INTRODUCTION OF THE REGULATION OF PEDESTRIAN HEAD PROTECTION IN JAPAN

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Paper Number 503

ABSTRACT

Pedestrian fatalities account for about 30% of all traffic accident fatalities in Japan. As head injuries in particular often lead to death or serious injury, it is important to reduce their severity, and so a new regulation for head protection is currently being drawn up.

The regulation is based on the results of discussions by IHRA, and applies to passenger vehicles and trucks built on a passenger car chassis weighing 2500 kg or less. The test procedure involves a sub-system test that uses two head form impactors, an adult head form and a child head form. The test area is zoned for both adult and child heads impacting against the bonnet top, and the regulation requires both adult and child head injuries to be reduced to the required level.

All new models of applicable vehicles introduced after 2005 will have to comply with the new regulation. After 2010, all new applicable vehicles will have to comply. Vehicles that have difficulty meeting the regulation requirements, such as low-bonnet-height vehicles and certain types of trucks, will have a two-year grace period in which to comply. This report explains the regulation in detail.

THE PRESENT CONDITION OF TRAFFIC ACCIDENTS RELATING PEDESTRIAN

Characteristics of Pedestrian-related Accidents

Figure 1 shows that the accidents involving pedestrians account for about 30% of all the traffic accidents in Japan, next to accidents involving people driving or riding in motor vehicles (40%) . The rate of fatality in those pedestrian-related accidents are two to four times higher than other forms of accidents (see Figure 2).

The statistics of casualties standardized by population distribution by age or those of fatalities by age indicate that the rate of meeting with accidents or being killed in such accidents increases among pedestrians at age 60 or over. This indicates that, the more Japanese society ages in future, the more pedestrians are likely to meet with accidents.

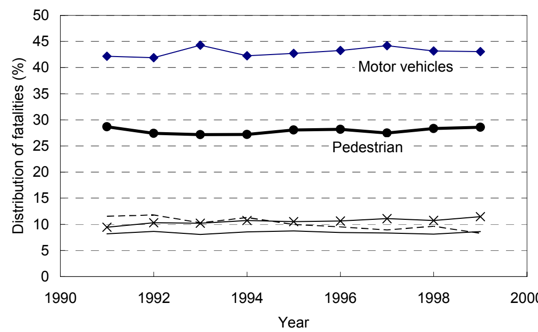


Figure 1 Distribution of Fatalities in Japan

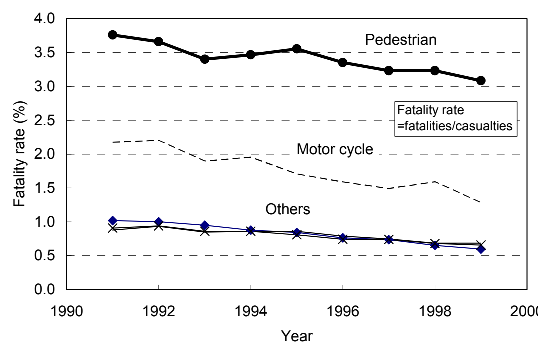


Figure 2 Fatality Rate in Japan

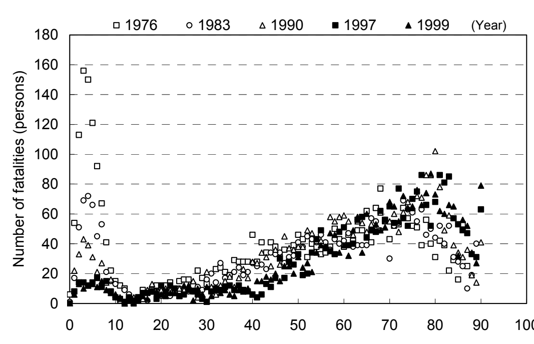


Figure 3 Number of Fatalities in Japan (by Age)

Vehicles Involved in Pedestrian-related Accidents

Since about 60% of pedestrian-related accidents happen with passenger cars and about 20% with trucks, a regulation on these vehicles for protection of pedestrians should be effective. Passenger cars and trucks of 2.5 t or less in gross vehicle weight, which will be subject to this regulation, represent around 75% of all the vehicles.

Parts of Body Most Injured in Pedestrian-related Accidents

Figure 4 shows the distribution of major injured body regions of pedestrian. Head injury accounts for about 60% of the fatalities, therefore, head protection is quite important. As for the vehicle impact speed (i.e. accident speed) of 40 km/h, the speed controlled by this regulation, represents about 70% of pedestrian-related accidents (see Figure 5).

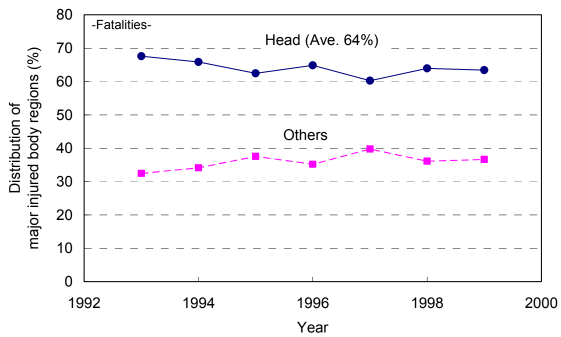


Figure 4 Distribution of Major Injured Body Regions of Pedestrian

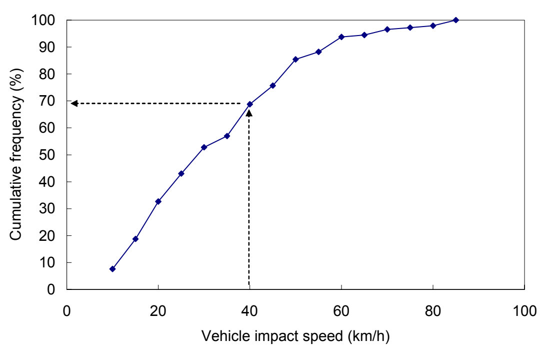


Figure 5 Cumulative Frequency of Vehicle Impact Speed (Accident Speed)

Parts of Vehicle Inflicting Injury on Pedestrians

The parts of vehicle inflicting injury on pedestrians are windshield, hood, fenders, window frames, A-pillar, their frequency being in this order. (see Table 1). When the pedestrian crashes into the windshield, the injury is often slight. It will be effective to regulate these parts starting from those it is most feasible to regulate.

Table 1 Distribution of Head Injury caused Parts

Body Region (Head)	All Age		Ages ≤ 15		Ages ≥ 16	
AIS2-6	(cases)	(%)	(cases)	(%)	(cases)	(%)
Part of the Vehicle						
Front Bumper	19	1.9	3	1.6	16	2.0
Bonnet/Wing	217	22.1	77	39.9	140	17.7
Leading Edge	9	0.9	2	1.0	7	0.9
Windscreen Glass	339	34.5	40	20.7	299	37.8
Windscreen Frame/A-pillars	142	14.4	5	2.6	137	17.3
Front Panel	5	0.5	5	2.6	0	0.0
Other Vehicle Source	41	4.2	8	4.1	33	4.2
sub total	772	78.5	140	72.5	632	80.0
Others						
Indirect Contact Injury	13	1.3	1	0.5	12	1.5
Road Surface Contact	172	17.5	46	23.8	126	15.9
Unknown	26	2.6	6	3.1	20	2.5
Total	983	100.0	193	100.0	790	100.0

Source: IHRA/PS/179

OUTLINE OF THE REGULATION FOR PEDESTRIAN SAFETY IN JAPAN

In view of the reality of traffic accidents in Japan, the MLIT will amend the Safety Regulations for Road Vehicles to introduce a regulation for pedestrian safety starting from the newly registered vehicles in 2005, based on testing methods and thresholds reviewed at IHRA . The outline of the regulation is as follows:

Scope of vehicles

- Passenger cars having no more than 10 seats
- Trucks having a GVW not exceeding 2,500kg and a similar front shape as the passenger cars above mentioned

Effective Date

<u>Vehicles except for vehicles defined in the next</u>

□New-type vehicles : September 2005

□Continuously-manufactured vehicles : September 2010

<u>Low height vehicles, Vehicles requiring high endurance, such as SUVs and trucks, Full cab over vehicles, Hybrid-engine vehicles</u>

□New-type vehicles : September 2007

□Continuously-manufactured vehicles : September 2012

Note: New-type vehicles, as a result of the modification on emission performance relating to “4. Kinds of engine and main construction (Only for improvement of emission performance)” and/or “13. Exhaust emission standard values stipulated in the Safety Regulations for Road Vehicles, the low exhaust emission motor vehicle approval enforcement procedure for approval” in the “Judgment Criteria for Identity of Types of Motor Vehicles”, will be considered as continuously - manufactured vehicles.

Outline of the regulation (See Appendix 1)

<u>Test Procedure</u>

a) Test area (See Appendix 2)

The child and adult head impactor test will be considered for the regulation.

Test area for child head impactor

: 1,000mm ≤ WAD ≤ 1,700mm

Test area for adult head impactor

: 1,700mm ≤ WAD ≤ 2,100mm

Note: WAD (Wrap-Around Distance) means the distance from the ground to the point on the bonnet along the vehicle front structure.

b) Impactor (See Appendix 3)

Child head impactor: Diameter 165mm, weight 3.5kg

Adult head impactor: Diameter 165mm, weight 4.5kg

c) Impact speed and angle

	Child head impactor		Adult head impactor	
	Speed (km/h)	Angle (deg)	Speed (km/h)	Angle (deg)
Category 1	32	65	32	65
Category 2	32	60	32	90
Category 3	32	25	32	50

(Above head impact conditions were estimated from the IHRA car-pedestrian 40km/h impact computer simulation results)

	Definition	Note
Category 1	Vehicle having a BLE height of less than 835mm	Sedan type
Category 2	Vehicle having a BLE height of not less than 835mm	SUV type
Category 3	Vehicle having a bonnet angle of not less than 30 deg.	1 Box type

Note: BLE height: Bonnet Leading Edge height

<u>Criteria</u>

HIC (Head Injury Criteria), defined by the following formula, should not exceed 1,000 on two-thirds or more of the test area. On the remaining area, HIC should not exceed 2,000.

$$HIC = \left\{ \frac{1}{t_2 - t_1} \int_{t1}^{t2} \mathrm{a}\, dt \right\}^{2.5} \left(t_2 - t_1\right)_{\max} \qquad (t_2 - t_1 \leq 15\text{msec})$$

LIFESAVING EFFECT

MLIT made an estimate of lifesaving effect of this pedestrian safety regulation, assuming that it is introduced and that all the vehicles concerned are replaced with vehicles complying to the regulation. The result predicts that it may reduce 125 fatalities among pedestrians of a total of about 3,000 a year. The estimate used the traffic statistics of 1999 and took into account passenger cars and trucks of 2800 kg or less in gross vehicle weight (the weight range of trucks being different from that of the regulation). The injury reference value was set to HIC 1,000 (to 1000 at 2/3 and to 2000 at 1/3 in the regulation).

		Pedestrian fatalities 2982 persons		National Police Agency traffic accident statistics (Fatalities in 30 days in 1999)
		Child	Adult	
		127	2855	
Parts of body injured -Rate of injuries caused by head crashing against vehicle	64%	81.3	1827.2	NPA Traffic Accident Statistics (1993 to 1999)
Vehicle types - Rate of vehicle types concerned	75%	61.0	1370.4	NPA Traffic Accident Statistics (Fatalities in 24 h in 1999)
Parts of vehicle inflicting injury concerned - Rate of head crashing against hood	41% (Child) 19% (Adult)	25.0	260.4	IHRA Statistics (Database on pedestrian-related accidents in the world)
Crash velocity concerned - Rate of velocity of 40 km/h or less	45□	11.2	117.2	ITARDA (Traffic accidents survey and analysis report, 1999)
Injury reference value - HIC 1000 or less 2/3area -HIC 2000 or less 1/3area	80%	9.0	93.7	Mac Lenghlin, et al. 'Vehicle Interactions with Pedestrians' Accident Injury – Biomechanics and Prevention, Springer-Verlag, N.Y. 1993
Life saving effect		9	94	
	Total	103 persons		

Notes: 1. Children are defined to be age 15 or below and adults age 16 or above.

2. Crash velocity is defined as the first crash velocity between the pedestrian and the vehicle.

FUTURE VISION

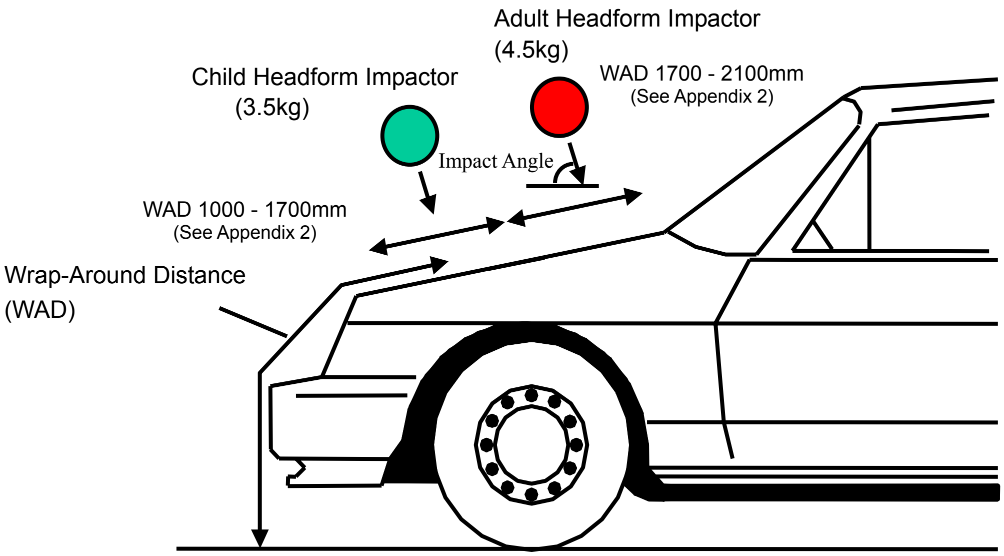
For international harmonization, it was agreed to establish a Global Technical Regulation for pedestrian safety. An informal group was organized under ECE/WP29/GRSP for this purpose.

According to its TOR, the informal group plans to finalize its written justification by the end of 2003 and its complete and detailed recommendation by 2005 for a head protection regulation and a leg protection regulation.

Accordingly, Japan plans, respecting the discussion to be held in this Informal Group to the maximum, to introduce also a regulation for leg protection, while working for the harmonization of head protection regulations.

Appendix 1

Illustration of the Draft Test Procedure



Appendix 2

Procedure to Determine The Test Area

The test area should be the area surrounded by the front test line, rear test line and side test lines.

Front test line:

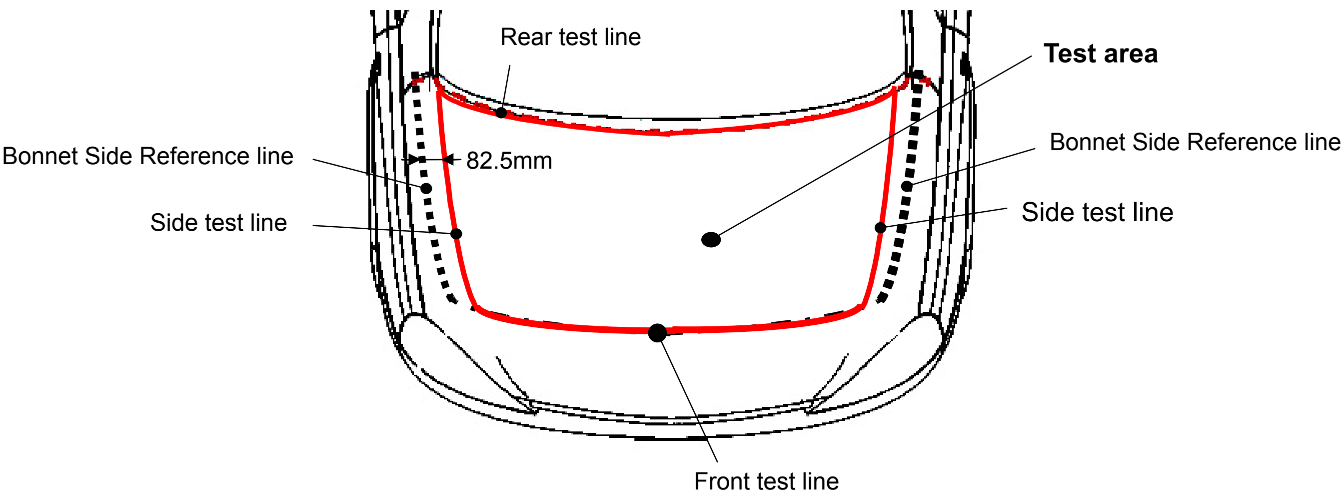
The rear side line was chosen out of two lines to be assigned to the front test line. One line was the line where WAD was 1,000mm. The other line was located 165mm backward from the Bonnet Leading Edge Reference line.

Rear test line:

The front side line was chosen out of two lines to be assigned to the rear test line. One line was the line where WAD was 2,100mm. The other line was located 82.5mm forward from the line where the impactor contacted the bonnet when the impactor contacted both the windscreen and bonnet, assuming that both the wiper arms and other equipment are removed.

Side test line:

The lines are located 82.5mm inside from the Bonnet Side Reference line.



Ground Reference Plane

A horizontal plane that passes through all tire contact points of a vehicle while the vehicle is in its normal ride state. (See Figure 1.)

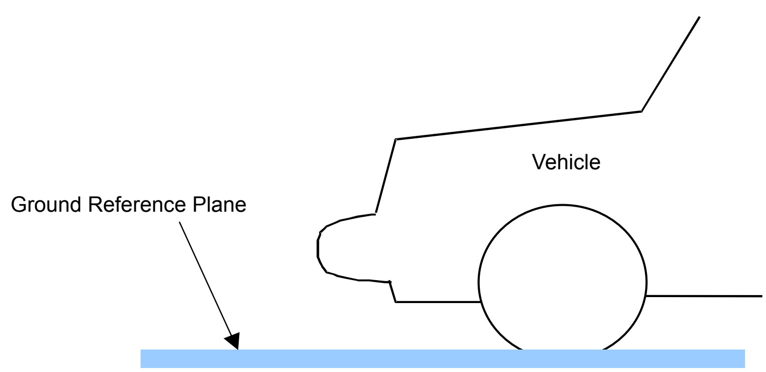


Figure 1: Ground Reference Plane

WAD

WAD (Wrap-Around Distance) is the geometrically traced distance from the contact point with the Ground Reference Plane, vertically below the front face of the bumper, to any point on the vehicle front structure. (See Figure 2.)

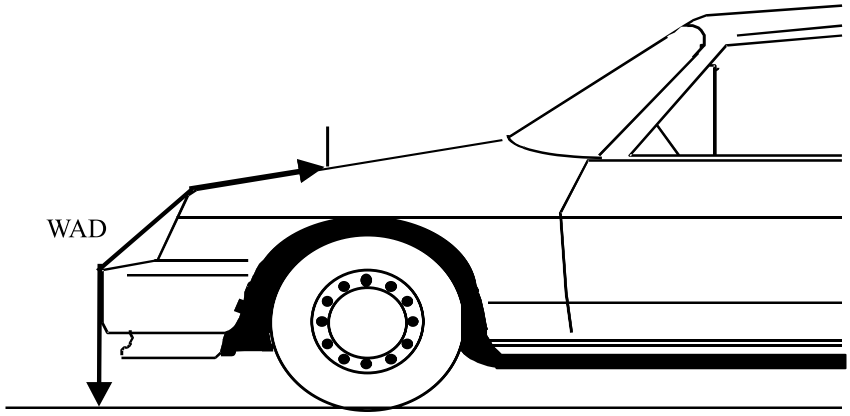


Figure 2 Definition of WAD

Bonnet Side Reference line

The geometric trace of the highest points of contact between a straight edge, held parallel to the lateral vertical plane of the vehicle and inclined 45 deg. is traversed down the side of the front structure, and the side of the front structure.

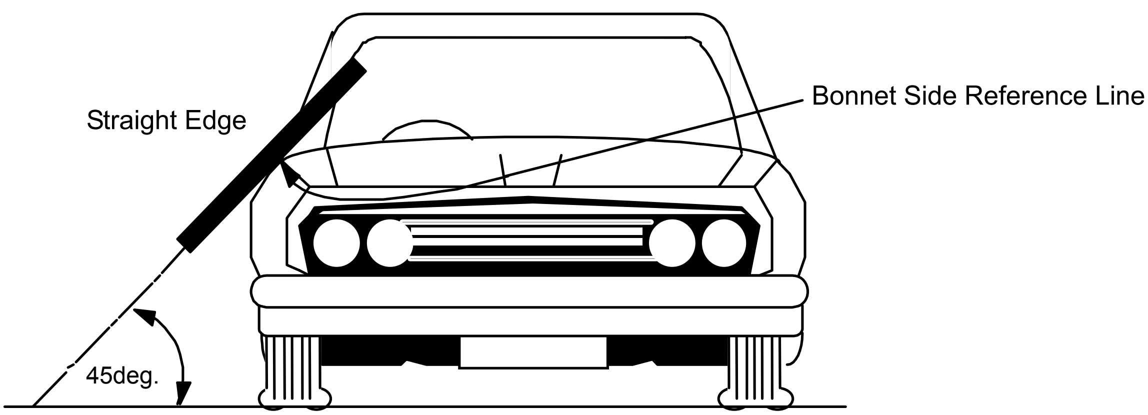


Figure 3 : Bonnet Side Reference Line

Bonnet Leading Edge (BLE) Reference line

The geometric trace of the highest points of contact between the straight edge that is held parallel to the vertical fore and aft planes of the vehicle with 1m length, the bottom point is 600mm above the Ground Reference Plane, and inclined 50 deg. is traversed down the front of the front structure, and the front of the front structure.

In the cases described below, the line will be determined by the respective method given:

(1) In the case that the straight edge is parallel with the vehicle front structure:
The angle of the straight edge should be changed to 40 deg. (See Figure 4-3.)

(2) In the case that the top point of the straight edge contacts the vehicle front structure:
The BLE Reference line should be the line where WAD is 1000mm. (See Figure 4-4.)

(3) In the case that the straight edge contacts the bumper:
The BLE Reference line should be determined without the bumper. (See Figure 4-5.)

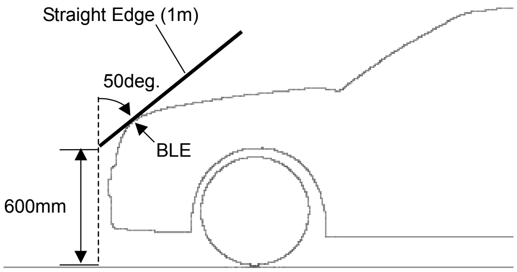


Figure 4-1 General

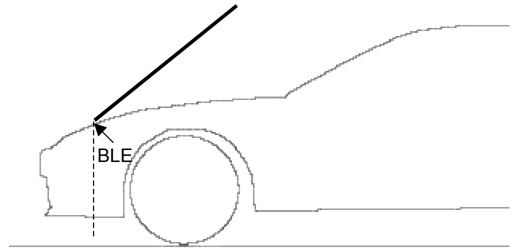


Figure 4-2 In the case that the bottom point of the straight edge contacts the vehicle front structure.

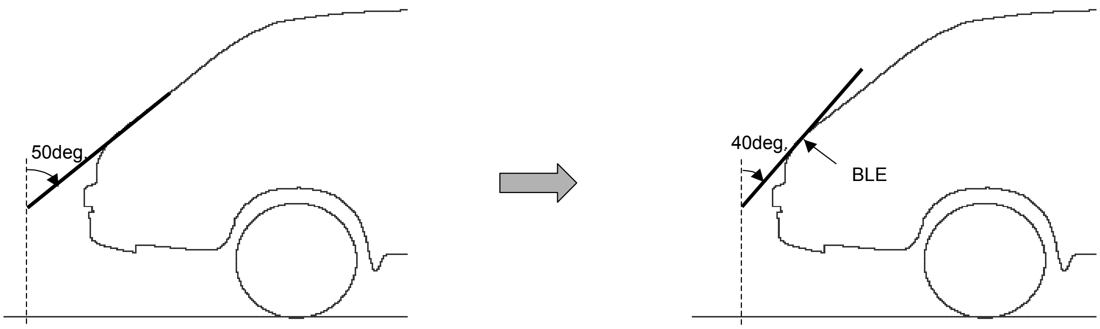


Figure 4-3 In the case that the straight edge is tangential to the vehicle front structure.

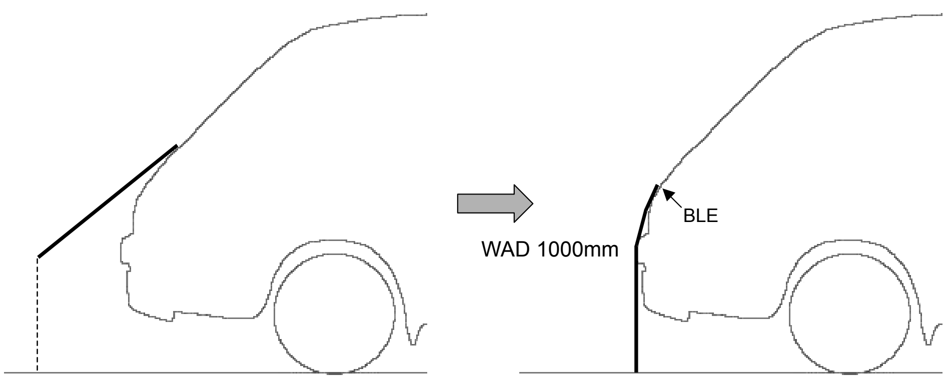


Figure 4-4 In the case that the top point of the straight edge contacts the vehicle front structure

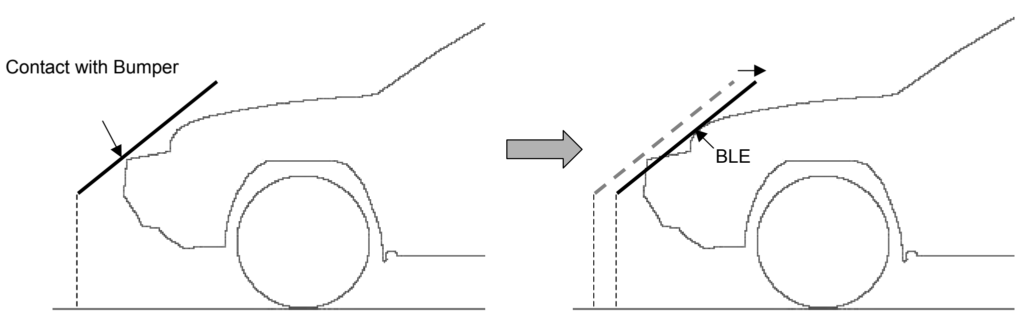


Figure 4-5 In the case that the straight edge contacts the bumper.

Appendix 3

**Specifications and Certification Test
of Head Form Impactors**

Impactor Specification	Japan MLIT proposal	
	Child Headform	Adult Headform
Mass	3.5±0.07 kg	4.5±0.1 kg
Diameter	165±1 mm	
Moment of Inertia	0.0075-0.020 kgm^2	0.0075-0.020 kgm^2
Location of the Accelerometer (seismic masses location)	In the direction of measurement axis: G.C.S.* ± 10 mm. In the direction perpendicular to the measurement axis: G.C.S.* ± 1 mm.	
Location of the Center of Gravit	G.C.S.* ± 2 mm.	
Natural Frequency	over 5000Hz	

Certification Test - Drop Test** -	Japan MLIT proposal	
	Child Headform	Adult Headform
Requirement	245-300 G	225-275 G
Test Condition:		
Drop height	376±1 mm	
Drop angle	Test Angle	
Temperature	20±2 deg.	
Humidity	10-70 %	
Spec. of steel plate		
- thickness	over 50 mm	
- area	over 300 mm square	
- friction	0.2-2.0 μm	
- others	rigidly supported	

* G.C.S.: Geometric Center of Sphere.
** No requirement for high speed impact certification test, instead of the natural frequency requirement as over 5000Hz.