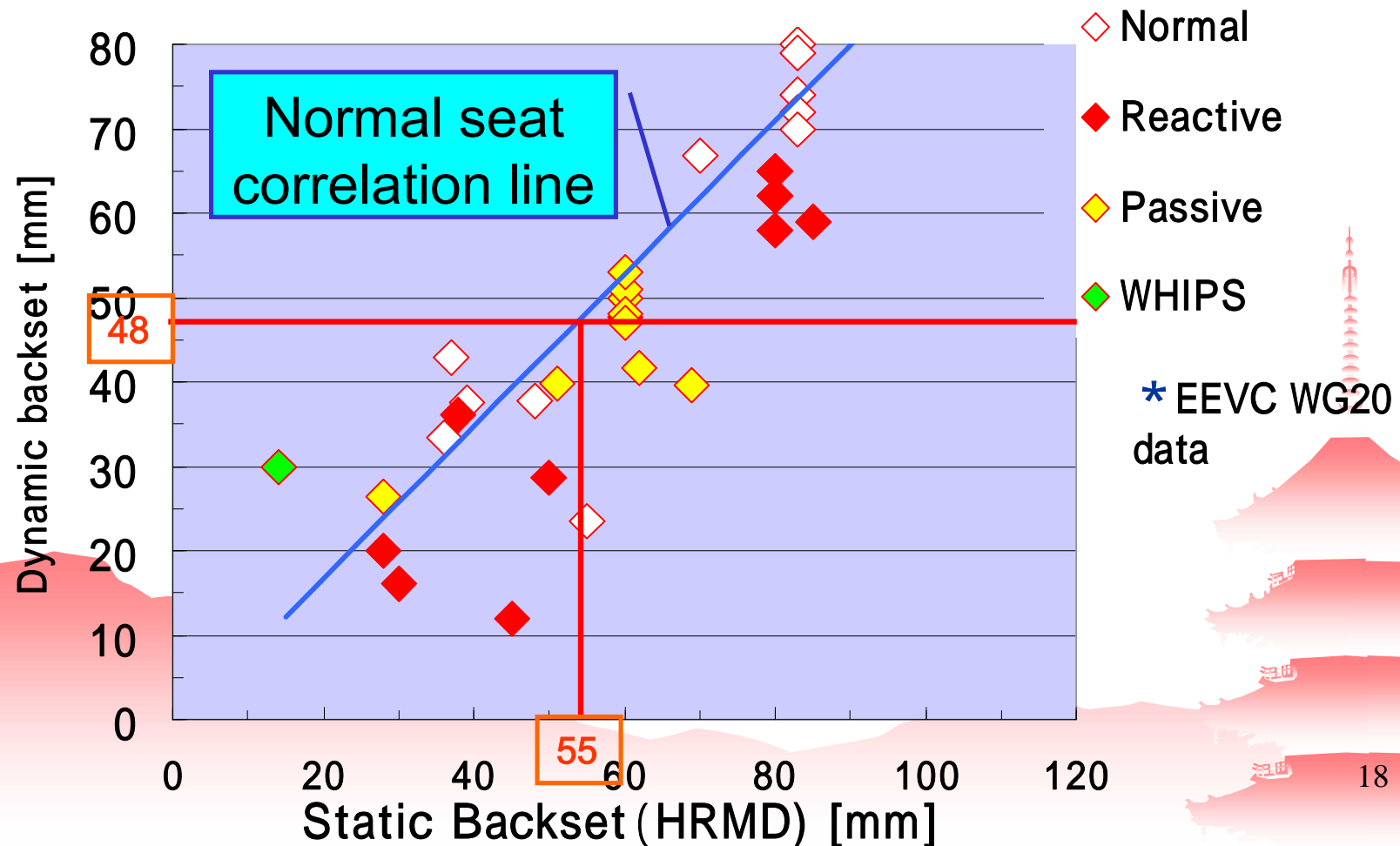


Fx and Upper neck MY show large variation.



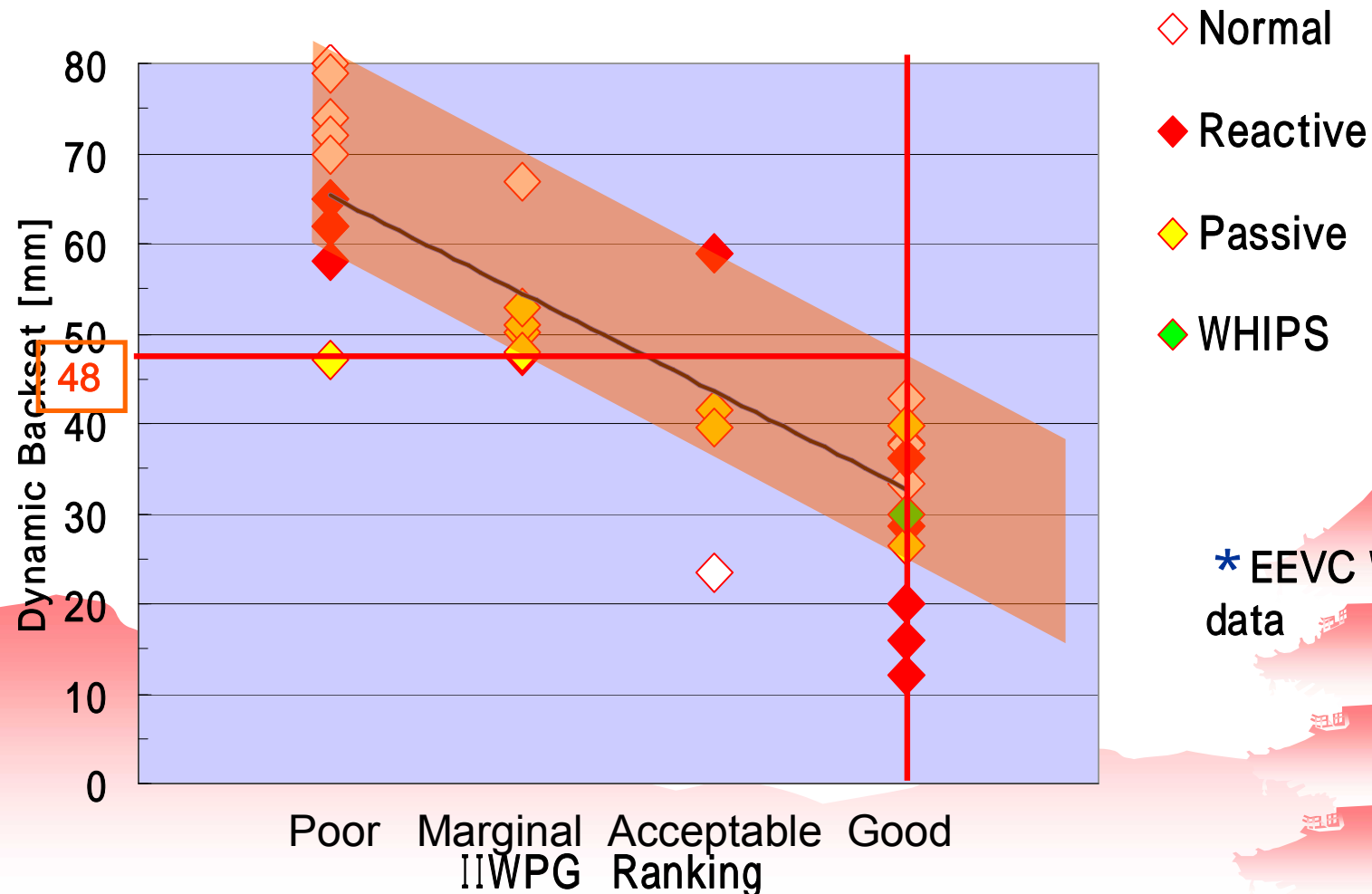
# Threshold study for Static Backset

- 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

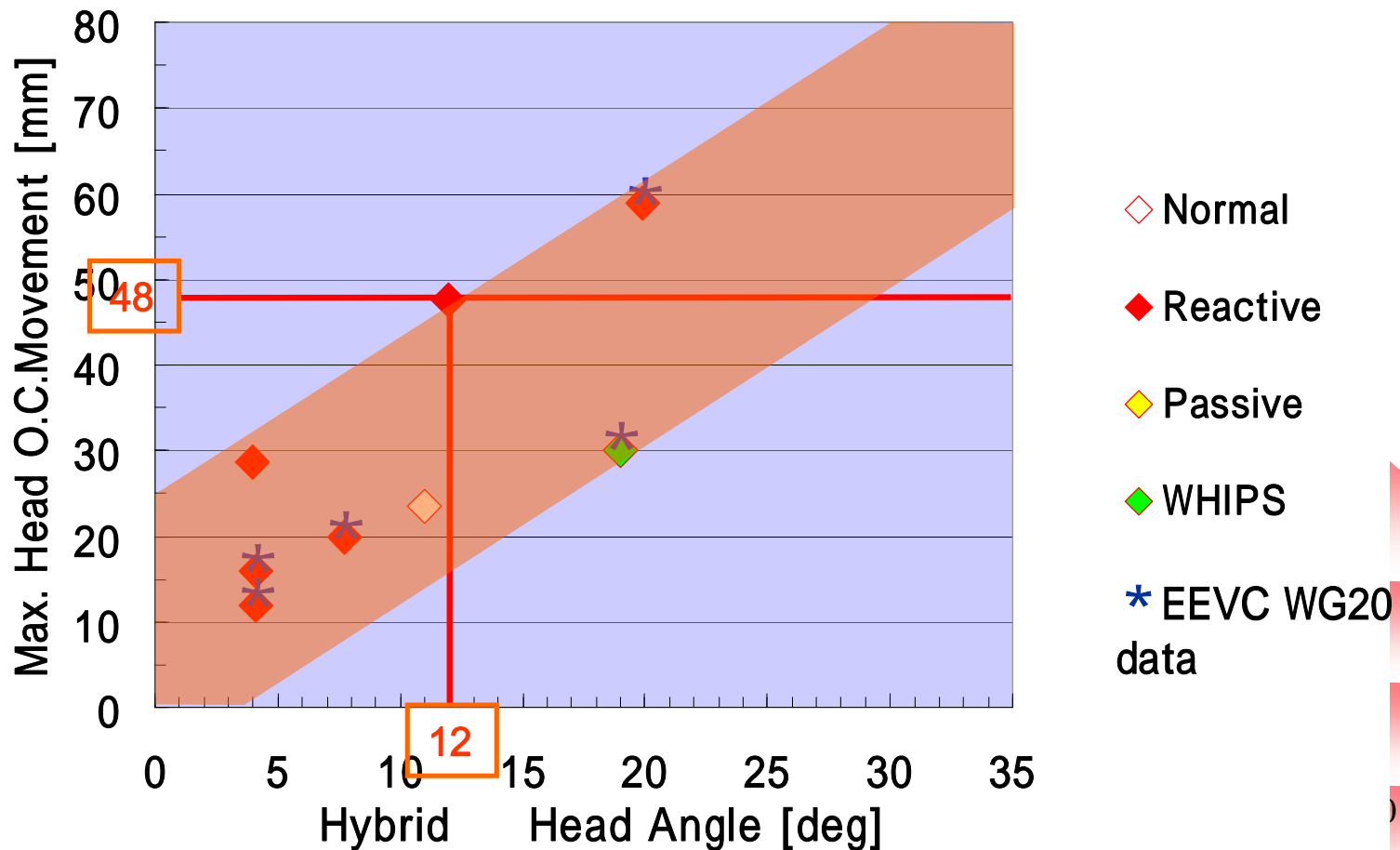
About [48mm] Dynamic backset is equivalent to achieve minimum performance level of IIWPG “GOOD” rating.



\* EEVC WG20 data

# 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  $\leq 55\text{mm}$



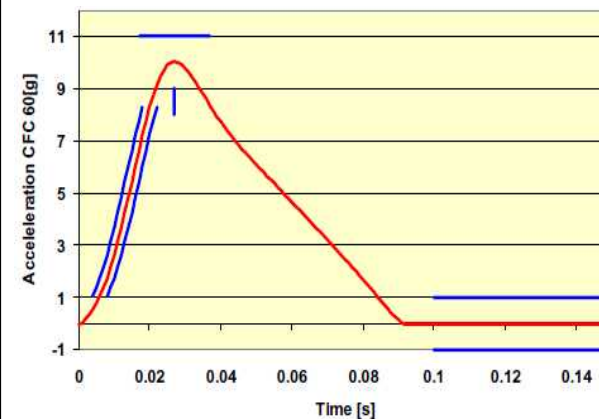
OR\*

R-point with Backset  $\leq 45\text{mm}$



## Dynamic Option

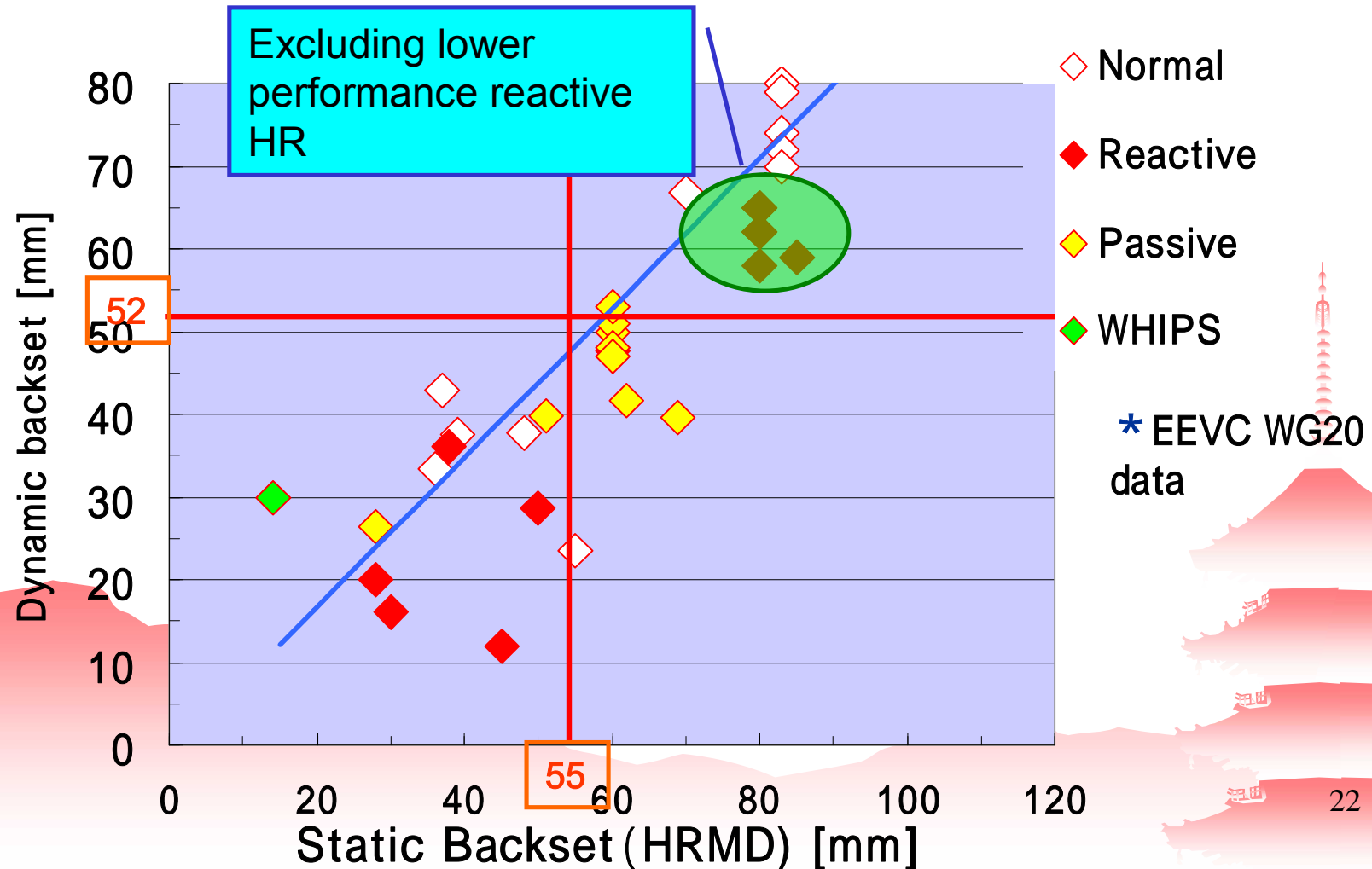
Bio RID II  
Dynamic backset  $\leq [52\text{mm}]$



\*: Manufacture's choice

# Effect of this proposed Threshold

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  $\leq$  [52]mm

Thank You

