

Submitted by the expert from Japan

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(55th GRSP, 19-23 May 2014,
agenda item 23(j))

Survey on Safety of New Mobility Vehicles

1. Background
2. Contents of Study
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3. Observations

As was reported at the 52nd GRSP regarding the Approval System for New Mobility, the dissemination of three- or four-wheeled “New Mobility Vehicles*” with a passenger capacity of 2 persons, that are smaller than the M1 category, is being studied in Japan from the standpoint of diversified transportation means and environmental countermeasures. Since 2013, a new approval system has been introduced regarding which New Mobility Vehicles can be put into use for operation on public roads under certain conditions. However, we think we need to study further appropriate and comprehensive safety regulations in order to enhance the future full-scale dissemination (assuming the operation of New Mobility Vehicles on public roads in the same way as ordinary vehicles).

As part of this study, we are now evaluating the performance of “New Mobility vehicles” and vehicles of the L category, that are similar to those, as examples.

Although this study is still underway, we would like to explain as an interim report to the GRSP the results of investigation in connection with the collision safety performance.

* “New Mobility vehicles”: The following vehicles are defined for the purpose of the approval system in Japan.

- The vehicle size, which means length, width, and height is same as kei-cars .
(Less than 3.4m,1.48m,2.0m)
- Carry one or two occupants (up to three occupants if two occupants are children(under 6 years old)).
- Have a rated output of 8 kW or less (It correspond 125 cc or less for internal combustion engine types)

- ◆ Survey on collision safety performance
 - ✓ Front collision safety test
(Similar in content to full-wrap)
 - ✓ Lateral collision safety test
(Similar in content to UN-R95)
 - ✓ Pedestrian head safety test
(Similar in content to UN-R127)
 - ✓ Pedestrian leg safety test
(Similar in content to UN-R127)

*Using flexible leg impactor

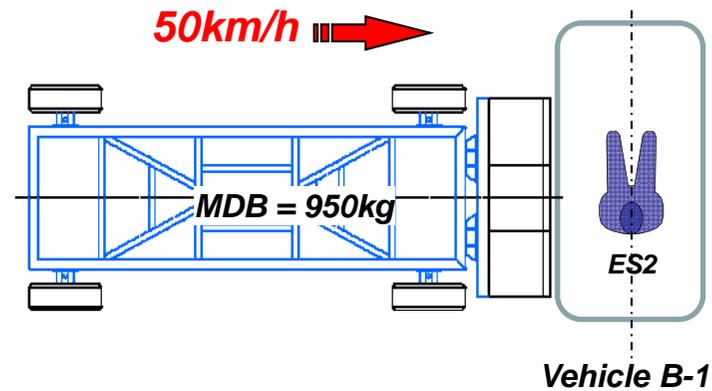
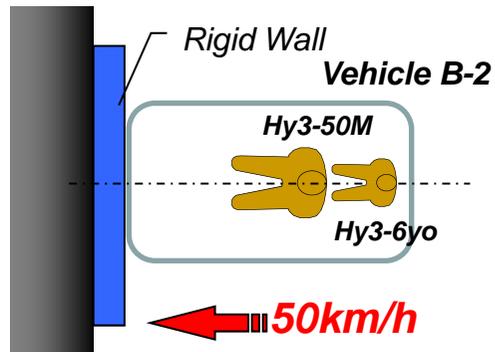
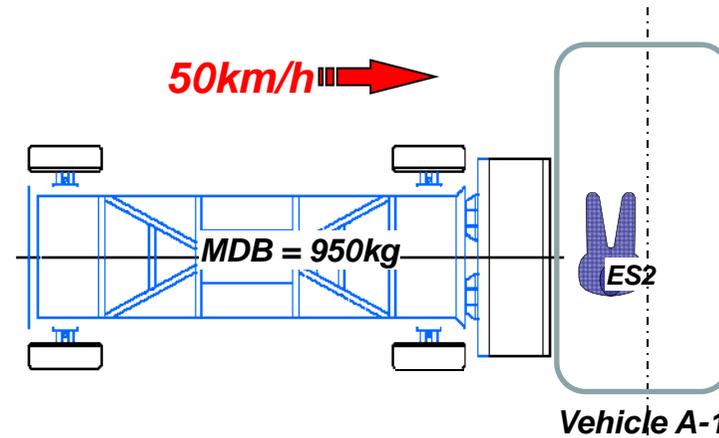
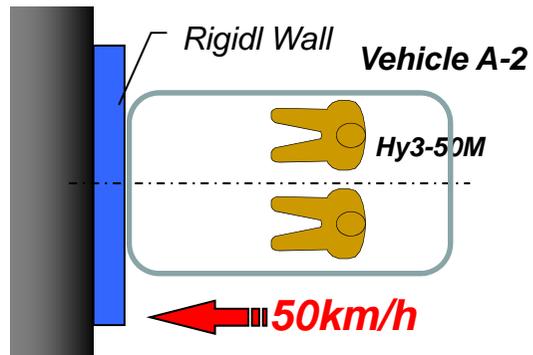
Tested Vehicles

	Vehicle A	Vehicle B
Category	L6, 2 occupants	L7, 2 occupants (in tandem)
Specs	Unloaded weight: 350 kg (Not including the engine) Whole length: 2720 mm, Whole width: 1500 mm	Unloaded weight: 375 kg (Not including the battery) Whole length: 2380 mm, Whole width: 1234 mm Whole height: 1454 mm, W/B: 1686 mm
Driving power, output, designed speed	400 cc Diesel, 45 km/h	Motor 13 kW, 80 km/h
Remark	Three-point seat belt for both the driver's seat and the passenger's seat	Four-point seat belt for the driver's seat and three-point seat belt for the rear seat Includes an airbag for the driver's seat as standard equipment. The doors are optional.
Number of vehicles tested	2 A-1: Pedestrian safety test → Used in the lateral collision test A-2: Used in the front collision test	2 B-2: Pedestrian safety test → Used in the lateral collision test B-2: Used in the front collision test

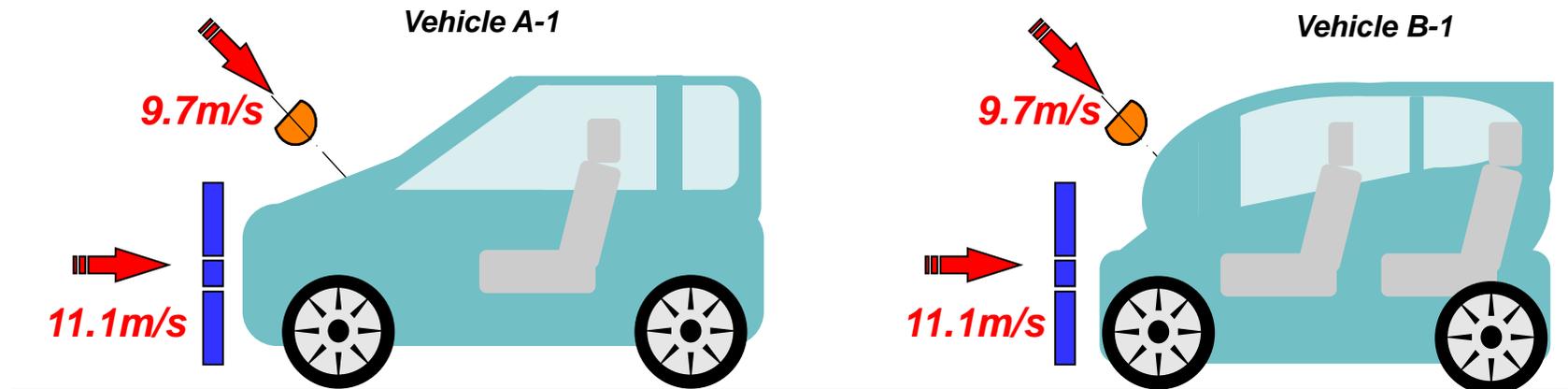
Collision Tests

(Full-wrap frontal collision test)

(Lateral collision test)



Pedestrian Protection Tests



2-2. Test Results (Full-wrap frontal collision test)



Car A

	Criteria	Driver Response
HIC36	≤ 1000	1212
Chest Acc. (3 msec)	≤ 60 g	49.8 g
Chest Deflection		29.4 mm
Femur Force	≤ 10 kN	Left ; 0.12 kN
		Right ; 1.64 kN

HIC ; Head Injury Criterion

Results

Aside from exceeding the reference value for head collision, the results cleared all requirements for M1. However, the seat frame was damaged, the engine slid backward and pushed the instrument panel backward (about 130 mm in the center).

Car B

	Criteria	Driver Response
HIC36	≤ 1000	627
Chest Acc. (3 msec)	≤ 60 g	57.8 g
Chest Deflection		32.1 mm
Femur Force	≤ 10 kN	Left ; 3.79 kN
		Right ; 10.69 kN

Results

Aside from slightly exceeding the reference value for right thigh collision, the results cleared all requirements for M1. However, most of the bolts fixing the driving battery were sheared and the battery front partially dropped off.

2-2. Test Results (Lateral collision test)

Car A

	Criteria	Driver Response
HPC	≤ 1000	352
Rib Deflection	$\leq 42\text{mm}$	28.3 mm
V*C	$\leq 1.0 \text{ m/s}$	0.25 m/s
Abdominal Force	$\leq 2.5\text{kN}$	1.65 kN
Pubic Force	$\leq 6 \text{ kN}$	3.51 kN

HPC; Head Performance Criterion
V*C; Viscous Criterion

Results

The results cleared the requirements for M1 on all evaluation criteria. Upon collision, however, the dummy's head stuck out of the car, the door hinges came off the body, and the door latches got released.

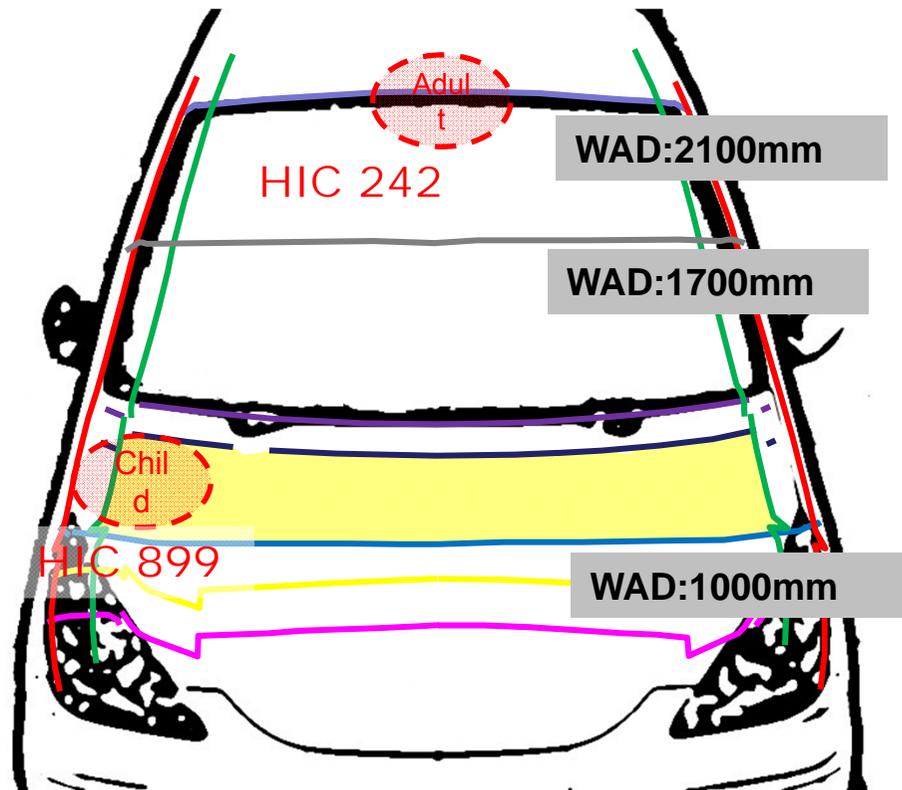
Car B

	Criteria	Driver Response
HPC	≤ 1000	1447
Rib Deflection	$\leq 42\text{mm}$	32.3 mm
V*C	$\leq 1.0 \text{ m/s}$	0.34 m/s
Abdominal Force	$\leq 2.5\text{kN}$	2.26 kN
Pubic Force	$\leq 6 \text{ kN}$	3.37 kN

Results

Aside from exceeding the reference values for head collision, the results cleared all requirements for M1.

2-2. Test Results (Pedestrian head safety test: Car A)



*The areas to be tested for adult pedestrian head protection performance as they are prescribed in the current test procedures don't exist on these mobilities for the limited size of their "hood". As an alternative, we defined those of the points, in the area which might collide with the pedestrian's head (WAD 1700 mm to 2100 mm), which might cause severer injuries as collision points.

<Standard>

HIC \leq 1000 (2/3 or more of the area)

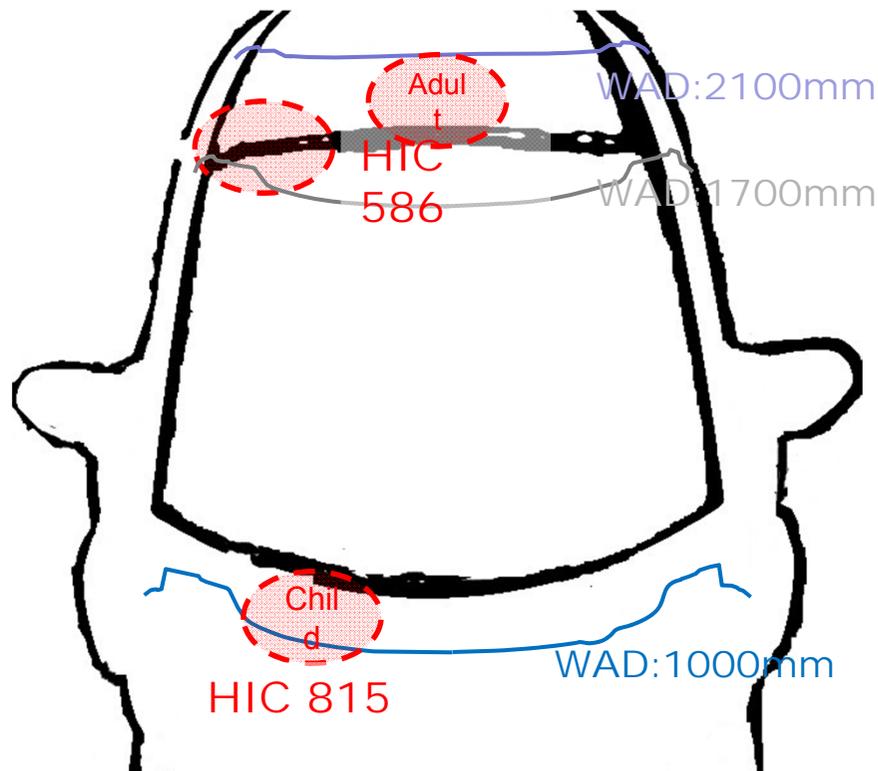
HIC \leq 1700 (Other areas)

Results

On both collision points, the results satisfied the standard applicable to M1.

WAD ; Wrap Around Distance

2-2. Test Results (Pedestrian head safety test: Car B)



*The areas to be tested for child and adult pedestrian head protection performance as they are prescribed in the current test procedures don't exist on these mobilities for the limited size of their "hood". As an alternative, we defined those of the points, in the area which might collide with the pedestrian's head (WAD 1000 mm to 2100 mm), which might cause more severe injuries as collision points.

<Standard>

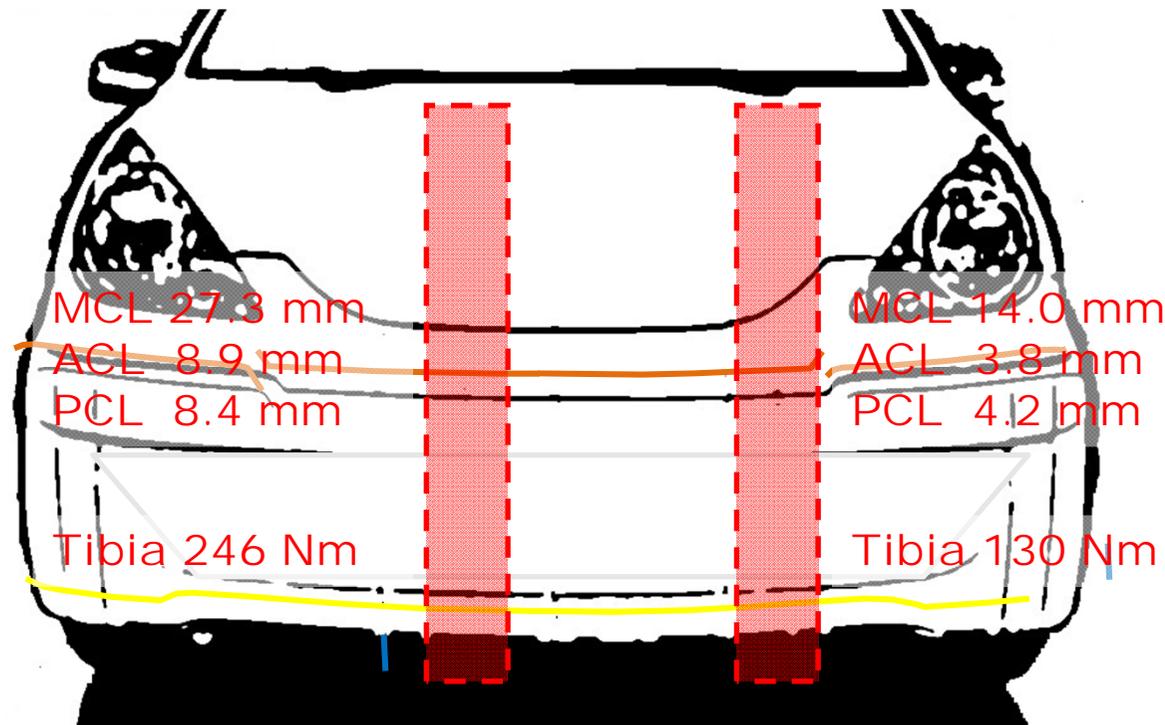
HIC \leq 1000 (2/3 or more of the area)

HIC \leq 1700 (Other areas)

Results

On both collision points, the results satisfied the standard applicable to M1.

2-2. Test Results (Pedestrian leg safety test: Car A)



<Standard>

MCL \leq 22mm

ACL \leq 13mm

PCL \leq 13mm

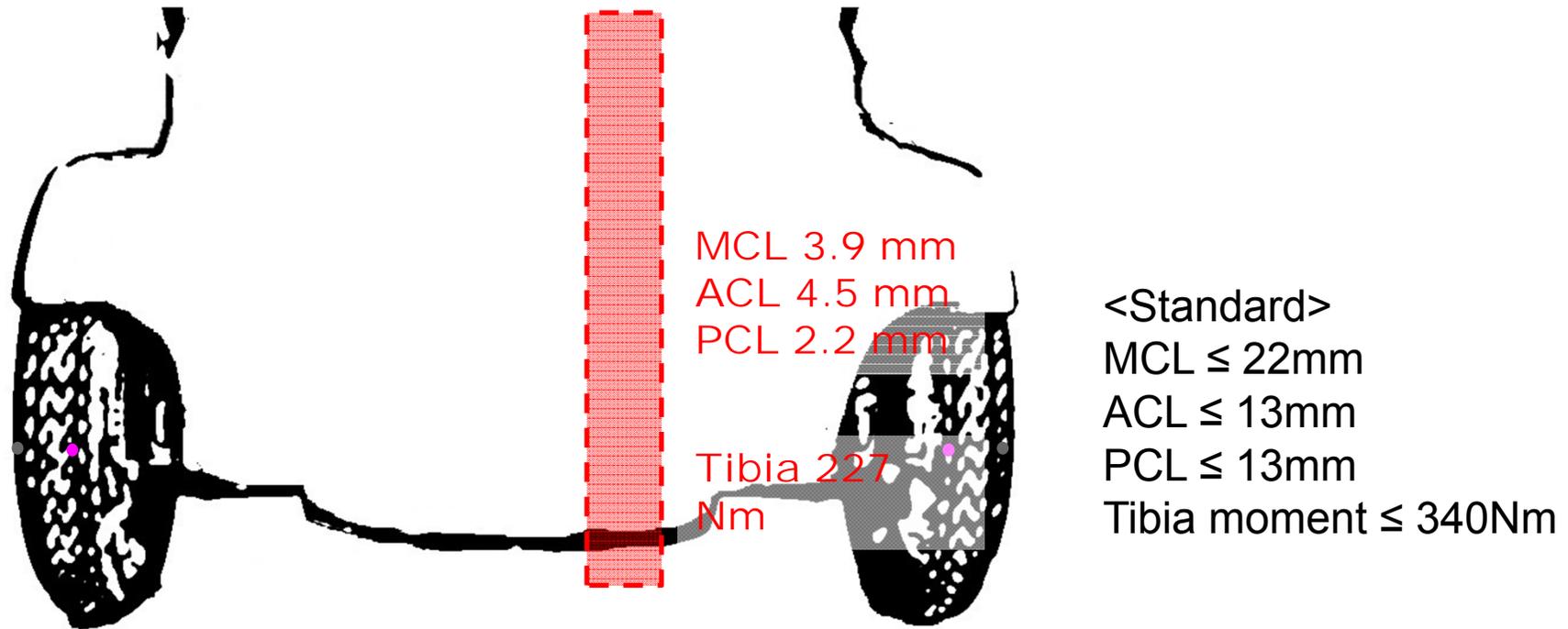
Tibia moment \leq 340Nm

Results

Aside from exceeding the reference values for MCL upon impact on the central area of the car, the results cleared all requirements for M1 on all evaluation criteria.

MCL; Medial Collateral Ligament
ACL; Anterior Cruciate Ligament
PCL; Posterior Cruciate Ligament

2-2. Test Results (Pedestrian leg safety test: Car B)



Results

On all evaluation items, the results satisfied the standard applicable to M1.

3. Observations

- We came to realize that some of the vehicles that are regarded as New Mobility vehicles may conform to the frontal collision (full lap) protection performance requirements and lateral collision protection performance requirements (UN-R95) that are presently required for passenger vehicles in Japan.
- As for the pedestrian protection performance tests, there are cases where no test area exists in light of the test procedure. Hence, we temporarily set a substitute area when performing the test. As a result, the test vehicle conformed to most items of the head protection performance and leg protection performance requirements. This indicates that most vehicles that are viewed as New Mobility vehicles have relatively low possibility of causing damage to pedestrians.
- These are what we have come to understand so far, but Japan is determined to consider this issue while making efforts to realize international harmonization with regard to New Mobility vehicles and will seek opinions from other countries at related GR's regarding the safety of New Mobility vehicles. Also we would like to exchange information if other countries have similar data and opinions regarding the safety of New Mobility vehicles.
- The vehicles that were tested this time are from L category, but very close to passenger cars. There are some other vehicles in the L category and New Mobility vehicles that are closer to motorcycles. We need to consider such vehicles too, when studying the safety requirements.

Thank you for your attention.