
Japan Research Activities in the GTR-7 Phase 2 IWG
**Crash pulse research status based on
Japan accident research and Vehicle
rear impact test**

JASIC/Japan

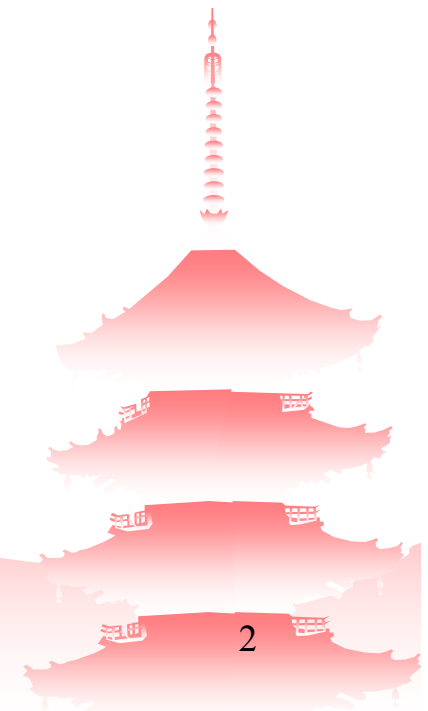
Feb. 2-3.2010



1. Accident analyses in Japan

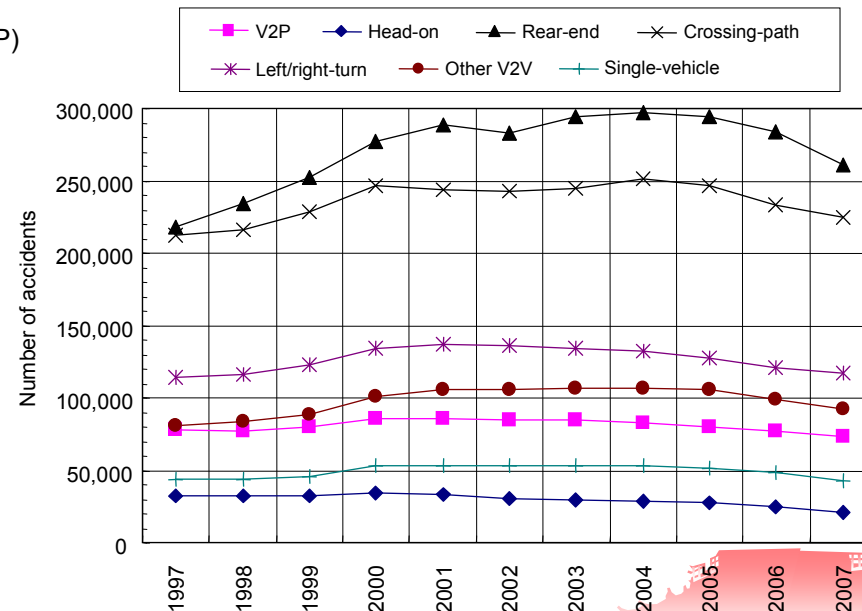
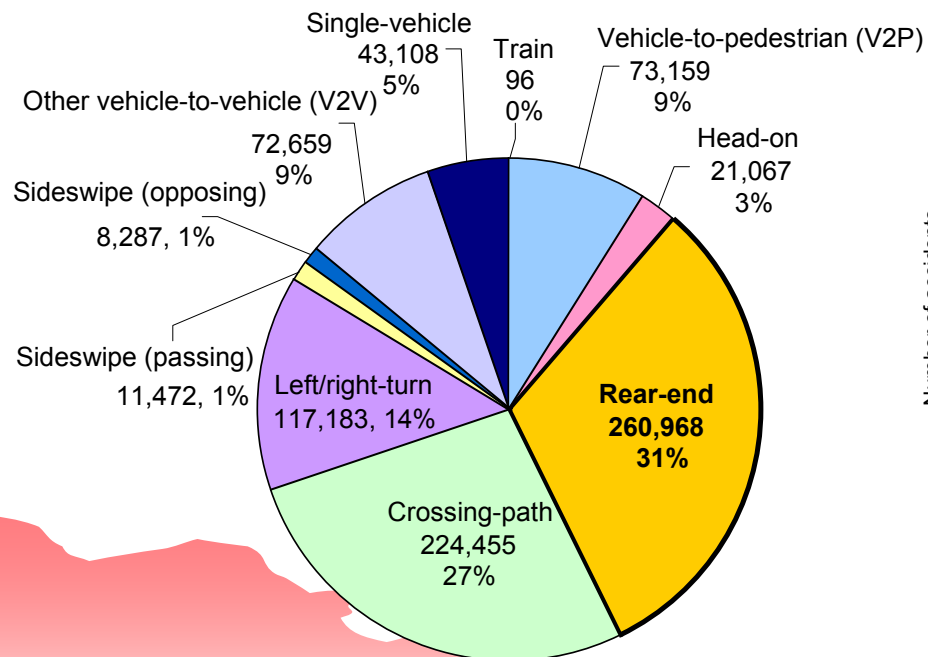
2. Vehicle crash test

3. Sled pulse proposal



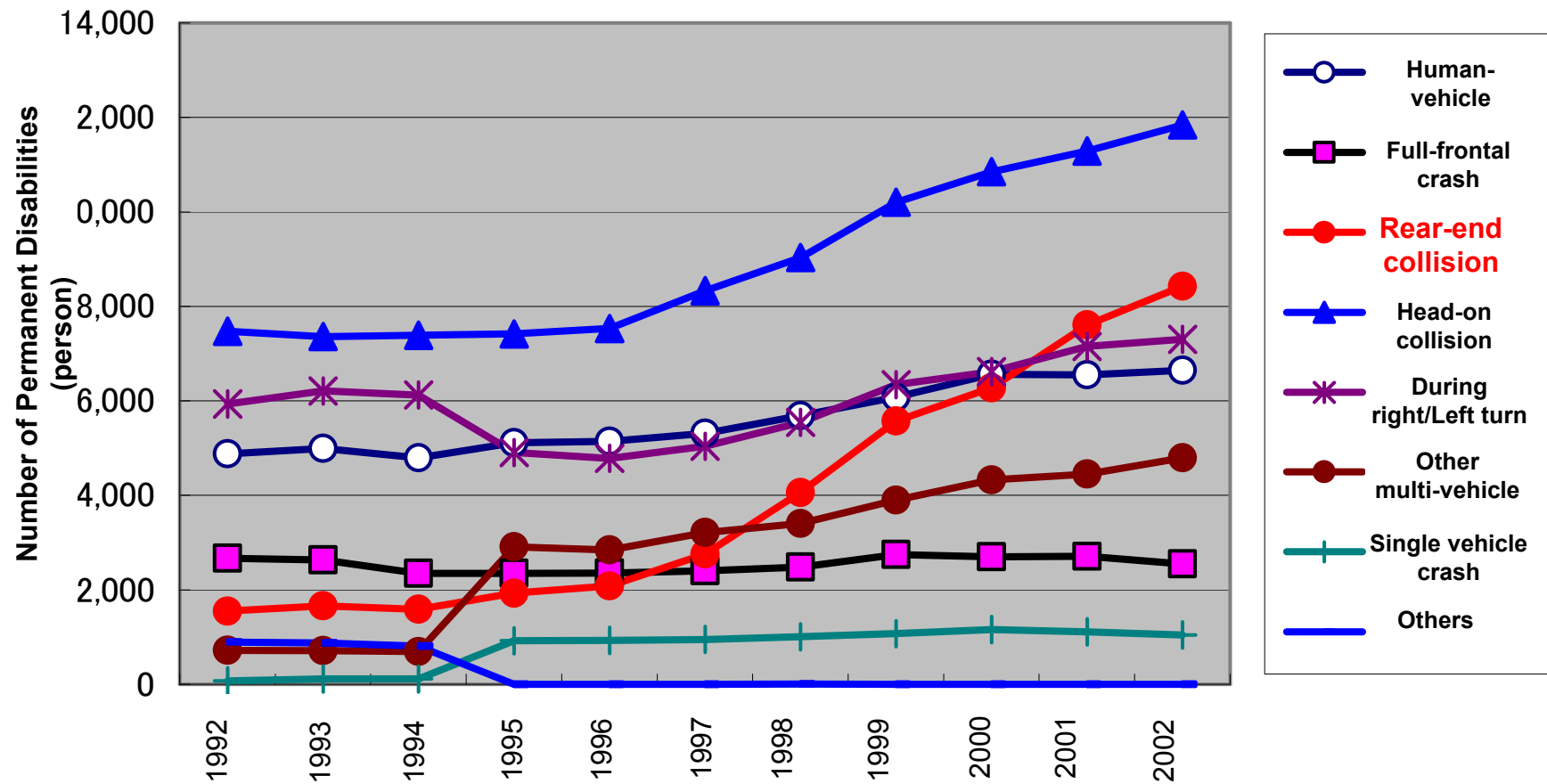
Trend of Rear-End Collision

- **Rear-End Collisions account for 32% of all traffic accidents.**
- **The number of rear-end collisions reached the highest in 2004, and remain at this high level since then.**



Trend of Permanent Disabilities by Rear-End Collisions

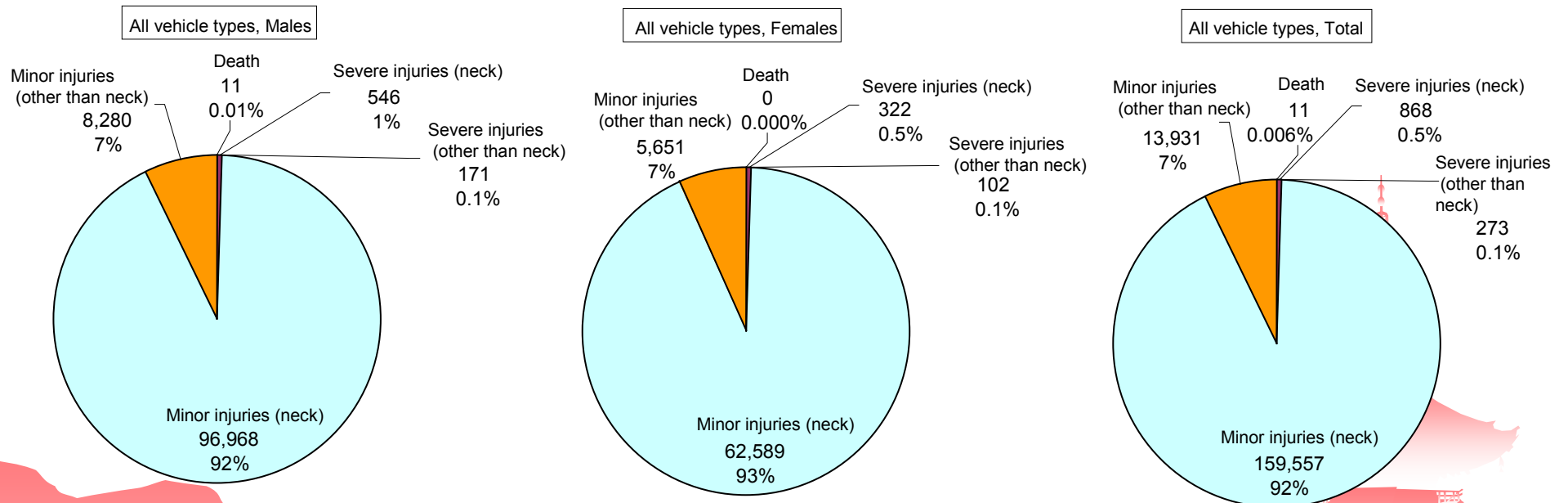
- The number of permanent disabilities by rear-end collisions have been significantly increasing in Japan since 1997.



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

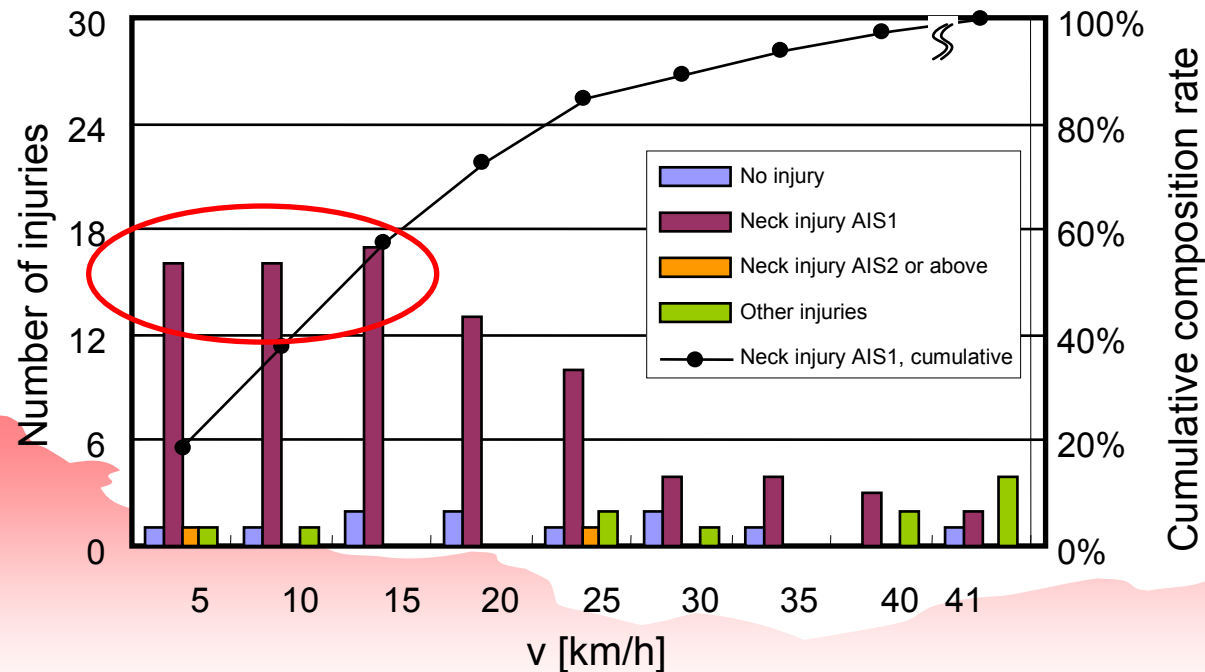
Type of Injuries due to Rear-End Collisions

- **Minor neck injuries account for 92% of injuries to drivers in rear-end collisions.**



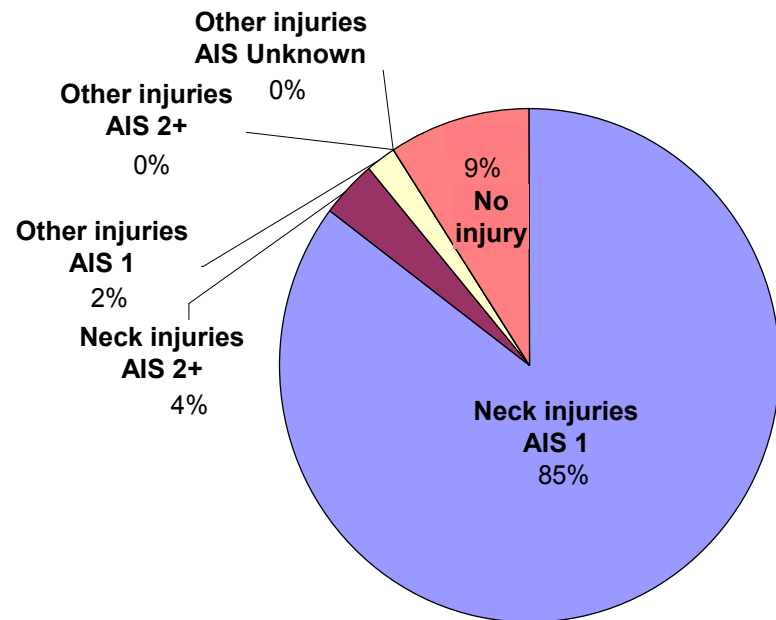
Delta V and Injuries to Drivers of Rear Impacted Vehicles

- AIS 1 (Minor) neck injury is the most frequent injury up to Delta V of 40km/h.
- The number of injuries is the highest at less than 15km/h Delta V .
- Tendency of AIS2+ neck injuries makes it difficult to analyze due to insufficient numbers.

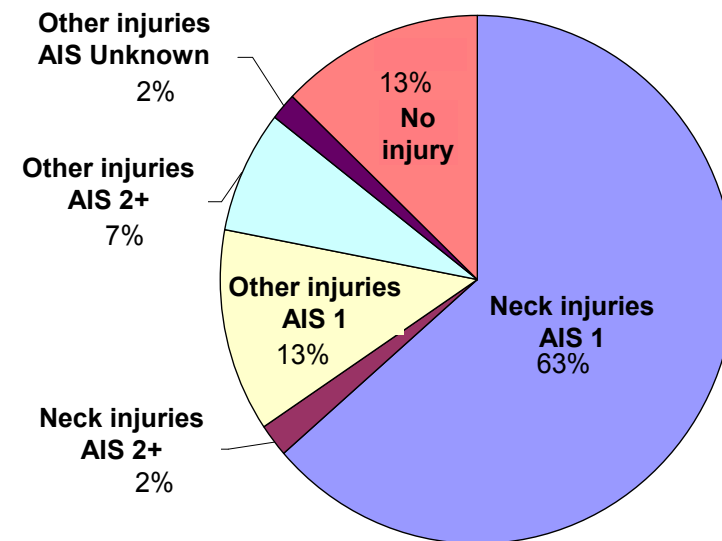


Injury Distribution at less than / more than or equal to Delta V 20km/h

- AIS1 neck injury presented the highest percentage for both Delta V of less than and more than or equal to 20km/h.
- Although the number of other injuries (upper & lower extremity, chest, abdomen, etc.) increases at delta V of 20km/h or more, AIS2+ neck injuries consist 2% even if delta V is 20km/h or more .



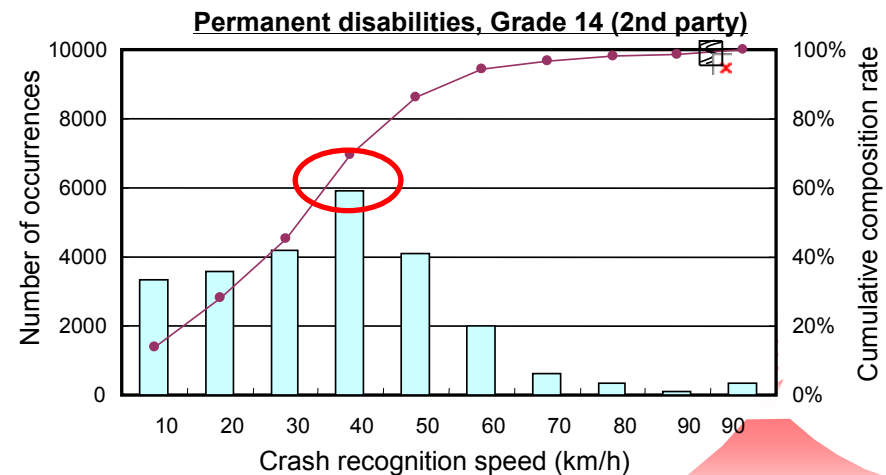
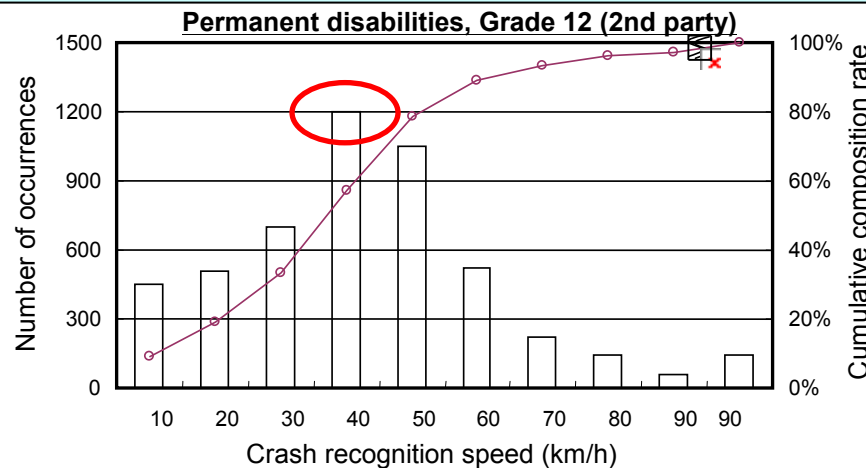
Injury Distribution at less than
Delta V of 20km/h :
Total 54 injuries
(1993 - 2006 micro analyses)



Injury Distribution at more than
or equal to Delta V 20km/h :
Total 55 injuries
(1993-2006 micro analyses)

Delta V study

- Head restraint GTR Phase 2 activities should aim to reduce minor neck injuries of WAD grade 2 or less (AIS1), especially long-term injuries (permanent disability).
- The number of long-term injuries is the highest at 30 - 40km/h crash recognition speed, which is about 16 - 22 km/h delta V.



Crash Recognition Speed

Speed at which the strike driver first recognizes a crash situation by perceiving the vehicle, person, object, etc.

Permanent Disabilities - Nervous Symptoms

"Traumatic cervical syndrome" (cervical spine sprain, cervical strain), which does not accompany any cervical spine bone or spinal cord injury such as dislocation or fracture of the cervical spine, is assessed as "disorder of the nervous symptom or mental disorder" if it is medically proven/explained that the future recovery cannot be expected.

Grade 12: With a local persistent neurological symptom

The symptom remaining in the head/neck, upper limb or back caused by traumatic cervical syndrome can be medically proven by objective findings such as those from neurological testing or images.

Grade 14: With a local neurological symptom

Although the symptom remaining in the head/neck, upper limb or back caused by traumatic cervical syndrome cannot be medically proven by objective findings such as those from neurological testing or images, its continuity/consistency is recognized from the situation where the injury occurred, progress of treatment, etc. and thus it can be explained, and it is medically presumed that it is

Crash pulse study (Car to Car)

1. Car to Car Test to reproduce typical accident case (30-50km/h)



Provided from NSVA

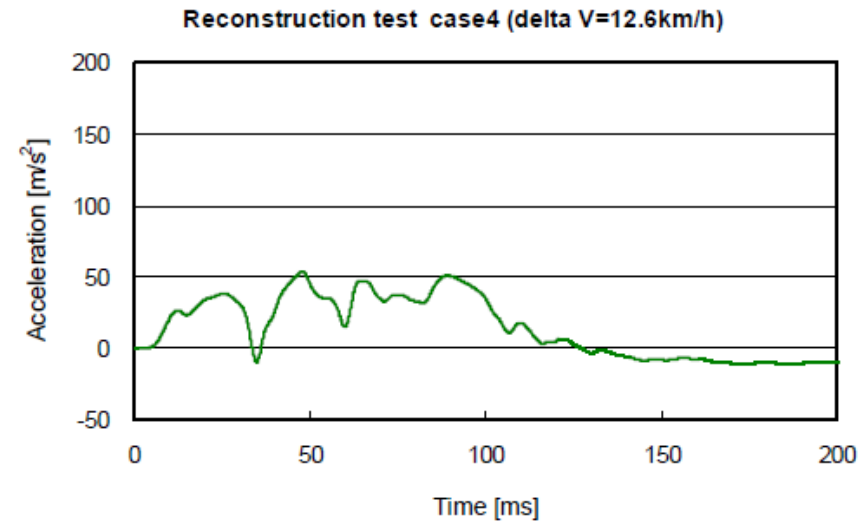
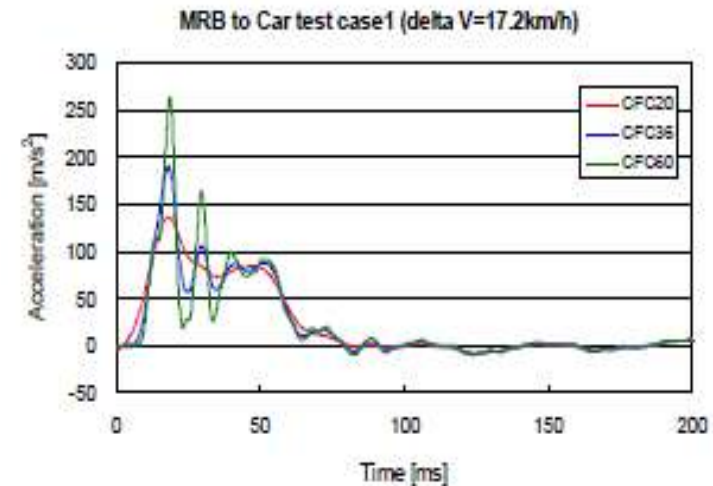


Table 5.3.1. Acceleration Pulse Overview (car to car test) [3][4][5]

Car to Car		Case 1		Case 2		Case 3		Case 4	
	Filter	Value	Time[msec]	Value	Time[msec]	Value	Time[msec]	Value	Time[msec]
Peak Vehicle C.G. Ax [g]	CFC80	10.4	48.7	18.8	68.4	18.8	68.3	5.5	47.7
Mean Vehicle C.G. Ax [g] (Tzero - TP)	---	4.88	111.6 (Tp)	8.17	88.8 (Tp)	8.02	73.9 (Tp)	2.80	127.4 (Tp)
Vehicle C.G. Vel. Change [km/h]	---	18.0	111.8	27.7	107.7	28.2	105.0	12.8	128.5
Impact speed [km/h]	---	35.2	---	48.8	---	30.1	---	28.1	---

Crash pulse study (MRB to Car)

1. Car to MRB Test to reproduce 35km/h crash. Provided from NSVA



<i>MRB to Car</i>		Case 1		Case 2		Case 3	
	Filter	Value	Time[msec]	Value	Time[msec]	Value	Time[msec]
Peak Vehicle C.G.Ax [g]	CFC20	13.9	18.2	11.5	43.3	14.4	12.5
Peak Vehicle C.G.Ax [g]	CFC35	19.4	18.2	13.2	14.1	21.8	11.8
Peak Vehicle C.G.Ax [g]	CFC60	26.9	18.6	16.1	14.2	29.8	11.7
Mean Vehicle C.G. Ax [g] (Tzero = TP)	—	6.14	79.5 (Tp)	8.08	59.5 (Tp)	7.06	70.7 (Tp)
Vehicle C.G. Vel. Change [km/h]	—	17.2	109.9	17.9	90.9	17.6	70.0
Impact speed [km/h]	—	35.1	—	35.4	—	35.5	—

Tp: Time during which the acceleration goes down after 90% of the maximum speed change is recorded [19]

Crash pulse study

Car to Car Test

<i>Car to Car</i>	Case 1	Case 2	Case 3	Case 4 *
Peak acceleration [m/s ²]	101.9	162.7	162.7	53.9
Mean acceleration [m/s ²]	47.63	80.07	78.60	27.44
Duration [ms]	111.6	107.7	105.0	128.5
Delta-V[km/h]	19.0	27.7	23.2	12.6
Impact speed [km/h]	35.2	49.9	30.1	29.1

* underride / override occurred

Proposed typical
crash pulse

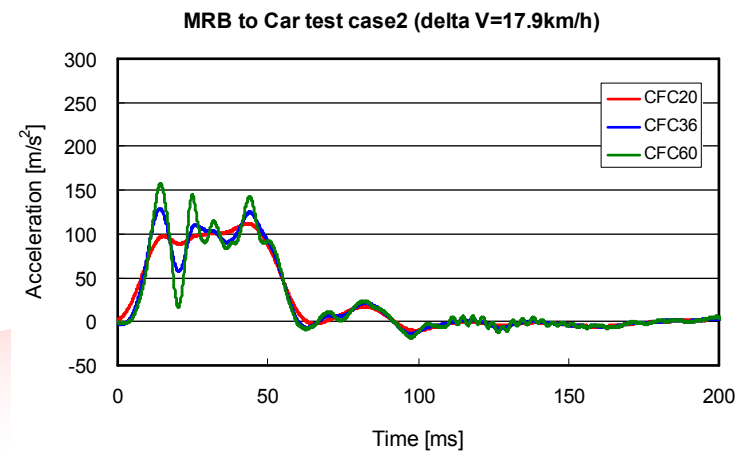
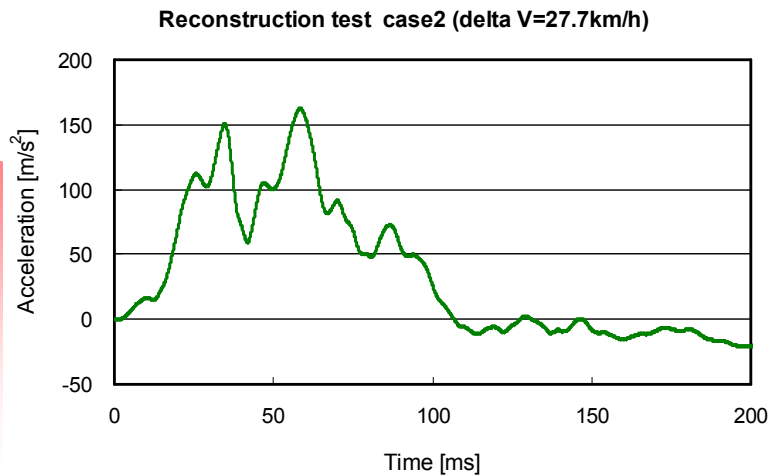
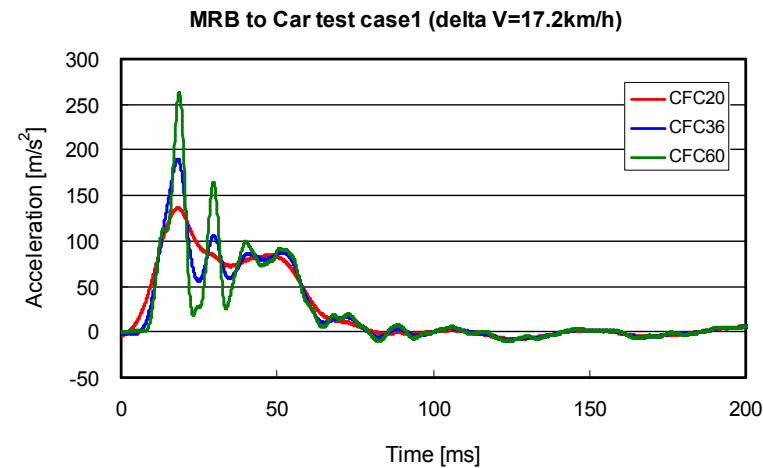
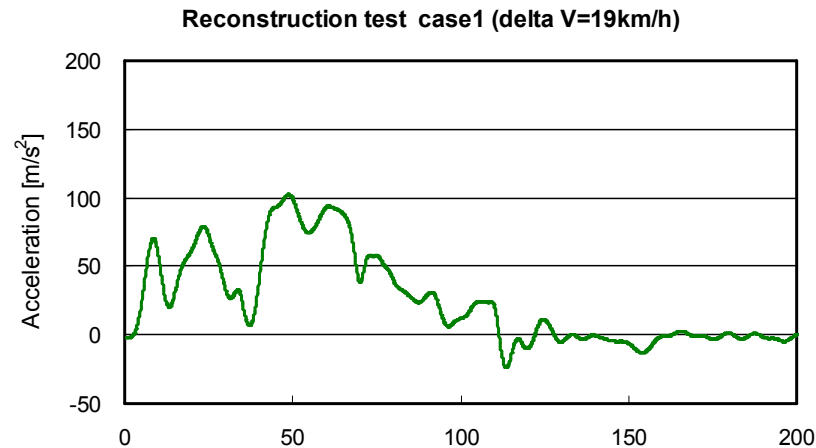
	Candidate
Peak acceleration [m/s ²]	100 130
Mean acceleration [m/s ²]	45 70
Duration [ms]	80 110
Delta V [m/s]	16 22

Moving Rigid Barrier to Car Test

<i>MRB to Car</i>	Case 1	Case 2	Case 3
Peak acceleration [m/s ²]	136.2	112.7	141.1
Mean acceleration [m/s ²]	60.17	79.18	69.19
Duration [ms]	109.9	90.9	70.0
Delta-V[km/h]	17.2	17.9	17.6
Impact speed [km/h]	35.1	35.4	35.5

Crash pulse study (Pulse shape)

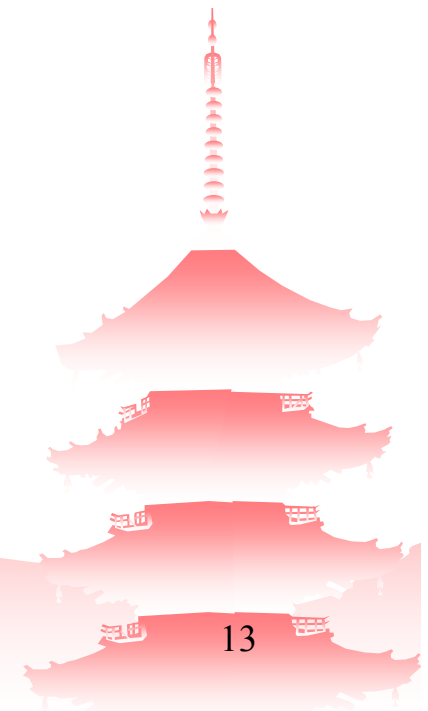
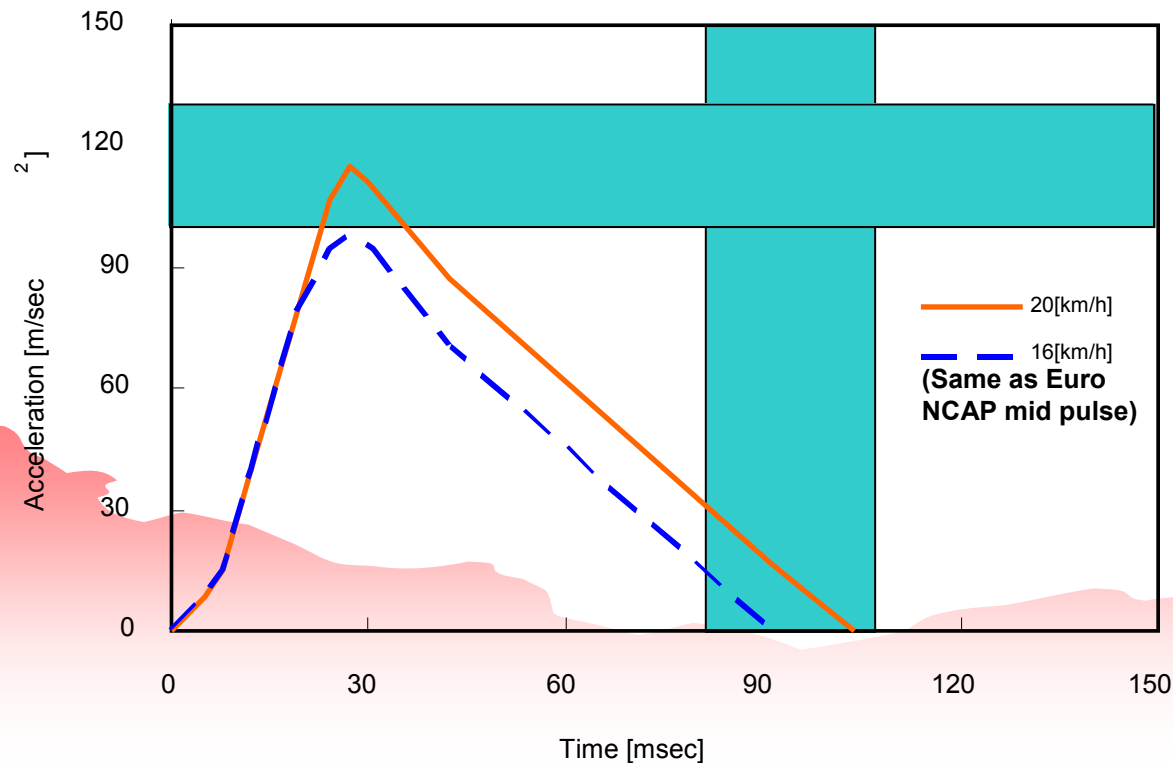
- Both car to car and MRB to car tests show “Triangle Shape Pulse”.



Test Pulse proposal

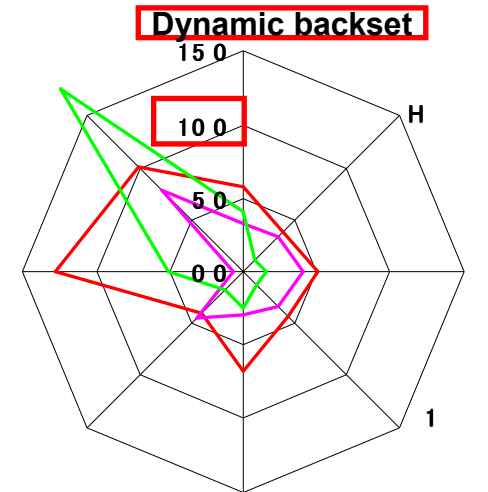
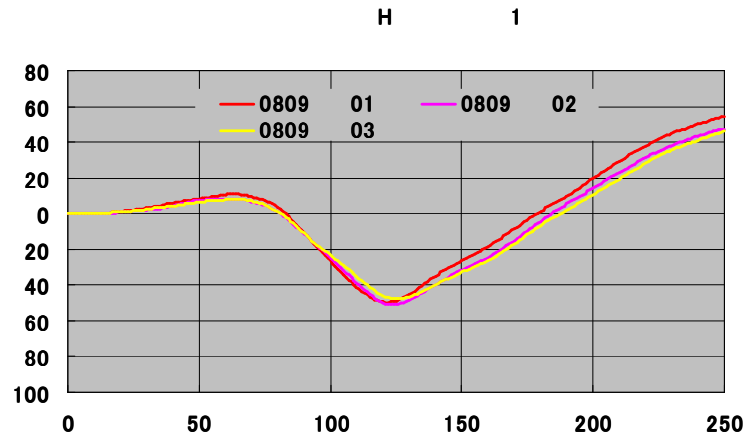
Following pulse is proposed.

- Delta V: 16 22 km/h
- Peak acceleration : 100 130 m/s²
- Mean acceleration : 45 70 m/s²
- Duration : 80 110 ms
- Pulse shape : Triangle Shape Pulse

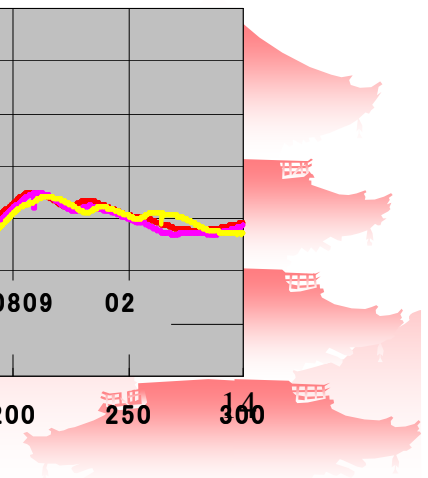
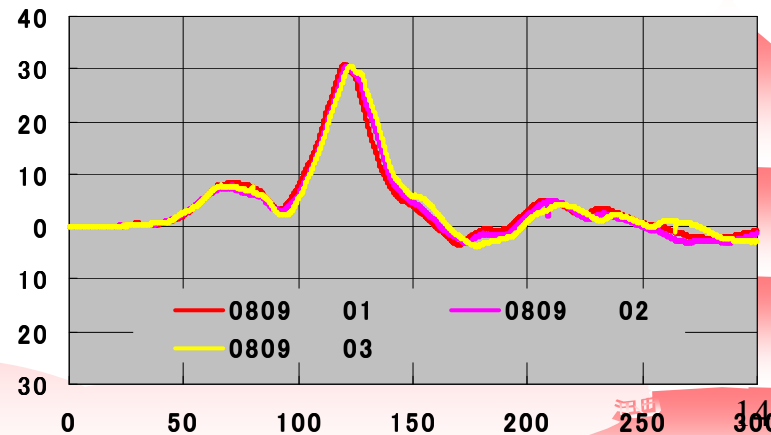
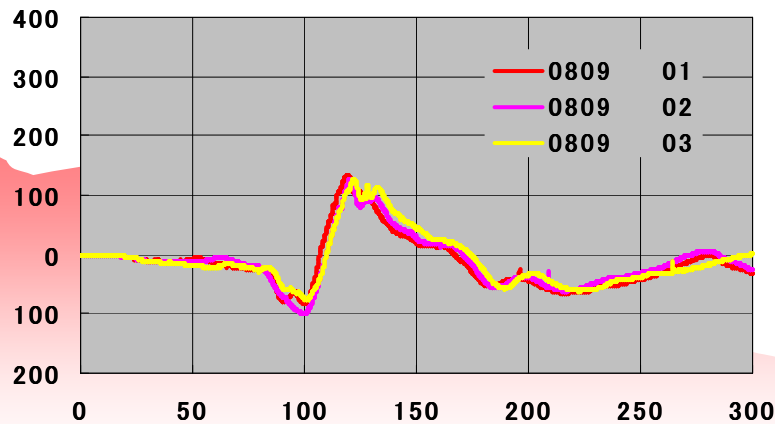


Repeatability Evaluation in case of 16km/h

Except for Upper neck MY, all other indicators show good repeatability.

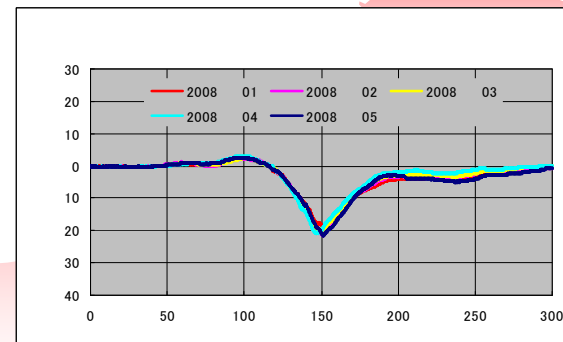
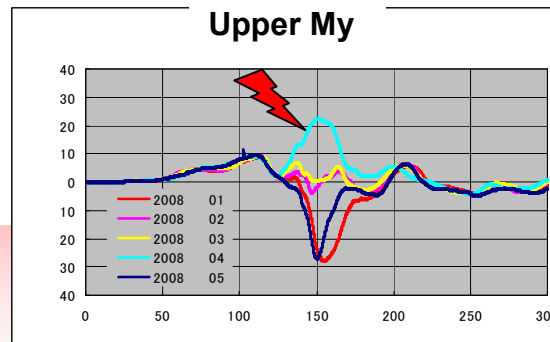
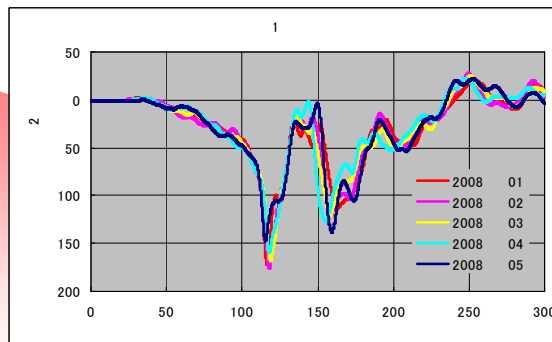
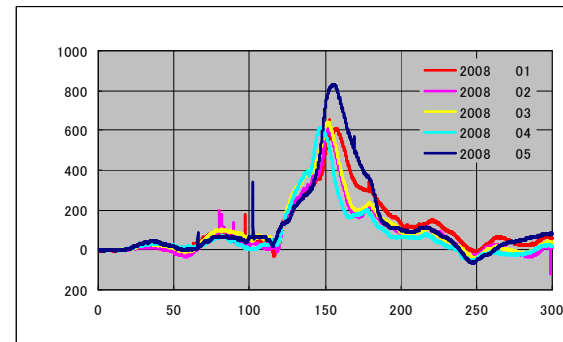
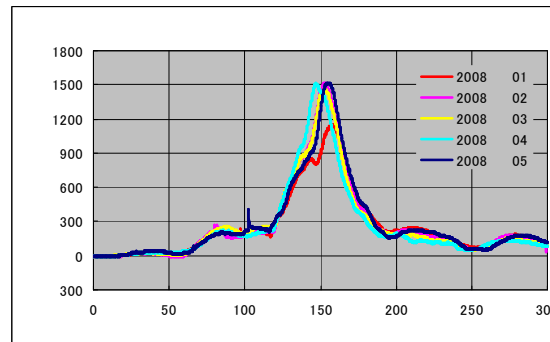
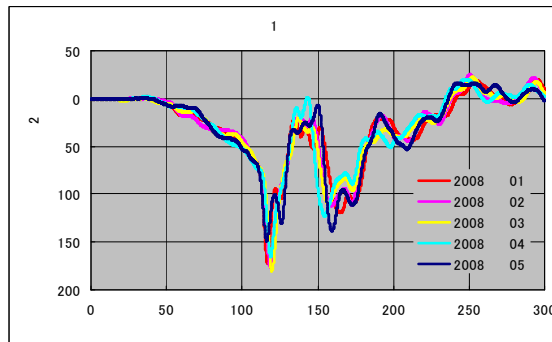
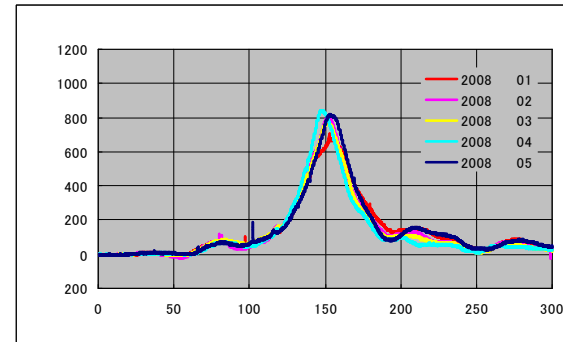
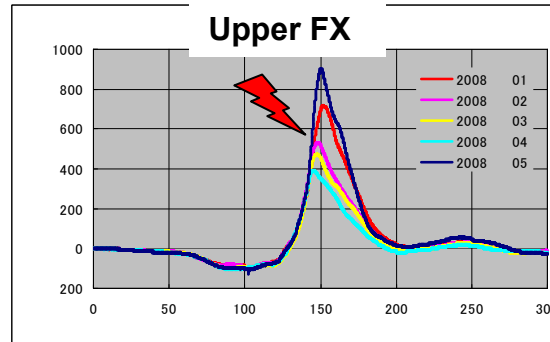
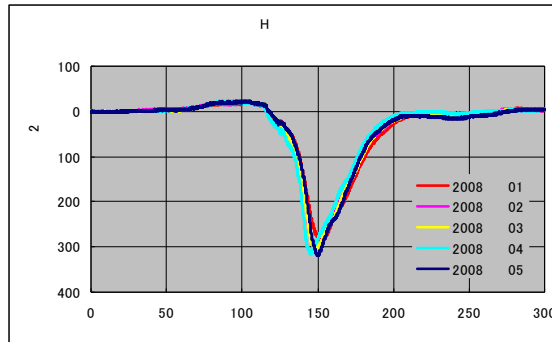


OC-T1 (mm) Standard Deviation	
Normal	4.3
Passive	1.6
Re-Active	2.5



Repeatability Evaluation in case of 20km/h

Reactive seat C : Upper FX and Upper My show large variation.



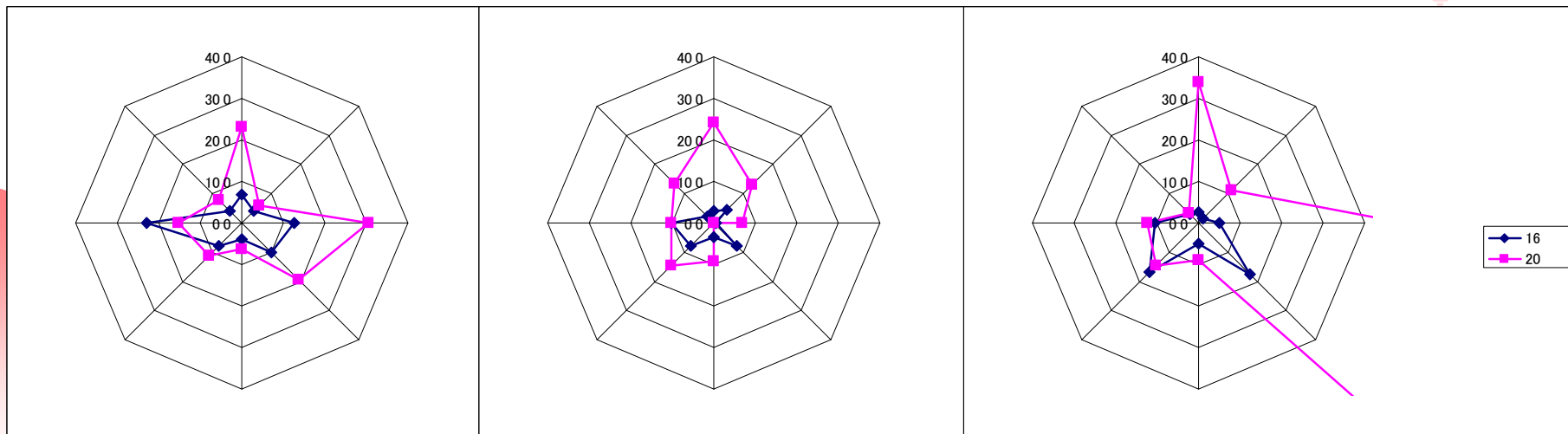
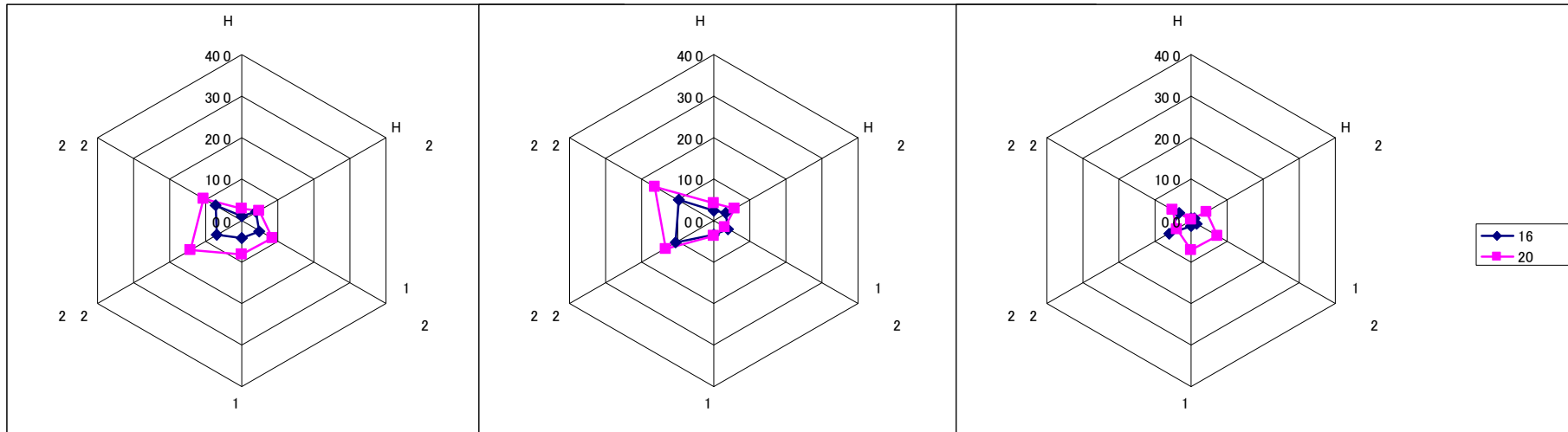
Repeatability CV. comparison between 16km/h and 20km/h

In case of 20km/h, variation tend to larger and out of limit.

Normal seat A

Passive seat B

Reactive seat C



Summary

- **Pulse with Delta V: 16 – 22 km/h is appropriate pulse to evaluate long term injuries.**
- **In case of 16km/h delta V, the repeatability and reproducibility will be able to achieve reasonable condition with dummy variation reduction.**
- **In case of 20km/h delta V, the repeatability and reproducibility will be larger due to seat deformations variation.**

Future Action

- **Evaluate Repeatability and Reproducibility with new calibration method at 16km/h delta V and higher delta V.**

Thank you for your attention!

