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Protection of Passengers in the Event of Lateral Impact of Vehicle

(version submitted for approval)

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Promulgated on ×××× - ×× - ×× Implemented on ×××× - ×× - ××

Promulgated by General Administration of Quality Supervision, Inspection and Quarantine, The People's Republic of China

Protection of Passengers in the Event of Lateral Impact of Vehicle

1 Scope

The Standards are applicable to the vehicles of Category M1 or N1 with the R point of its lowest seat not exceeding 700mm from the ground as its mass is the reference mass.

2 Regulatory Documents Being Quoted

The articles of the following document are adopted by the Standards, and become the articles of the Standards. For all those documents with dates indicated, their subsequent amendments (excluding the contents of errors) or revised versions shall not be applicable to the Standards. Nevertheless, people of different circles are encouraged to study whether the latest versions of these documents can be included in the Standards after negotiation is made. For all those documents with no date indicated, their latest versions shall be applicable to the Standards.

GB/T 15089 Classification of Power-Driven Vehicles and Trailers

ISO 6487: 2000 Road vehicles - Measurement Techniques in Impact Tests - Apparatuses and Instruments

GB 14166-2002 Adult Passengers' Safety Belt and Restraint System of Motor Vehicles

GB 14167-93 Safety Belt Anchorages of Motor Vehicles

3 Terms and Definitions

The following terms and definitions are applicable to the Standards.

3.1 Vehicle Type

Referring to the motor vehicles with no dissimilarity in the following major aspects:

3.1.1 the vehicle's length, width and gap from the ground having unfavourable effects on the performance regulated in the Standards;

3.1.2 the passenger compartment wall structure, size, outline and material having unfavourable effects on the performance regulated in the Standards;

3.1.3 the passenger compartment appearance's interior structure and size as well as the type of protective system having unfavourable effects on the performance regulated in the Standards;

3.1.4 position (front, rear and central) of engine;

3.1.5 unladen mass having unfavourable effects on the performance regulated in the Standards;

3.1.6 selectively installed parts and interior decoration parts having unfavourable effects on the performance regulated in the Standards;

3.1.7 front-row seat type and R point position having unfavourable effects on the performance regulated in the Standards;

3.2 Passenger Compartment

Referring to the space that carries passengers. It is enclosed by top shell, floor, lateral shell, vehicle door, glass windows, and front and rear compartment wall boards or back-support board of rear-row seat.

3.3 R Point

Referring to the reference point regulated by vehicle manufacture, where:

3.3.1 it is determined according to the structure of vehicle;

3.3.2 it is the theoretical position of the turning point (H point) of the body/thigh when the normal driver's seat is at the lowest and farthest position., or the position regulated by the vehicle manufacturer to each seat.

3.4 H Point

Regulated in Attachment I of Appendix A of the Standards.

3.5 Capacity of Fuel Tank

Referring to the capacity of fuel tank regulated by the vehicle manufacturer.

3.6 Transverse Plane

Referring to the vertical plane being perpendicular to the vertical central plane of vehicle.

3.7 Protective System

Referring to the device having restrained and/or protective action to passenger.

3.8 Type of Protective System

Referring to the type of protective device with no dissimilarity in the following major aspects:

a. technical characteristics;

b. geometric size;

c. composing materials.

3.9 Reference Mass

Referring to the mass of unladen vehicle with 100g added (mass of the laterally impacted dummy and measurement equipment).

3.10 Unladen Mass

Referring to the mass of a driving vehicle carrying no driver, no passenger and no goods. But the capacity of fuel tank should be 90% full, and there should be some suitable tools and a spare tyre in the vehicle.

3.11 Mobile Deformable Barrier

Referring to the device composed of a trolley and impactor for causing impact with the test vehicle.

3.12 Impactor

Referring to the deformable part installed in the front position of the mobile deformable barrier.

3.13 Trolley

Referring to the wheeled frame structure which can be freely driving along the vertical axle towards the point of impact, and its front end is for installation of impactor.

4 Technical Requirements

4.1 A vehicle has to receive test according to Appendix B of the Standards. The test should be done to the lateral side of driver's seat.

If the lateral structure of vehicle is unbalanced and such difference affects the performance of lateral impact, the manufacturer and the inspection body should negotiate with each other and do the test according to Article 4.1.1 or 4.1.2.

4.1.1 Impact test is done to the lateral side of driver's seat. The vehicle manufacturer should submit to the supervisory authority the information which is consistent with the lateral performance of driver's seat.

4.1.2 For the reason of structural characteristics of vehicle, the test is done to the side opposite to the lateral side of driver's seat. But it needs the clear authorization of the supervisory authority.

4.2 Performance Criterion

4.2.1 After a vehicle has received the impact test according to Appendix B of the Standards, its performance should be able to meet the following requirements:

4.2.1.1 Head performance criterion (HPC) should be less than or equal to 1,000: When there is no head contact occurrence, the measurement or calculation of the HPC value is not required, only the words, "no head contact" should be recorded.

4.2.1.2 Chest performance criterion:

(a) Rib deformation criterion (RDC) should be less than or equal to 42mm;

(b) Viscosity criterion (VC) should be less than or equal to 1.0m/s.

4.2.1.3 Pelvis performance criterion: Pubis synthesis peak force (PSPF) should be less than or equal to 6kN.

4.2.1.4 Abdomen performance criterion: Abdomen performance criterion (APC) should be less than or equal to an internal force 2.5kN (equivalent to external force 4.5kN).

4.3 Special Requirements

4.3.1 In the testing process, vehicle doors should not be open.

4.3.2 After the impact test, the unused tools should be able to:

4.3.2.1 open sufficient quantity of vehicle doors, enabling the passengers to get in and out of the vehicle normally. If necessary, the seat back or the seat can be inclined, ensuring that all the passengers can be evacuated;

4.3.2.2 release the dummy from the restraint system;

4.3.2.3 move the dummy out of the vehicle.

4.3.3 When all the internal components fall, there should be no sharp object or edges protruding so as to prevent the possibility of further harm to passengers.

4.3.4 Provided that the risk to passengers of injury is not increasing, the collapse caused by permanent deformation is allowed to appear.

4.3.5 After the impact test, if there is any continuous liquid leakage to the fuel supply system, the leaking speed should not exceed 30g/min.; if the leaked liquid from the fuel supply system blends with liquid from other systems, and the individual liquids cannot be easily separated and identified, then while determining the leaking speed of the continuous leakage, all the collected liquids should be recorded.

5 Alteration of Vehicle Type

5.1 Should there be any alteration affecting the structure, such as alteration to the seats, number and type of interior decorations, installation method, and the positional alteration of the mechanical parts and control device of vehicle affecting the lateral energy absorption of vehicle, then the certifying supervisory authority should be informed. The supervisory authority should adopt one of the following handling methods:

5.1.1 The alteration made is considered to have no significant unfavourable effect, and the vehicle can still meet the requirements under any circumstances; or

5.1.2 the inspection body is requested to further provide test reports:

5.1.2.1 If the structural appearance of vehicle is altered or the reference mass is changed by 8%, the supervisory authority should judge whether the alteration has any significant effect on the test result, so as to determine whether the test should be performed again according to Appendix B of the Standards.

5.1.2.2 If the inspection body and the vehicle manufacturer consider after negotiation that no repetition of the whole test is required for the alteration of vehicle type, then partial tests can be done, provided that the change of reference mass does not exceed 8% or the number of front-row seats is not altered. For the alteration of seat type or interior decorations, it is not required to repeat the whole test. For the methods of partial tests, please refer to Appendix D.

Appendix A
(Regulatory Appendix)
Determination Procedures of Seat's H Point and Actual Seat Back Angle of Motor Vehicles

A.1 Purposes

The procedures described in this Appendix are to determine the "H" point and actual back angle of one or several seats of a motor vehicle, and to inspect the relationship between the measurement data and the designed technical requirements regulated by the vehicle manufacturer.[*/]

A.2 Definition

Referring to this appendix itself:

A.2.1 Reference Data: Referring to one or several characteristics of a particular seat:

A.2.1.1 "H" point and "R" point, as well as the relationship between them.

A.2.1.2 Actual seat back angle and designed seat back angle, as well as the relationship between them.

A.2.2 Three-Dimensional "H" Point Device (3-D H Device): Referring to the device determining "H" point and actual seat back angle. The description of this device is shown in Attachment I of this Appendix.

A.2.3 "H" Point: Referring to the articulated centre between the trunk and thigh of 3-D H device placed on the vehicle seat as regulated in A.4 below. The "H" point is located at the middle point of the centre line of the "H" point indication button by the two sides of the device. Theoretically, the "H" point and "R" point are consistent (please refer to the tolerable difference specified in A.3.2.2). Once the "H" point is determined according to the procedures of A.4, the relative seat cushion of the "H" point is considered as fixed and shall move with the adjustment of the seat.

A.2.4 "R" Point or Reference Point of Seat: Referring to the designed point for each seat regulated by the vehicle manufacturer. It is determined according to the

[*/] Position of any non-front-row seat. If "H" point cannot be determined by "3-D H point device" or procedures, the "R" point indicated by the manufacturer can be adopted, provided that it is recognized by the certifying body.

3-dimensional coordinates system.

A.2.5 Trunk Line: Referring to the centre line of probe rod when the probe rod of 3-D H device is in the furthest back position.

A.2.6 Actual Seat Back Angle: Referring to the included angle between the Vertical line of "H" point and the trunk line. It is measured by the seat back angle protractor of the 3-D H device. Theoretically, the actual seat back angle and the designed seat back angle are consistent (please refer to the tolerable difference specified in A.3.2.2).

A.2.7 Designed Seat Back Angle: Referring to the included angle between the Vertical line of "R" point and the relative trunk line of the designed seat back position regulated by the vehicle manufacturer.

A.2.8 Passenger's Central Plane (C/LO): Referring to the central plane of the 3-D H device placed on the specified position of each seat. It is indicated by the coordinates of "H" point on "Y" axis. For single seats, the central plane of seat is just the C/LO. For other seats, the C/LO is regulated by the manufacturer.

A.2.9 Three-Dimensional (3-D) Coordinates System: Referring to the system described in Attachment II of this Appendix.

A.2.10 Reference Sign: The point (hole, plane, sign or track) on the vehicle body determined by the manufacturer.

A.2.11 Vehicle Measurement Position: Referring to the vehicle position on the coordinates of the 3-D Coordinates System determined by the reference sign.

A.3 Requirements

A.3.1 Provision of Data

In order to state clearly the compliance with the requirements of the Standards, each seat being requested to provide reference data should provide all the following or appropriately selected data in the format regulated in Attachment III of this Appendix:

A.3.1.1 The coordinates of "R" point in the 3-D coordinates system;

A.3.1.2 Designed seat back angle;

A.3.1.3 All the data required for adjusting (if adjustable) the seat to the measurement position regulated in A.4.3.

A.3.2 Relationship between Measurement Data and the Designed Requirements

A.3.2.1 The “H” point coordinates and the actual seat back angle acquired in the procedures regulated in A.4 of this Appendix should be respectively compared with the “R” point coordinates and the designed seat back angle value provided by the manufacturer.

A.3.2.2 If the “H” point determined by the coordinates is located within the square whose sides in horizontal and Vertical directions are both 50mm and whose diagonal lines intersect at the “R” point, and the deviation of the actual seat back angle from the designed seat back angle is less than 5^{o}, then regarding the abovementioned seat position, the relative positions of the “R” point and the “H” point as well as the relative relationship between the designed seat back angle and the actual seat back angle are considered to meet the requirements.

A.3.2.3 If the abovementioned conditions are met, the “R” point and the designed seat back angle should be adopted to prove that the requirements of the Standards are being complied with.

A.3.2.4 If the “H” point or the actual seat back angle does not meet the requirements of A.3.2.2, determination must be re-conducted twice (in total three times). If the results of the two tests meet the requirements, the conditions specified in A.3.2.3 shall be applicable.

A.3.2.5 If at least 2 of the 3 operations described in A.3.2.4 do not meet the requirements of A.3.2.2, or if the inspection cannot proceed because the vehicle manufacturer has not provided the data related to the position of “R” point or the designed seat back angle, then the centre of the shape formed by the points measured on these 3 occasions or the average value of the points measured on these 3 occasions shall be applied in all the situations where the “R” point or the designed seat back angle involving the Standards are mentioned.

A.4 Determination Procedures of “H” Point and Actual Seat Back Angle

A.4.1 As requested by the manufacturer, the vehicle should carry out pre-processing under conditions of $20^{o}C \pm 10^{o}C$ in order to determine that the seat material has reached the room temperature. If the seat to be inspected has never been sat in, it should be given two trials by a person or device at 70kg~80kg for 1 minute each time, so as to make the seat and its back deformed. If requested by the manufacturer, before placing the 3-D H device, all the seat assemblies should be kept unladen for at least 30 minutes.

A.4.2 The vehicle should be situated at the measurement status as defined in A.2.11.

A.4.3 First of all, the seat should be adjusted (if adjustable) to the furthest back normal driving or sitting position regulated by the vehicle manufacturer. Only the vertical adjustment of seat is considered, but excluding the seat stroke for any purpose other than normal driving or sitting position. If there is the existence of other seat adjustment methods (such as vertical, angle, seat back, etc.), the seats should be adjusted to the positions regulated by the vehicle manufacturer. As for suspended seats, its erect position should be rigidly fixed at the normal driving position regulated by the manufacturer.

A.4.4 The sitting region contacted by the 3-D H device should be covered with a piece of fine cotton cloth of sufficient size and suitable quality. If possible, use a piece of plain cotton cloth with 18.9 yarns/cm^2 and at the density 0.228kg/m^2, or a piece of adhesive-bonded cloth with the same characteristics. If the seat test is carried out outside the vehicle, the floor placed with the seat and the floor of vehicle placed with the seat must have the same basic characteristics. [*/]

A.4.5 Place the seat board and back board assembly of the 3-D H device, making the C/LO meet the central plane of 3-D H device. If the 3-D H device is placed too far outside to have touched the edge of seat and made the 3-D H device not horizontal, the 3-D H device should be moved inwards according to the relative C/LO as requested by the manufacturer.

A.4.6 Install the feet and legs assembly on the base board assembly. It can be installed independently. It can also be installed with a T-shaped rod together with the legs assembly. The straight line going through the 2 "H"-point indication buttons should be parallel to the ground and perpendicular to the vertical central plane of the seat.

A.4.7 Adjust the positions of both feet and legs of the 3-D H device as follows:

A.4.7.1 Design the sitting position: Driver and the offside passenger in the front row.

A.4.7.1.1 Move the both feet and legs assembly forward, so both feet are placed on the floor naturally. If necessary, place them between different control pedals. If possible, make the distance from the left and right feet to the central plane of 3-D H device almost the same. If necessary, re-adjust the seat board or adjust the legs and feet assembly backwards, making the levelling instrument for inspecting the transverse position of the 3-D H device stay horizontal. The straight line going through the 2 "H"-point indication buttons should be kept perpendicular to the vertical

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[*/] Angle of inclination, and the height difference and surface quality of installation frame of seat central plane of the seat.

A.4.7.1.2 If the left leg and right leg cannot keep parallel and the left foot cannot touch the ground, the left foot should be moved to make it touch the ground. The straight line going through the two “H”-point indication buttons should still be kept perpendicular to the vertical central plane of seat.

A.4.7.2 Designated position of seat: Outer side in the rear row

For the seat in the rear row or the auxiliary seat, the positions of both legs should be adjusted according to the regulation of the manufacturer. If both feet are placed in the positions of different heights, the foot contacting the seat in the front row should be taken as a reference for placing another foot, making the transverse levelling instrument on the seat board of the device show that it keeps horizontal.

A.4.7.3 Other designed positions of seats

The general procedures regulated in A.4.7.1 should be complied with. But the placing of feet should be done according to the regulations of the vehicle manufacturer.

A.4.8 Install the weights of legs and thighs, and adjust the level of 3-D H device.

A.4.9 Let the back board incline forward to the frontal limited position weight. Use T-shaped rod to pull the 3-D H device away from the seat back. Then one of the following methods is used for placing the 3-D H device back onto the seat.

A.4.9.1 If the 3-D H device has a tendency to slide backwards, the following procedures should be carried out: Allow the 3-D H device to slide backwards until it is not required to apply a horizontal forward support force on the T-shaped rod (i.e. until the back board touches the seat back). If necessary, place the legs again.

A.4.9.2 If the 3-D H device does not have a tendency to slide backwards, the following procedures should be carried out: Apply a horizontal backward force on the T-shaped rod, making the 3-D H device slide backwards until the seat board touches the back of seat (please see Figure 2 in Attachment I of this Appendix).

A.4.10 At the intersection of hip angle protractor and the outer shell of T-shaped rod, a force of 100N ± 10N should be applied onto the back board and seat board assembly of the 3-D H device. The application direction of force should be along the straight line going through the abovementioned intersection and reaching the outer shell of the thigh rod (please see Figure 2 in Attachment I of this Appendix). Then the back board should be put back to the seat back. Each of the following operation procedures should be carried out carefully so as to prevent the 3-D H device from sliding forward.

A.4.11 Install the weights of left and right hips, and then add the 8 trunk weights in an interlocking order so as to keep the 3-D H device horizontal.

A.4.12 Let the back board incline forward to eliminate the tension towards the seat back. Within the area of 10^o, shake the 3-D H device to the left and right and repeat the shaking 3 times so as to eliminate the concentrated friction between the 3-D H device and the seat.

In the shaking process, the T-shaped rod of the 3-D H device may stay away from the regulated horizontal and vertical reference positions. Thus, during shaking, appropriate lateral force should be applied on the T-shaped rod. When holding the T-shaped rod to shake the 3-D H device, the action should be careful and cautious so as to avoid applying any accidental force in the vertical or forward-backward direction.

When the abovementioned operation is being carried out, both feet of the 3-D H device should not be restrained by anything. If the positions of both feet are altered, adjustment is temporarily not required.

Place the back board to the seat back again. Check if the two levelling instruments are kept horizontal. In the process of shaking the 3-D H device, if the positions of both feet are altered, adjustment has to be made as follows:

The left and right feet are alternately lifted from the floor to reach the lowest necessary height until there is no additional effect added to both feet. In the process of lifting the feet, both feet should be able to turn freely, and no forward or lateral load should be added. When each foot is placed back to its position, the heel of the device should touch the supporting structure designed for it.

Check if the transverse levelling instrument is kept horizontal. If necessary, apply a lateral force on the top of back board so as to keep the seat board of the 3-D H device stay horizontal on the seat.

A.4.13 Hold the T-shaped rod tightly, ensuring the 3-D H device on the seat cushion does not slide forward. The following operation procedures should be continued:

(a) Put the back board to the seat back again;

(b) At about the height of the centre of the trunk weight of the 3-D H device, the backward horizontal force of no more than 25N should be alternately applied to and removed from the seat back angle rod (probe rod in the head space) until the hip angle protractor shows that it has reached a stable position after the force is removed. Then make sure that there is no foreign downward or transverse force applied on the 3-D H device. If the 3-D H device needs to be adjusted to be horizontal, the back board should be turned forward, and the procedures stated in A.4.12 should be repeated.

A.4.14 Measurement

A.4.14.1 Measure the coordinates of the "H" point in the 3-D coordinates system.

A.4.14.2 When the probe rod is in the furthest back position, the seat back angle protractor of the 3-D H device should read the value of actual seat back angle.

A.4.15 If it is necessary to reinstall the 3-D H device, then before the re-operation, the seat assembly should be kept unladen for at least 30 minutes.

A.4.16 If the seats of the same row are thought to be the same (such as the long seat, same seat, etc.), only one "H" point and one actual seat back angle on each row are required to be determined. The 3-D H device described in Appendix 1 of this Appendix should be placed on a representative position of this row. This position should be:

A.4.16.1 In the first row: the driver's seat

A.4.16.2 In other rows: an outer side seat.

Appendix A - Attachment I

Description of Three-Dimensional “H” Point Device */

(3-D H Device)

A.I.1 Back Board and Seat Board

Back board and seat board are made of strengthened plastic material and metal. They simulate the trunk and thighs of human body. They are mechanically hinged to the “H” points. For measuring the actual seat back angle, a protractor is fixed on the probe rod hinged with the “H” point. The centre line of the thigh is determined by the adjustable thigh rod fixed on the seat board. It is also the reference line of the hip angle protractor.

A.I.2 Trunk and Leg Parts

The leg rod part connects with the seat board assembly at the T-shaped rod linking with the knees. This T-shaped rod can adjust the transverse extension of the thigh rod. A protractor is installed on the leg rod to measure the knee angle. Degrees are engraved on the shoes and feet assembly for measuring the feet angles. The two levelling instruments determine the spatial position of the device. Each of the trunk weights is placed at the relative centre of gravity so as to provide the same pressure as a man of 76kg. All the joints of the 3-D H device should be inspected. Check if they can work freely, and if there is any obvious friction or obstruction.

*/ For more detailed information about the structure of the 3-D H device, please contact Society of Automotive Engineers (SAE), 400 Commonwealth Drive, Warrendale, Pennsylvania 15096, U.S.A.

Back board

Head spatial probe rod

Trunk weight suspending frame

Seat back angle levelling instrument

Seat back angle protractor

Hip angle protractor

Seat board

H point indication button

Thigh weight cushion

T-shaped rod connecting with knee joint

H point supporting axle

Transverse levelling instrument

Thigh rod

Knee protractor

Protractor of included of leg

Figure A.1 Names of components of the 3-D H device unit: mm

Trunk weight

Action direction and action point of load

Hip weight

Alteration range from 108 to 424

Thigh weight

Leg weight

Figure A-2 Size of components of the H device and load distribution

Appendix A - Attachment II

Three-Dimensional Coordinates System

A.II.1 Three-dimensional coordinates system is defined as three positively intersecting planes built by the vehicle manufacturer (please see Figure 3).[*/]

A.II.2 The vehicle measurement gesture is determined by the position of vehicle on the supporting plane. When placing the vehicle, the coordinates of the reference sign have to be consistent with the one regulated by the manufacturer.

A.II.3 Determine the coordinates of the "R" point and "H" point being relative to the reference signs regulated by the vehicle manufacturer.

Y-coordinate zero plane (vertical longitudinal zero plane)

X-coordinate zero plane (vertical transverse zero plane)

Z-coordinate zero plane (horizontal zero plane)

Supporting plane

Figure A.3 Three-dimensional coordinates system

[*/] This reference system meets the requirements of ISO4130-1978.

Appendix A - Attachment III

Reference Data of the Positions of Seats

A.III.1 Code numbers of reference data

List the reference data of the position of each seat in proper order. The position of seat is indicated by a 2-digit code. The first digit is an Arabic numeral indicating the row of seats from the front to the rear. The second digit is an uppercase letter indicating the position of seat in a certain row. When observing the vehicle in forward driving direction, the following letters can be used for indication:

L: left side

C: central

R: right side

A.III.2 Description of the vehicle measurement gesture

A.III.2.1 Coordinates of different reference signs

X·····

Y·····

Z·····

A.III.3 Reference data table

A.III.3.1 Positions of seat: ..

A.III.3.1.1 Coordinates of "R" point

X·····

Y·····

Z·····

A.III.3.1.2 Designed seat back angle

A.III.3.1.3 Technical adjustment requirements of seat:*/

Horizontal:

*/ Delete as appropriate

Vertical :

Angle:

Seat back angle:

Remarks: The reference data of the rest of the seats can be listed in A.3.2 and A.3.3 of this Appendix.

Appendix B
(Regulatory Appendix)

Procedures of Impact Test

B.1 Facilities

B.1.1 Testing Site

The testing site should be big enough to accommodate the driving system of mobile deformable barrier, and install the mobile and testing equipments after the impact event. The ground surface of the site where vehicle impact and mobility is to take place should be horizontal, flat, dry and clean.

B.2 Testing conditions

B.2.1 The test vehicle should be kept static.

B.2.2 The mobile deformable barrier should possess the characteristics regulated in Appendix C of the Standards. Its inspection requirements are regulated in Appendix C. The mobile deformable barrier should be installed with appropriate devices so as to avoid impacting with the test vehicle for the second time.

B.2.3 The track of the vertical perpendicular bisecting plane of the mobile deformable barrier should be perpendicular to the vertical perpendicular bisecting plane of the impacted vehicle.

B.2.4 The distance between the vertical perpendicular bisecting plane of the mobile deformable barrier and the cross-sectional vertical plane of the test vehicle going through the R point of the laterally impacted front row seat should be within the range of ± 25cm. At the moment of impact, make sure that the upper and lower deviation between the limited horizontal central plane of the upper, lower edges on the front surface of the deformable barrier and the determined positions before testing should be within the range of ± 25cm.

B.2.5 Unless specially specified in the Standards, the instrument should meet the requirements of ISO6487-2000.

B.2.6 During the lateral impact test, the temperature of the dummy should be stabilised at $22^{o}C \pm 4^{o}C$.

B.3 Testing speed

At the moment of impact, the speed of the mobile deformable barrier should be 50 km/h ± 1 km/h, and kept stabilized at least 0.5m before the impact. The accuracy of the measurement instrument is 1%. If the test is done under a higher impact speed and the vehicle meets the technical requirements of Chapter 4 in the Standards, it is also considered as passed.

B.4 Status of vehicle

B.4.1 General requirements

The test vehicle should be able to reflect the characteristics of the series of products, which should include all the accessories normally installed, and should be at normal operation status. Some parts and accessories can be replaced by the parts of the same mass, provided that such replacement shall not create any effects to the test results.

B.4.2 Requirements of the outfits of vehicle

The test vehicle should be equipped with all the selected parts having effects on the test results.

B.4.3 Mass of vehicle

B.4.3.1 The mass of the test vehicle should be the reference mass regulated in 3.9 of the Standards. Its mass deviation should be adjusted to ± 1% of its reference mass.

B.4.3.2 The fuel tank should be filled with water. The mass of water being poured in should be 90% of the fuel tank capacity regulated by the manufacturer.

B.4.3.3 All other systems (brake system, lubricating system, cooling system, etc.) can be emptied. The mass of the discharged liquids should be compensated.

B.4.3.4 If the mass of the vehicle measurement equipment loaded on vehicle exceeds 25kg, some parts without significant effects on the test results should be decreased so as for compensation.

B.4.3.5 The mass of the vehicle measurement equipment should not make each axle's load create any alteration of more than 5%. Besides, the alteration volume of each axle's load should not exceed 20kg.

B.5 Preparations of vehicle

B.5.1 At least the windows on the impact side should be closed.

B.5.2 The vehicle doors should be closed but not locked.

B.5.3 The gear stick should be in the neutral position. Release the brake of vehicle.

B.5.4 If the seat has a comfort adjustment system, it should be adjusted to a position regulated by the vehicle manufacturer.

B.5.5 If the seat of the dummy and its parts and accessories are adjustable, they should be adjusted to the following positions:

B.5.5.1 The forward-backward control of seat should be adjusted and locked at the position closest to the middle point. If this position is just between two locking slots, it should be locked in the slot close to the rear part. When the dummy cannot be correctly placed, and the designed “H” point (x_1, z_1) of the driver’s seat or the passenger’s seat in the front row meet the following equation (i.e. this point lies in the right side region of the straight line A in Figure B.1), appropriate adjustment is allowed to be made to this seat until the dummy is correctly placed, so as to make the designed “H” point located on the right hand side of the straight line A of the horizontal coordinate in Figure B.1, and try to make it close to the straight line A.

$$X < \frac{1670 - Z}{1.94}$$

In this equation:

X is the horizontal distance in forward-backward direction between the designed “H” point and the horizontal straight line going through the designed centre of the accelerator pedal surface and being perpendicular to the vertical central plane of vehicle. The unit of distance is mm.

Z is the vertical distance in forward-backward direction between the designed “H” point and the horizontal straight line going through the surface design centre of the accelerator pedal and being perpendicular to the vertical central plane of vehicle, and the unit of distance is mm.

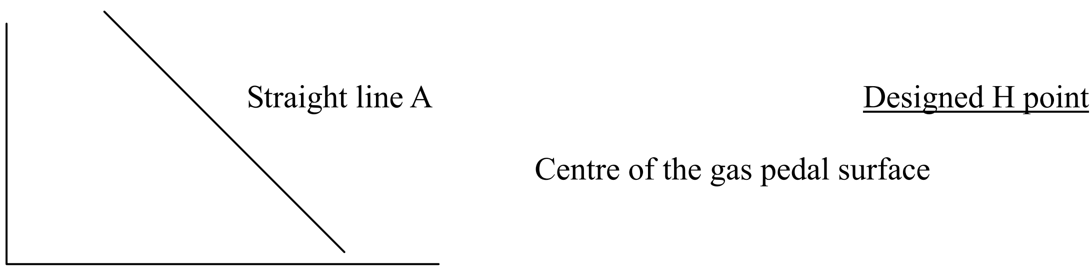


Figure B.1 Referential position of the dummy to be installed.

B.5.5.2 The head cushion should be adjusted until its surface and the centre of gravity of the dummy s head are on the plane of the same height. If it cannot be done, the head cushion should be adjusted to the highest position.

B.5.5.3 Unless specifically regulated by the manufacturer, the seat back should be adjusted, making the trunk reference line of the 3-D H device incline backward at $25^o \pm 1^o$.

B.5.5.4 If there are both adjustable seats and fixed seats in the vehicle, the effective forward-backward stroke of all the adjustable seats should be adjusted to the middle position. Its height should be adjusted according to the height of the fixed seat. If there is no locking position in the middle point of the adjustment stroke, it should be adjusted to the lower, rear locking point of this position, or its outer side middle point should be used. As for the adjustment of rotation (inclination), it must be adjusted backward, bringing the fake head move to the right at the same time. If the dummy stays outside the sitting space of passenger and its head touches the top of the vehicle, then the seat back angle or the forward-backward control of seat should be adjusted, so as to ensure the existence of a 10mm gap between the head of the dummy and the top of vehicle.

B.5.6 Unless especially regulated by the manufacturer, the positions of other front-row seats should be adjusted to be the same seat positions as the dummy.

B.5.7 If the steering is adjustable, it should be adjusted to the middle position of the stroke.

B.5.8 The air pressure of tyres should be adjusted to the air pressure value regulated by the manufacturer.

B.5.9 Regarding the placing of vehicle, it should be guaranteed that the axle is horizontal until all the preparation work is completed and the lateral-impact dummy is placed.

B.5.10 The test vehicle should be situated at the status regulated in B.4.3. The vehicle's suspension system with adjustable gap from the ground should be adjusted to the manufacturer's regulated gap from the ground at the normal driving speed of 50km/h, for carrying out the test. If necessary, auxiliary support can be added to prove this, but the impact performance of the test vehicle should not be affected.

B.6 Lateral-impact dummy and its placement

B.6.1 According to Appendix E or F of the Standards, the lateral-impact dummy should be placed on the front-row seat by the lateral impact side as regulated in Appendix E or F.

B.6.2 Safety belt or other restraint system selected for the vehicle type is worn by the dummy. The safety belt and safety belt fixed point should comply with GB14166, “Safety Belt and Restraint System for Adult Passengers of Road Vehicle” and GB14167, “Fixed Point of Safety Belt Installation of Vehicle”

B.6.3 According to the regulation of the manufacturer, the safety belt or restraint system worn by the dummy should be adjusted until it is suitable for the dummy to wear. If the manufacturer does not have any regulation for that, the height should be adjusted to the middle position. If this adjustment is unavailable, it should be adjusted to the lower part closest to the middle position.

B.7 Measurement of lateral impact on the dummy

B.7.1 Record the readings of the following measurement instruments.

B.7.1.1 Dummy head measurement

It is the 3-direction resultant acceleration value on the centre-of-gravity position of head. The head measurement passages should meet the requirements of ISO6487-2000:

CFC: 1,000Hz

CAC: 150g

B.7.1.2 Dummy chest measurement

The 3 measurement passages of chest rib deformation should meet the requirements of ISO6487-2000:

CFC: 1,000Hz

CAC: 60g

B.7.1.3 Dummy pelvis measurement

The measurement passage of force received by pelvis should meet the requirements of ISO6487-2000:

CFC: 1,000Hz

CAC: 15kN

B.7.1.4 Dummy abdomen measurement

The measurement passage of force received by abdomen should meet the requirements of ISO6487-2000:

CFC: 1,000Hz

CAC: 5kN

B.8 Determination of performance parameters

The test results should meet the requirements of 4.2 of the Standards.

B.8.1 Head performance criterion (HPC)

In the event of head contact, the head performance criterion (HPC) includes the calculation of the whole contact process from the initial contact to the final contact. HPC is the maximum value of the following calculation:

$$HPC = (t_2 - t_1)\left[\frac{1}{t_2 - t_1}\int_{t2}^{t2} a dt\right]^{2.5}$$

In the equation, a is the resultant acceleration (m/s^2) of the centre of gravity of the dummy's head. It is indicated by the multiple of the acceleration of gravity g (9.81 m/s^2). The grade of acceleration-time passage frequency is 1,000Hz; t_2 and t_1 denote the two random moments in the impact process from the initial contact to the final contact.

B.8.2 Chest performance criterion

B.8.2.1 Chest deformation volume: Referring to the chest deformation peak value. It is the maximum deformation value of any rib tested by the rib displacement sensor. The passage frequency wave-filtration grade is 180 Hz.

B.8.2.2 Viscosity criterion: Referring to the peak value of viscosity response. It is the maximum value of the product after multiplying the instant compression tested on any rib of half of the chest by the rib deformation rate. The passage frequency wave-filtration grade is 180 Hz. To calculate this value, the reference width of the rib of half of the chest is 140mm.

$$VC = \max\left[\frac{D}{0.14} \times \frac{dD}{dt}\right]$$

In this equation, D (m) = rib deformation.

The calculation method is shown in B.9.

B.8.3 Abdomen performance criterion

It is the peak value of force received by abdomen. It is the maximum value of the resultant of 3 forces tested by the force sensor at 39mm below the covering object on the lateral surface of the impacted dummy. The passage frequency wave-filtration grade is 600 Hz.

B.8.4 Pelvis performance criterion

Referring to pubis synthesis peak force (PSPF). It is the maximum value tested by the load sensor installed at the pubis of the pelvis. The passage frequency wave-filtration grade is 600 Hz.

B.9 Calculation procedures of the viscosity criterion of dummy

The viscosity criterion (VC) is acquired from the calculation of the instantly created rib compression and rib deformation rate, which are both acquired from the measurement of the rib deformation. The rib deformation response is acquired after primary wave filtration at 180Hz. The compression at the *t* moment is the ratio of deformation after wave filtration to the half chest's width of the laterally impacted dummy. It can be measured on the metal rib (0.14m).

$$C_{(t)} = \frac{D_{(t)}}{0.14}$$

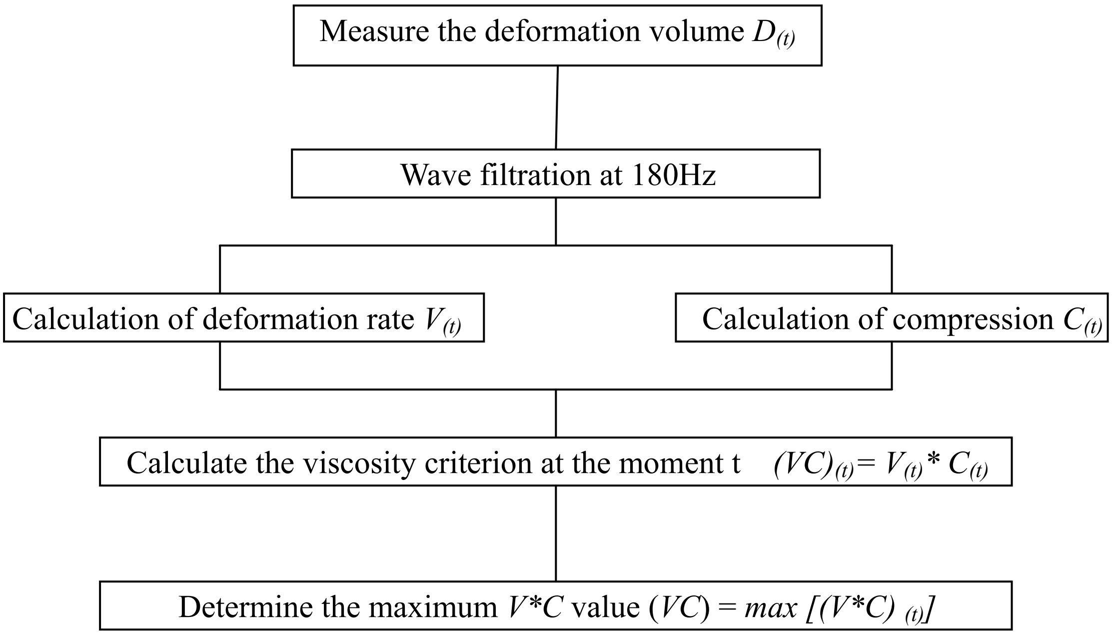
The rib deformation rate at the *t* moment is acquired from the calculation of deformation after wave filtration.

$$V_{(t)} = \frac{8\,[D_{(t+1)} - D_{(t-1)}] - [D_{(t+2)} - D_{(t-2)}]}{12\delta t}$$

Where, $D_{(t)}$ is the deformation (m) at the *t* moment.

δt is the time interval (s) of deformation measurement volume. Its maximum value is 125×10^{-4}s.

The chart of calculation procedures is as follows:


Measure the deformation volume $D_{(t)}$
Wave filtration at 180Hz
Calculation of deformation rate $V_{(t)}$
Calculation of compression $C_{(t)}$
Calculate the viscosity criterion at the moment t $(VC)_{(t)} = V_{(t)} * C_{(t)}$
Determine the maximum $V*C$ value $(VC) = max\ [(V*C)_{(t)}]$

Appendix C
(Regulatory Appendix)

Characteristics of Mobile Deformation Barrier

C.1 Characteristics of mobile deformation barrier

C.1.1 Mobile deformation barrier is composed of an impactor and trolley

C.1.2 The total mass is 950kg ± 20kg.

C.1.3 The centre of gravity is within 10mm on the vertical perpendicular bisecting plane, being 1,000mm ± 30mm from the front axle and 500mm ± 30mm from the ground.

C.1.4 The distance between the front surface of impactor and the centre of gravity of the barrier is 2000mm ± 30mm.

C.1.5 Under the static status before impact, the lower edge of the frontal surface of impactor leaves a gap of 300mm ± 5mm from the ground.

C.1.6 The distance between the front and rear wheels of the trolley is 1500mm ± 10mm.

C.1.7 The wheelbase of trolley is 3000mm ± 10mm.

C.2 Characteristics of impactor

The impactor is composed of 6 independent beehive-shaped aluminium weights, 3 front aluminium boards and 1 rear aluminium board. Pre-processing should be done to the beehive-shaped aluminium weights (referred to as "beehive aluminium weights," hereinafter), making the force increase with the enlargement of deformation.

C.2.1 Beehive aluminium weight

C.2.1.1 Geometric characteristics

C.2.1.1.1 The impactor is a combination of 6 parts. Its form and occupied position are shown in Figures C.1 and C.2. The length and width directions of each beehive aluminium weight are defined according to Figure C.3 that the length is 500mm ±

5mm, and the width is 250mm ± 3mm.

C.2.1.1.2 The impactor is divided into upper group and lower group. The lower group's height is 250mm ± 3mm, and thickness is 500mm ± 2mm. The lower group is thicker than the upper group by 60mm ± 2mm.

C.2.1.1.3 The beehive aluminium weights should be placed in 6 regions according to the regulations in C.1. Each weight (including the incomplete beehive unit) should fully occupy the region.

C.2.1.2 Tight pre-pressing

C.2.1.2.1 The front surface of the beehive aluminium weight with front board has to carry out tight pre-pressing.

C.2.1.2.2 Before the test, the front surfaces of the beehive aluminium weights 1, 2 and 3 should be pre-pressed for 10mm ± 2mm, making its thickness reach 500mm ± 2mm (please see Figure C.2).

C.2.1.2.3 Before the test, the front surfaces of the beehive aluminium weights 4, 5 and 6 should be pre-pressed for 10mm ± 2mm, making its thickness reach 440mm ± 2mm (please see Figure C.2).

C.2.1.3 Characteristics of material

C.2.1.3.1 The beehive unit of the beehive aluminium weight should be 19mm ± 1.9mm (please see Figure C.4).

C.2.1.3.2 The beehive units of the upper group of impactor should be made of 3003 aluminium.

C.2.1.3.3 The beehive units of the lower group of impactor should be made of 5052 aluminium.

C.2.1.3.4 During tight pressing of the processed beehive aluminium weight, its force-deformation curve should lie within the curve region regulated in Figure C.10. These processed beehive materials forming the impactor should be cleaned so as to clear any residue left in times of the shaping of beehive aluminium weight.

C.2.1.3.5 The mass change of each lot of beehive aluminium weights should not exceed 5% of the average mass of this lot of beehive aluminium weights.

C.2.1.4 Static test

C.2.1.4.1 A sample should be taken out from each lot of the processed beehive aluminium weight units to receive static test. The experimental rules are shown in C.4.

C.2.1.4.2 The force-deformation curve of each beehive aluminium weight should lie within the curve range regulated in Figure C.10. Each beehive aluminium weight is defined to have its own force-deformation curve region.

C.2.1.5 Dynamic test

C.2.1.5.1 Check the dynamic deformation characteristics in the impact test according to the testing methods of C.5.

C.2.1.5.2 When the following situations are satisfied, its deformation characteristics are allowed to deviate from the boundary of force-deformation region of the rigidity characteristic of impactor regulated in C.11.

C.2.1.5.2.1 There is deviation in the very beginning of impact, and the impactor starts to deform within the range of 150mm.

C.2.1.5.2.2 The deviation does not exceed 50% of its closest instant relative boundary limit.

C.2.1.5.2.3 The relative displacement of each deviation should not exceed the deformation of 35mm. The total displacement should not exceed 70mm (please see Figure C.11).

C.2.1.5.2.4 The total energy deviating from the boundary limit should not exceed 5% of the impactor's energy.

C.2.1.5.3 Beehive aluminium weight 1 and beehive aluminium weight 3 are the same. For their rigidity, it is guaranteed that their force-deformation curve is within the shadow of 2a in Figure C.11.

C.2.1.5.4 Beehive aluminium weight 5 and beehive aluminium weight 6 are the same. For their rigidity, it is guaranteed that their force-deformation curve is within the shadow of 2d in Figure C.11.

C.2.1.5.5 For the rigidity of beehive aluminium weight 2, it is guaranteed that its force-deformation curve is within the shadow of 2b in Figure C.11.

C.2.1.5.6 For the rigidity of beehive aluminium weight 4, it is guaranteed that its force-deformation curve is within the shadow of 2c in Figure C.11.

C.2.1.5.7 The force-deformation curve of the whole impactor should be within the shadow of 2e in Figure C.11.

C.2.1.5.8 According to the regulations of C.5, an impact speed of 35km/h ± 2km/h is used to carry out a lateral-force barrier impact test so as to verify the force-deformation curve.

C.2.1.5.9 The dissipation energy of beehive aluminium weight 1 and beehive aluminium weight 3 should be 9.5kJ ± 2kJ each.

C.2.1.5.10 The dissipation energy of beehive aluminium weight 5 and beehive aluminium weight 6 should be 3.5kJ ± 1kJ each.

C.2.1.5.11 The dissipation energy of beehive aluminium weight 2 should be 4kJ ± 1kJ.

C.2.1.5.12 The dissipation energy of beehive aluminium weight 4 should be 15kJ ± 2kJ.

C.2.1.5.13 The total dissipation energy during the impact is 45kJ ± 3kJ.

C.2.1.5.14 Through the data integral calculation of acceleration sensor, the maximum deformation counted as from the impactor starts the contact should be 330mm ± 20mm.

C.2.1.5.15 After the dynamic test, the final static deformation of the residue of impactor on the plane at the height B (Figure C.2) should be equal to 310mm ± 20mm.

C.2.2 Front board

C.2.2.1 Geometric characteristics

C.2.2.1.1 The dimension of front board is: width 1,500mm ± 1mm, height 250mm ± 1mm, and thickness 0.5mm ± 0.06mm.

C.2.2.1.2 After assembly, the general size of impactor (as shown in Figure C.2) is: width 1,500mm ± 2.5mm, and height 500mm ± 2.5mm.

C.2.2.1.3 The upper edge of front board of lower group and the lower edge of front board of upper group should be arrayed and matched within 4mm.

C.2.2.2 Characteristics of materials

C.2.2.2.1 Front board is made of aluminium alloy of AIMg2 and AIMG3 series, with percentage elongation ≥ 12%, and maximum tensile strength ≥ 175 N/mm^2.

C.2.3 Back board

C.2.3.1 Geometric characteristics

C.2.3.1.1 The geometric characteristics should meet the requirements of Figure C.5 and Figure C.6.

C.2.3.2 Characteristics of materials

C.2.3.2.1 The back board is composed of aluminium alloy at a thickness of 3mm. The back board is made of aluminium alloy of AIMg2 and AIMG3 series, with its hardness between 50HB and 65HB. There are small holes on the board for ventilation. The position, diameter and pattern of holes are shown in Figures C.5 and C.7.

C.2.4 Position of beehive aluminium weight

The beehive aluminium weight is at the centre of the hollowed region of the rear board (Figure C.5).

C.2.5 Binding for fixing

C.2.5.1 The binder used by front and rear boards should be the double-portion polyurethane (PU) {e.g. the Ciba Geigy XB5090/1 resin with XB5304 hardener} or the equivalent object. The even application of the binder on the front board should not exceed 0.5kg/m^2, and the maximum thickness of film is 0.5mm.

C2.5.2 The smallest binding strength of the back board is 0.6 MPa (87psi). Test should be done according to C.2.5.3.

C.2.5.3 Test of binding strength

C.2.5.3.1 According to the regulations of ASTM (American Society for Testing and Materials) C297-6, horizontal tensile testing method should be applied to the test of binding strength.

C.2.5.3.2 The size of the test weight is 100mm × 100mm at the thickness of 15mm.

It is adhered to a ventilated back board sample. The used beehive aluminium weight should represent the characteristics of impactor. It refers that the chemical etching has reached an extent that it is close to the back board of barrier, only that no pre-pressing is made.

C.2.6 Traceability

C.2.6.1 The impactor should be engraved with continuous serial number, either by etching or other carving method available for permanent preservation. Each weight should be indicated with the lot number and manufacturing date.

C.2.7 Installation of impactor

C.2.7.1 It should be fixed on the trolley according to Figure C.8. For fixing, 6 M8 bolts should be used. The front part of wheels of the trolley should not be greater than the general size of the barrier. In order to prevent the back board from bending during the installation and tightening of bolt, suitable spacer should be placed between the back board flange in the lower layer and the trolley surface.

C.3 Ventilation system

C.3.1 The interface between trolley and ventilation system should be firm, hard and flat.

The ventilation device is a part of the trolley, instead of a part of the impactor provided by the manufacturer.

The geometric characteristics of the ventilation device are shown in Figure C.9.

C.3.2 Installation procedures of ventilation device

C.3.2.1 The ventilation device is installed on the front board of the trolley.

C.3.2.2 Make sure that the standard feeler at the thickness 0.5mm cannot be inserted in any point of the ventilation device and trolley surface. If there appears a gap of greater than 0.5mm, the frame of the ventilation system should be replaced or adjusted until the gap is not greater than 0.5mm.

C.3.2.3 Dismantle the ventilation device from the front board of trolley.

C.3.2.4 Fix a 1.0mm-thick cork liner board at the front board of trolley.

C.3.2.5 Re-install the ventilation device in the front, and tightly fix it so there is no gap left.

C.4 Static test

C.4.1 A sample or several samples should be taken out from each lot of the processed beehive aluminium weight (according the lot method), and undergo tests according to the following experimental procedures.

C.4.2 The size of beehive aluminium weight applied to static test should be the normal size of impactor, i.e. top layer 250mm × 500mm × 440mm, lower layer

250mm × 500mm × 500mm.

C.4.3 The sample should be compressed between two parallel loading boards. The loading boards should be at least 20mm exceeding the cross-section edge of beehive aluminium weight.

C.4.4 The compression speed is 100mm per minute, with an error of 5%.

C.4.5 The smallest sampling frequency of static compression data is 5Hz.

C.4.6 Continue doing the static test until the beehive aluminium weights 4, 5 and 5 are compressed to be 300mm and the beehive aluminium weights 1, 2 and 3 are compressed to be 350mm.

C.5 Dynamic test

Whenever every 100 beehive aluminium weights are produced, the manufacturer should use the force test wall fixed on the rigid barrier to do the dynamic test once. The testing method is as follows:

C.5.1 Installation

C.5.1.1 Testing site

The testing site should be big enough to accommodate the driveway of mobile deformable barrier, fixed barrier and the necessary equipment of test. In the rear part of the driveway, the rigid barrier should contain at least 5m of horizontal and polished road surface.

C.5.1.2 Fixing of rigid barrier and force testing wall

C.5.1.2.1 The rigid barrier is made of reinforced concrete, with its front width no smaller than 3m, height not lower than 1.5m, and thickness and weight guaranteed no less than 70 tons.

C.5.1.2.2 The front plane should be perpendicular to positively intersect with the central axis of driveway. The surface is installed with load sensor which can measure the load of each aluminium weight on the mobile deformable barrier at the instant of impact. The centre of the impact flat board should match with the centre of the selected mobile deformable barrier. The distance between their edges should be 20mm. The installation of sensors and the surface of flat board should satisfy the regulations of ISO6487-200 shown in the attachment.

C.5.1.2.3 When surface protection device is installed, this device should be composed of plastic synthetic boards (thick 12mm ± 1mm). It is installed on each load sensor, and the sensitivity of sensor would not be reduced.

C.5.1.2.4 The rigid barrier can be fixed or placed on the ground. But it has to be fixed by the additional fixing device. When the characteristics of the load sensor on the rigid barrier are different, but the same results can be achieved, then it can also be used.

C.5.2 Driving of mobile deformable barrier

During the instant impact, the mobile deformable barrier should not receive any direction change and action of driving device. It should perpendicularly cause impact with the barrier. The aiming accuracy of the impact position is within 10mm.

C.5.3 Measurement device

C.5.3.1 Speed

The impact speed is 35km/h ± 2km/h. The accuracy of the measurement device is 1%.

C.5.3.2 Load

The measurement device should meet the requirements of ISO 6487-2000:

CFC of each weight: 60Hz;

CAC of the 1st and 3rd parts: 200kN;

CAC of the 4th, 5th and 6th parts: 100kN;

CAC of the 2nd part: 200kN;

C.5.3.3 Acceleration

C.5.3.3.1 Vertical acceleration should be measured at 3 different positions in the vertical direction of trolley. One is in the middle, and two at the two sides. They are located at the positions where they cannot be bended.

C.5.3.3.2 The central acceleration sensor is located within 500mm of the centre of gravity of the mobile deformable barrier, and situated within the vertical perpendicular plane at a distance of ± 10mm from the centre of gravity of the mobile deformable barrier.

C.5.3.3.3 The height difference of the installation of lateral acceleration sensor is ± 10mm. The difference of its distance from the front part of the mobile deformable barrier should not exceed ± 20mm.

C.5.3.3.4 The measurement device should meet the requirements of ISO 6487-2000:

CFC: 1000Hx (before integration);

CAC: 50g.

C.5.4 General requirements of mobile deformable barrier

C.5.4.1 The characteristics of the mobile deformable barrier should meet the regulations of C.1 of this Appendix, and be recorded.

C.5.5 General technical requirements of impactor

C.5.5.1 When the output signal of the 6 load sensors satisfy the requirements of this Appendix, the impactor is regarded as passed.

C.5.5.2 There should be serial numbers, with manufacturing date included, on the impactor.

C.5.6 Data processing

C.5.6.1 Original data: During the time $T = T_0$, all the deviations in data should be eliminated. The elimination methods of deviation are recorded on the test report.

C.5.6.2 Wave filtration

C.5.6.2.1 Wave filtration should be done to the original data before processing / calculation.

C.5.6.2.2 The wave filtration grade of the data for the acceleration sensor to apply to integration is CFC 180, ISO 6487:2000.

C.5.6.2.3 The wave filtration grade of the data for the acceleration sensor to apply to pulse counting is CFC 60, ISO 6487:2000.

C.5.6.2.4 The wave filtration grade of the data of load sensor is CFC 60, ISO 6487:2000.

C.5.6.3 Calculation of surface deformation of mobile deformation barrier

C.5.6.3.1 After integrating (after wave filtration at CFC 180) collected from all the 3 acceleration sensors twice, the deformation of the deformable unit of impactor can be acquired.

C.5.6.3.2 Initial conditions of deformation volume:

C.5.6.3.2.1 Speed: Referring to the impact speed (coming from the speed measurement device)

C.5.6.3.2.2 The deformation is 0.

C.5.6.3.3 The left, central and right deformation-time curves of the mobile deformable barrier is drawn.

C.5.6.3.4 The maximum deviation of deformation calculated by 3 acceleration sensors should be within 10mm. Otherwise, those exceeding the range should be eliminated so as to ensure that the deformation difference calculated by 2 acceleration sensors is below 10mm.

C.5.6.3.5 If the deformation measured by the left, right and central acceleration sensors are below 10mm, the average acceleration value of 3 acceleration sensors can be used for calculating the deformation on the surface of barrier.

C.5.6.3.6 If there are only two acceleration sensors with deformation being below 10mm, the average acceleration value of these 2 acceleration sensors can be used for calculating the deformation on the surface of barrier.

C.5.6.3.7 If the deformation measured by all 3 acceleration sensors (left, right and central) are below 10mm, examination and inspection should be done to the original data so as to find out the cause of such a great alteration. Under these circumstances, the laboratory shall decide the data of which acceleration sensor can be used to determine the deformation of the mobile deformable barrier. If there is no usable data of sensor, the test has to be redone, and complete explanation should be given in the test report.

C.5.6.3.8 After the united application of the data of average deformation vs. time and the data of load wall force vs. time, the force-deformation data of each impactor can be obtained.

C.5.6.4 Calculation of energy

The energy absorbed by each impactor and the whole surface of mobile deformable barrier should be the calculated peak value of the deformation of impactor.

$$E_n = \int_0^1 F_n \, . \, ds_{\,mean}$$

Here:

t_o denotes the moment of initial contact

t_1 denotes the moment that the trolley stops, i.e. u = 0

s denotes the deformation of impactor calculated according to 5.6.3

C.5.6.5 Determination of dynamic force value

C.5.6.1 Make a comparison between the total impulse I of all the force integral calculated during the contact period and the changes of the momentum change (M*Δ V).

$$E_K = \frac{1}{2} M V_i^2$$

where,

V_i is the impact speed. M is the mass of the whole mobile deformable barrier.

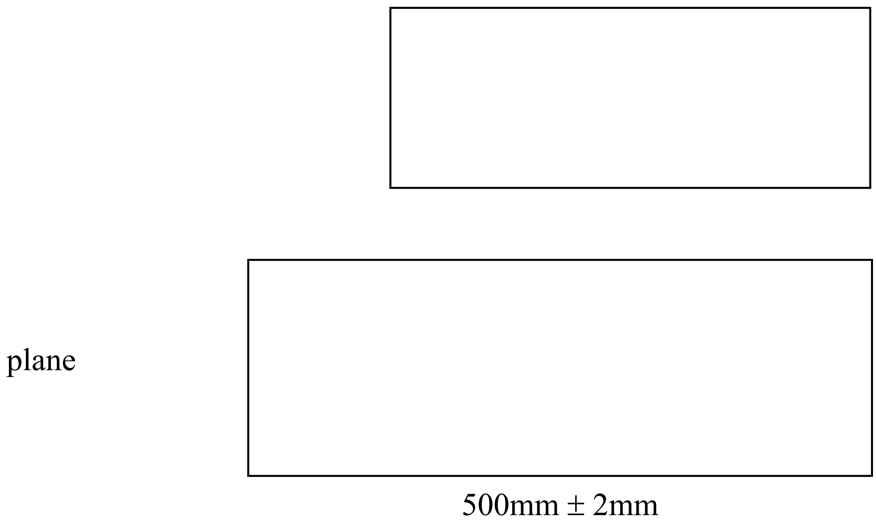
C.5.6.5.3 If the momentum change (M*Δ V) exceeds total impulse (I) ± 5%, or the absorbed total energy ($\sum E_N$) exceeds E_K ± 5%, the test data has to be inspected so as to determine the cause of the mistake.

Appendix C - Attachment I
Design of Impactor

unit: mm

Figure C.1 Size of impactor (front)

unit: mm



(including front board, but excluding rear board)

Figure C.2 Size of impactor (lateral)

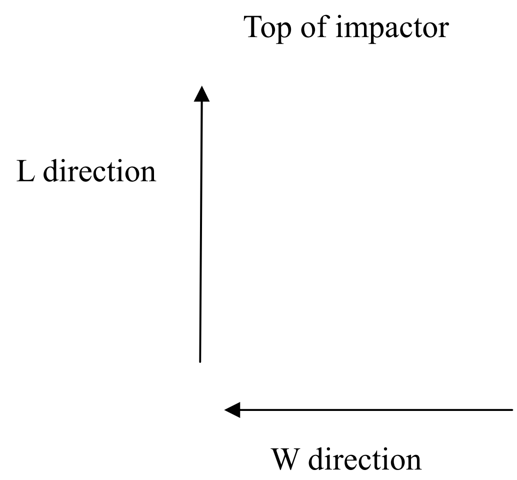


Figure C.3 Expansion direction of beehive aluminium weight

Figure C.4 Size of beehive aluminium weight unit

Appendix C - Attachment II

Design of Back Board

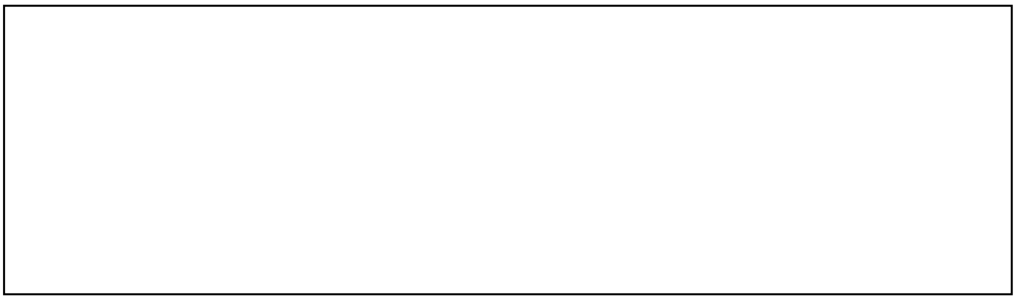


Figure C.5

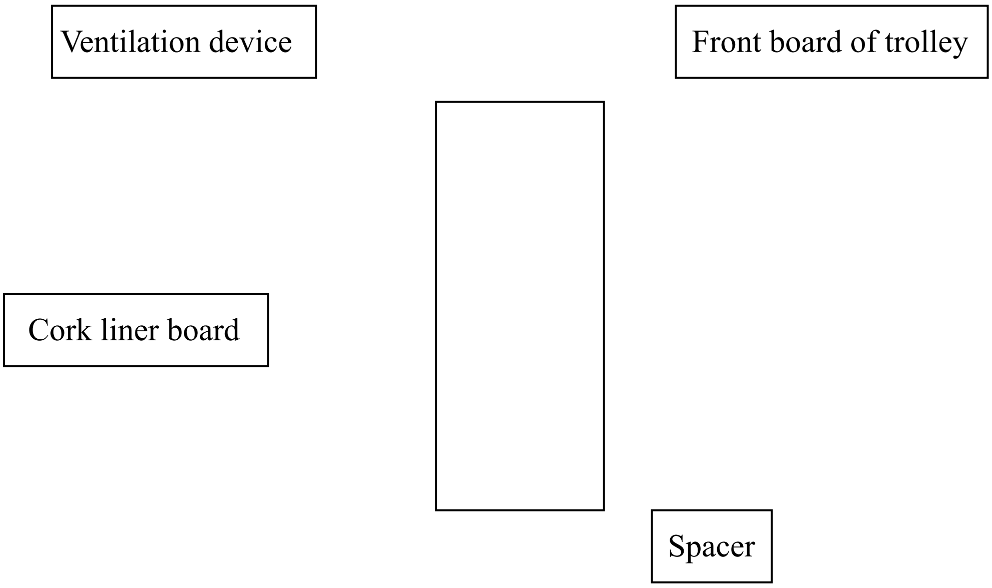


Figure C.6 Ventilation device of fixed back board on the board of trolley

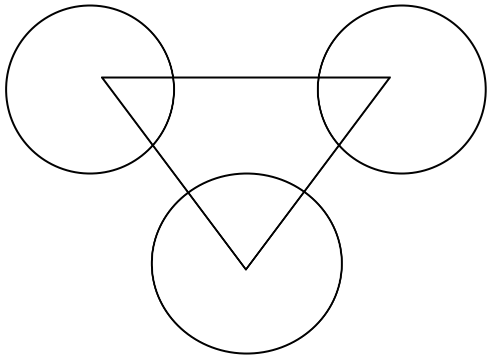
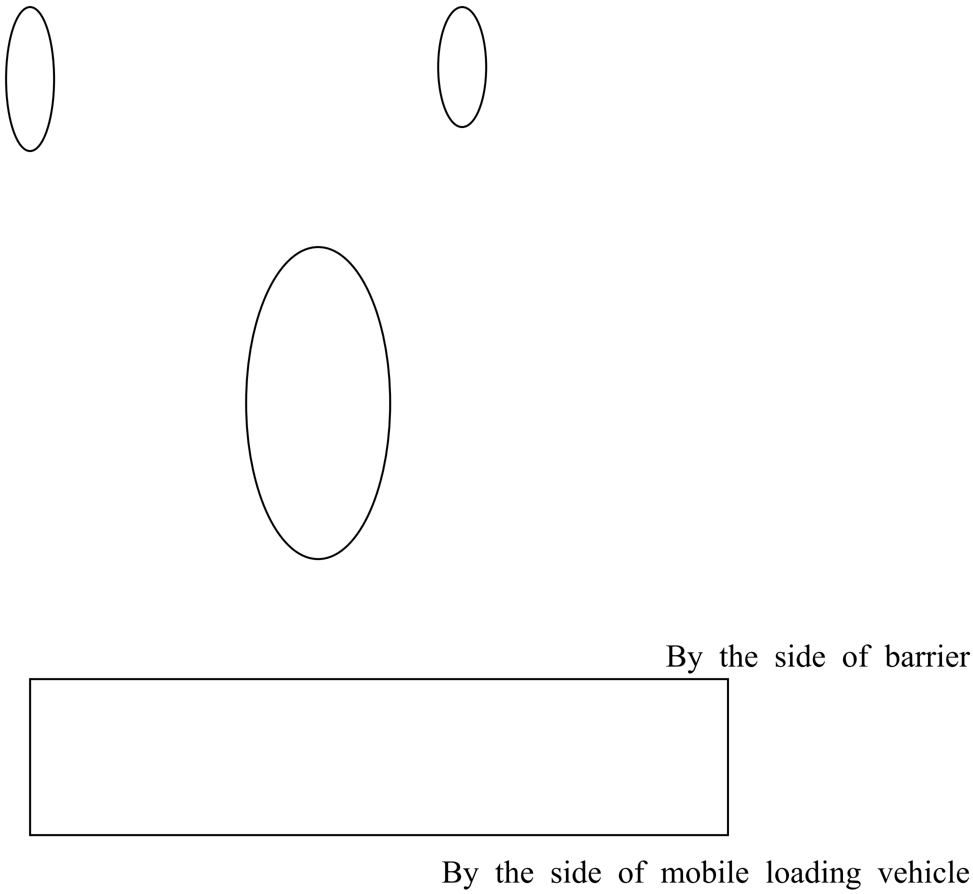


Figure C.7 Pattern and interval of ventilation holes on the ventilation board



(The installed holes on the base flange should be hollowed for easy installation, but the gripping should be tight so as to prevent the connecting part from falling during the impact.)

Figure C.8 Top and bottom parts of the back board flange

Appendix C - Attachment III

Ventilation Frame

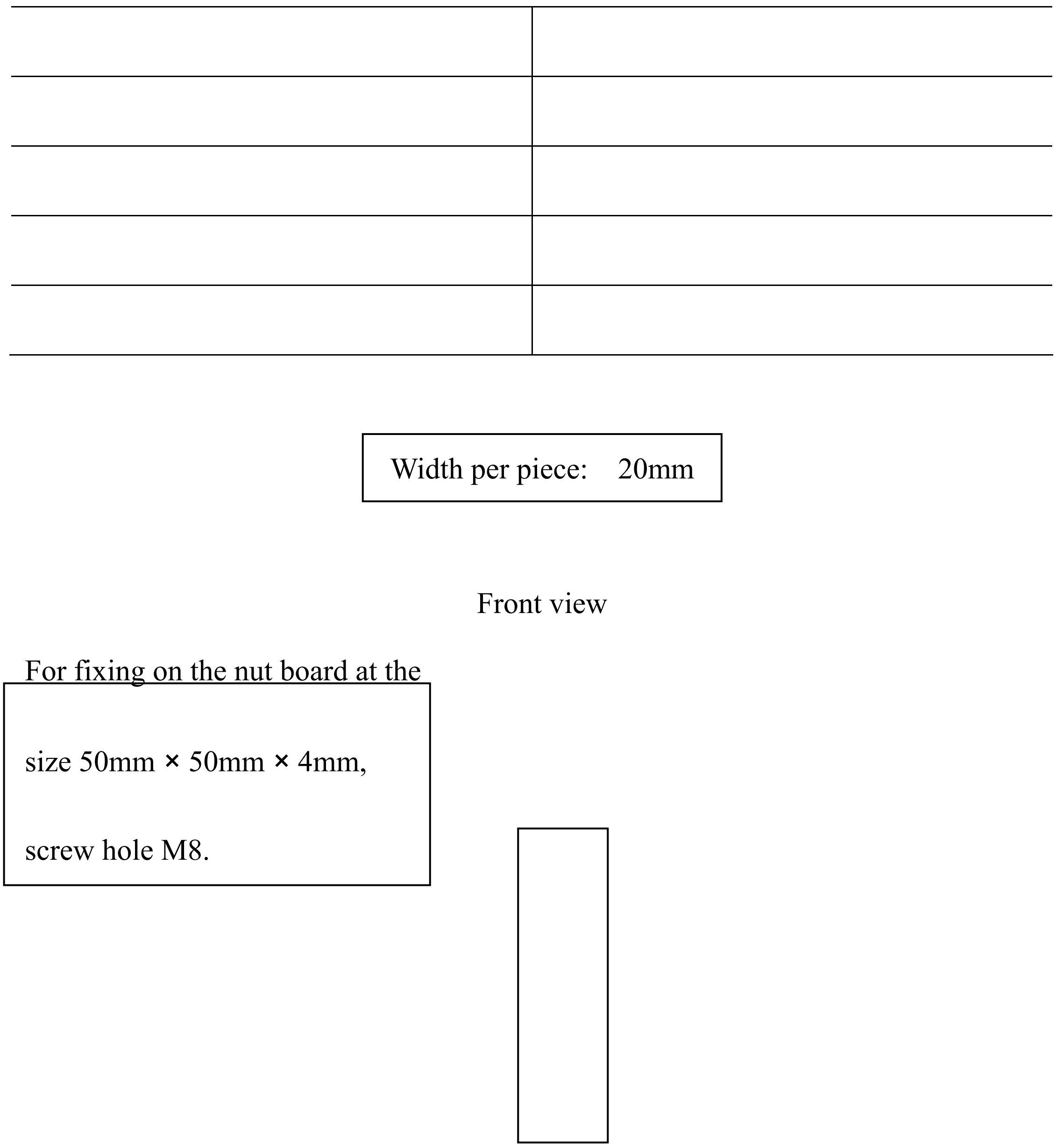


Figure C.9 Ventilation device

The ventilation device is composed of laths at 5mm thick and 20mm wide. On each lath in a vertical direction are punched with 9 ventilation holes at the diameter of 8mm. Please see the side view of lath above.

Appendix C - Attachment IV

Force of Static Test - Deformation Curve

Weights 1, 3

Figure 1a

Weight 2

Figure 1b

Weight 4

Figure 1c

Weights 5, 6

Figure 1d

Figure C.10 Force of static test - Deformation curve

Appendix C - Attachment V

Force of Dynamic Test - Deformation Curve

Weights 1, 3

Figure 2a

Force

(kN)

Deformation (cm)

Weight 2

Figure 2b

Force

(kN)

Deformation (cm)

Weight 4

Figure 2c

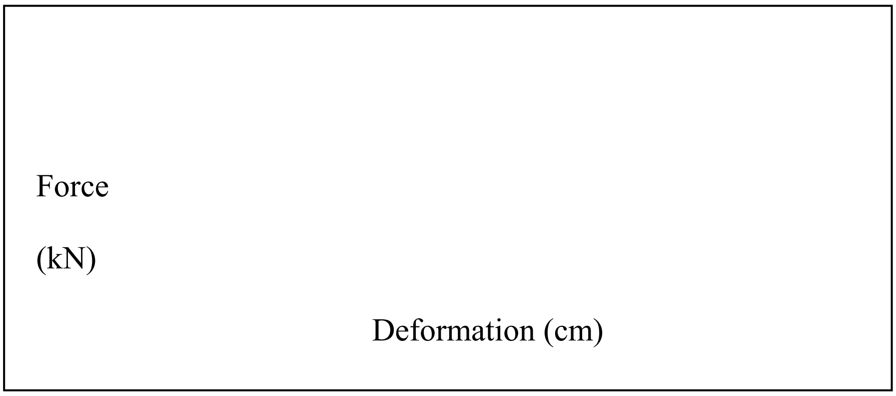
Force

(kN)

Deformation (cm)

Weights 5, 6

Figure 2d



All the beehive weights

Figure 2e

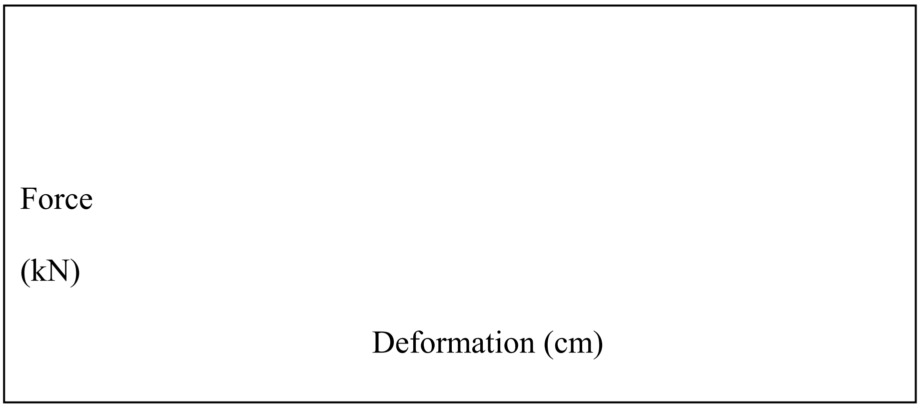


Figure C.11 Force of dynamic test - Deformation curve

Appendix D

(Regulatory Appendix)

Partial Tests

D.1 Purposes

This test aims at verifying that the vehicle type after alteration and the vehicle type having passed the test have equivalent or better energy absorption characteristics.

D.2 Procedures

D.2.1 Reference test

D.2.1.1 Install the interior-decoration buffer materials of the original vehicle used in the approval test on the new lateral structure of the test vehicle. Use the two different impactors shown in Figure D.1 to carry out two dynamic tests.

D.2.1.1.1 The head-shaped impactor regulated in D.3.1.1 of this Appendix is made to impact at the speed $24\ _{0}^{+1}$ km/h on the area available to be impacted by the lateral-impact dummy's head in the original test. The test results are recorded and the HPC value is calculated. However the test should not be carried out under the following circumstances:

It means that when the Standards is doing the test of Appendix B,

the head has no contact, or

the head only contacts the windscreen, which is not made of pressed glass.

D.2.1.1.2 The trunk weight impactor regulated in D.3.2.1 of this Appendix is made to impact at the speed $24\ _{0}^{+1}$ km/h on all the area available to be impacted by the lateral-impact dummy's shoulders, upper arms and chest in the original test. The test results are recorded and the HPC value is calculated.

D.2.2 Approval test

D.2.2.1 When installing the new interior-decoration buffer materials and seats in the lateral structure of the vehicle to carry out the approval test, the tests regulated in D.2.1.1.1 and D.2.1.1.2 of this Appendix should be repeated. The new test results are recorded and the HPC value is calculated.

D.2.2.1.1 If the HPC values calculated in these two approval tests are lower than those acquired in the reference test (use the interior-decoration buffer materials or seats in the initial approval test), the improved vehicle type is considered to be passed.

D.2.2.1.2 If the new HPC value is greater than that of the reference test, the new interior decoration buffer materials and seats should be used for carrying out lateral impact test of the whole vehicle.

D.3 Equipments of test

D.3.1 Head-shaped impactor (Figure D.2)

D.3.1.1 This device is a rigid fully-guided straight-line impactor at the mass 6.8 kg. Its impact surface is a semi-spherical surface at the diameter 165 mm.

D.3.1.2 The head-shaped impactor is installed with 2 acceleration sensors and a speed measurement device. Its measurement direction is the impact direction.

D.3.2 Trunk weight impactor (Figure D.3)

D.3.2.1 This device is a rigid fully-guided straight-line impactor at the mass 30 kg. The size and cross-section are indicated in Figure D.3.

D.3.2.2 The trunk weight impactor is installed with 2 acceleration sensors and a speed measurement device. Its measurement direction is the impact direction.

Figure D.1 Impactor is used to carry out partial test

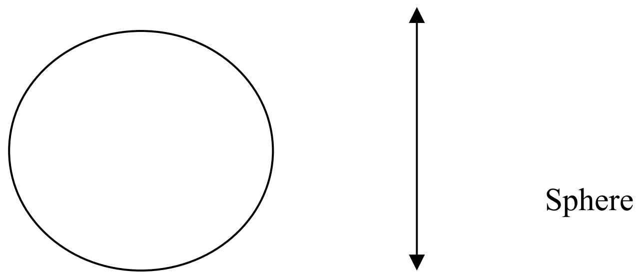


Figure D-2　Head-shaped impactor

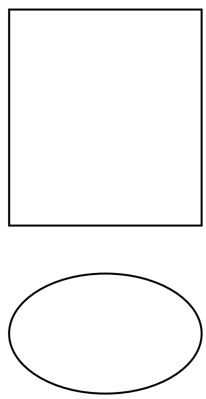


Figure D-3　Trunk weight impactor

Appendix E

(Regulatory Appendix)

Technical Regulations and Placement procedures of Lateral-Impact Dummy (I)

E.1 Outline

E.1.1 The size and mass of a lateral-impact dummy represents a lower-arm-free adult man of the 50^{th} percentile.

E.1.2 The lateral-impact dummy is composed of metallic and plastic frame covered by simulated muscle made of resin, plastics and foam.

E.1.3 This Appendix regulates the EuroSID 1 type lateral-impact dummy. The detailed description and technical illustration of the demarcation and measurement equipments are shown in the User's Handbook of EuroSID Type I Lateral-Impact Dummy.

E.2 Structure

E.2.1 The general description of lateral-impact dummy is specified in Figure E.1 and Table 1 of this Appendix.

E.2.2 Head

E.2.2.1 The details of the head are specified in the part No. 1 in Figure E.1 of this Appendix.

E.2.2.2 The head is composed of aluminium shell covered by a layer of plastic ethylene skin. Three-axial acceleration sensor and weight distribution object can be installed in the shell.

E.2.3 Neck

E.2.3.1 The details of the neck are specified in the part No. 2 in Figure E.1 of this Appendix.

E.2.3.2 The neck is composes of the head/neck juncture part, neck/chest juncture part and the central connecting part of the two juncture parts.

E.2.3.3 The head/neck juncture part (part No. 2a) and the neck/chest juncture part (part No. 2c) of neck are composed of 2 aluminium discs connected by a screw with semi-spherical head and 8 resin buffer weights.

E.2.3.4 The central part (part No. 2b) of the cylinder is made of resin. Each of its two ends has a fixed whole aluminium disc.

E.2.3.5 The neck is installed on the neck frame. Please see the part No. 3 in Figure E.1 of this Appendix.

E.2.3.6 The two surfaces of the supporting frame of neck forms an angle of 25^o. Since the shoulder board has an inclination of 5^o, the neck and trunk forms an angle of 20^o.

E.2.4 Shoulders

E.2.4.1 The details of shoulders are specified in the part No. 4 in Figure E.1 of this Appendix.

E.2.4.2 A shoulder is composed of a shoulder board, 2 collarbones and a shoulder blade.

E.2.4.3 The shoulder board (part No. 4a) is composed of an aluminium-made spacer, an aluminium-made cover board and an aluminium-made base board.

E.2.4.4 The collarbone (4b) is made of polypropylene, with two resin strings (part No. 4c) hooking backwards the rear part of the shoulder board. The outer edges of the two collarbones should be able to accommodate the standardised upper arm.

E.2.4.5 The shoulder blade (part No. 4) is made of low-density PU foam, and fixed on the shoulder board.

E.2.5 Chest

E.2.5.1 The details of chest are specified in the part No. 5 in Figure E.1 of this Appendix.

E.2.5.2 The chest is composed of a rigid thoracic vertebra and 3 same rib modules.

E.2.5.3 The thoracic vertebral cavity (part No. 5a) is made of steel. A lead-stuffed plastic vertebral back board (part No. 5b) is fixed on the rear surface.

E.2.5.4 The upper surface of the thoracic vertebral cavity inclines backwards at 5^o.

E.2.5.5 The rib module (part No. 5c) is composed of the steel-made rib covered by muscle-simulated PU foam (part No. 5d), a piston module (part No. 5e) joining the rib and vertebral cavity, a hydraulic shock absorber (part No. 5f) and a rigid shock-absorbing spring component (part No. 5g).

E.2.5.6 There is a spring of twisting rod (part No. 5h) inside the piston-cylinder module.

E.2.5.7 A displacement sensor (part No. 5i) can be installed on the front surface of the cylinder. It contacts with the interior side of rib.

E.2.6 Upper arm

E.2.6.1 The details of upper arm are specified in the part No. 6 in Figure E.1 of this Appendix.

E.2.6.2 The upper arm is composed of plastic bone covered by muscle-simulated PU and PVC skin.

E.2.6.3 Discontinued angles of 0^{o}, 40^{o} and 90^{o} are allowed to be formed between the upper arm and trunk line at the shoulder/arm joint.

E.2.6.4 The shoulder/arm joint is only allowed to have bending/stretching rotational movements.

E.2.7 Lumbar vertebra

E.2.7.1 The details of lumbar vertebra are specified in the part No. 7 in Figure E.1 of this Appendix.

E.2.7.2 The lumbar vertebra is composed of solid resin bowl body. The upper and lower surfaces of the bowl body are two steel boards with a steel wire inside.

E.2.8 Abdomen

E.2.8.1 The details of the abdomen are specified in the part No. 8 in Figure E.1 of this Appendix.

E.2.8.2 The abdomen is composed of metallic casting (part No. 8a) covered by PU foam.

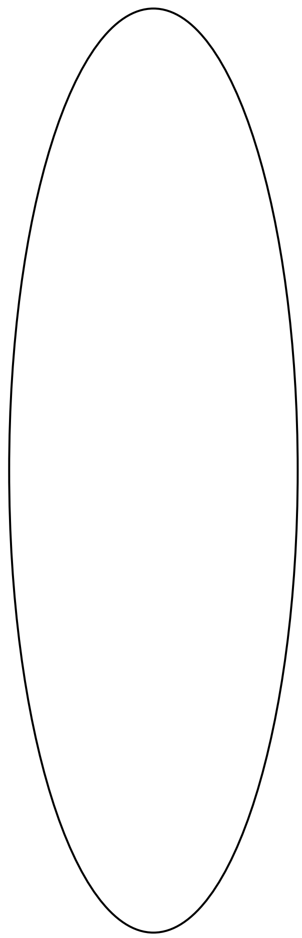
E.2.8.3 The central part of the abdomen is the metallic casting (part No. 8a) with a cover board installed at its top.

E.2.8.4 The covering object (part No. 8b) is made of PU foam. The foam on the two sides is connected by a bending resin weight stuffed with lead balls.

E.2.8.5 Between the foam covering object and rigid casting on each side, 3 force sensors (part No. 8c) and 3 non-measurement “dummy” parts can be installed.

E.2.9 Pelvis

E.2.9.1 The details of the pelvis are specified in the part No. 9 in Figure E.1 of this Appendix.



(F = front view, S = side view, T = vertical view)

Figure E.1 Structure of lateral-impact dummy

E.2.9.2 The pelvis is composed of a sacrum, 2 bone wings, 2 arm joints and a foam skin.

E.2.9.3 The sacrum (part No. 9a) is composed of a lead-stuffed aluminium weight and an aluminium board fixed on its top.

E.2.9.4 The bone wing (part No. 9b) is made of PU.

E.2.9.5 The hip joint (part No. 9c) is made of steel. It is composed of the upper thighbone and spherical joint. The spherical joint connects with the axis going through the H point of dummy.

E.2.9.6 The muscle-simulated system (part No. 9d) is composed of the stuff of PU foam and PVC skin. At H point, the skin is replaced by a piece of foamed PU foam (part No. 9e), which is installed on a steel board. The steel board is fixed on the bone wing by an axle going through the spherical hinge.

E.2.9.7 At the convergence of sacrum, the bone wings are linked together by force sensor (part No. 9f) or “dummy ” sensor.

E.2.10 Leg

E.2.10.1 The details of leg are specified in the part No. 10 in Figure E.1 of this Appendix.

E.2.10.2 The leg is made by metallic frame covered by the muscle-simulated PU foam and plastic skin.

E.2.10.3 The knee and ankle joints are only allowed to have bending/stretching rotational movements.

E.2.11 Coat

E.2.11.1 The details of coat are specified in the part No. 11 in Figure E.1 of this Appendix.

E.2.11.2 The coat is made of resin, covering the shoulders, chest, upper arms, abdomen, lumbar vertebra and upper pelvis.

Table 1 Components of lateral-impact dummy

Part	Serial No.	Name	Quantity
1		Head	1
2		Neck	1
	2a	Head/neck juncture board	1
	2b	Central part	1
	2c	Neck/chest juncture board	1
3		Neck frame	1
4		Shoulder	1
	4a	Shoulder board	1
	4b	Collarbone	2
	4c	Resin string	2
	4d	Shoulder blade	1
5		Chest	1
	5a	Thoracic vertebra	1
	5b	Vertebral back board	1
	5c	Rib module	3
	5d	Muscle-covering rib	3
	5e	Piston module	3
	5f	Shock absorber	3
	5g	Shock-absorbing spring	3
	5h	Spring of twisting rod	3
	5i	Displacement sensor	3
6		Upper arm	2
7		Lumbar vertebra	1
8		Abdomen	1
	8a	Central casting	1
	8b	Muscle-simulated covering object	1
	8c	Force sensor	3
9		Pelvis	1
	9a	Sacrum	1
	9b	Bone wing	2
	9c	Hip joint	2
	9d	Muscle covering object	1
	9e	H point foam weight	2
	9f	Force sensor	1
10		Leg	2
11		Coat	1

E.3 Assembling of dummy

E.3.1 Head-neck

E.3.1.1 The screw with semi-spherical head for assembling the neck should be applied with 10Nm torque.

E.3.1.2 The head is fixed on the head-neck juncture board by 3 bolts.

E.3.1.3 The neck/chest juncture board is fixed on the neck frame by 4 bolts.

E.3.2 Neck-shoulders-chest

E.3.2.1 The neck frame is fixed on the shoulder board by 4 bolts.

E.3.2.2 The shoulder board is fixed on the surface of thoracic vertebral cavity by 3 bolts.

E.3.3 Shoulder-arm

E.3.3.1 The upper arm is fixed on the collarbone and adjusted by a bolt and bearing. The upper arm is placed at the torque 0.6 Nm as needed by the standard position.

E.3.4 Chest-lumbar vertebra-abdomen

E.3.4.1 The lumbar vertebral joint is fixed at the lower part of lumbar vertebra by 2 bolts.

E.3.4.2 The lumbar vertebral joint is fixed at the top of lumbar vertebra by 2 bolts.

E.3.4.3 The convex edge on the central casting of abdomen is placed between the lumbar vertebral joint and lumbar vertebra.

E.3.5 Lumbar vertebra-pelvis-leg

E.3.5.1 The lumbar vertebra is fixed on the lumbar vertebral base board by 3 bolts.

E.3.5.2 The lumbar vertebra is fixed on the sacrum of pelvis by 3 bolts.

E.3.5.3 The leg is fixed on the upper thighbone-hip joint of the pelvis by a bolt.

E.3.5.4 Use the knee and ankle joints to assemble the leg and make the adjustment.

E.4 Major parameters

E.4.1 Mass

E.4.1.1 The mass of the major parts of dummy is shown in Table 2 of this Appendix.

Table 2　Mass of the dummy parts

Name of Part	Mass (kg)	Major Constituent Parts
Head	4.0 ± 0.4	Entire head (including 3-direction acceleration sensor)
Neck	1.0 ± 0.1	Neck (excluding neck frame)
Chest	22.4 ± 1.5	Neck frame, shoulders, upper arm connecting bolt, thoracic vertebral cavity, vertebral back board, rib module, rib deformation sensor, lumbar vertebral joint, shoulder blade, central casting of abdomen, abdomen force sensor, ⅔ of coat
Arm	1.3 ± 0.1	Upper arm (including the placed board of each arm part)
Abdomen	5.0 ± 0.5	Abdomen muscle covering object and lumbar vertebra
Pelvis	12.0 ± 1.0	Bone, lumbar vertebral base board, hip spherical joint, upper thighbone, bone wing, pelvis force sensor, pelvis muscle covering object, ⅓ of coat
Leg	12.5 ± 1.0	Legs, hips and thighs and the muscle from each leg to the upper thighbone
Total	72.0 ± 0.5	

E.4.2　Major size

E.4.2.1　The major size of the lateral-impact dummy (including coat) is shown in Figure E.2 and Table 3 of this Appendix.

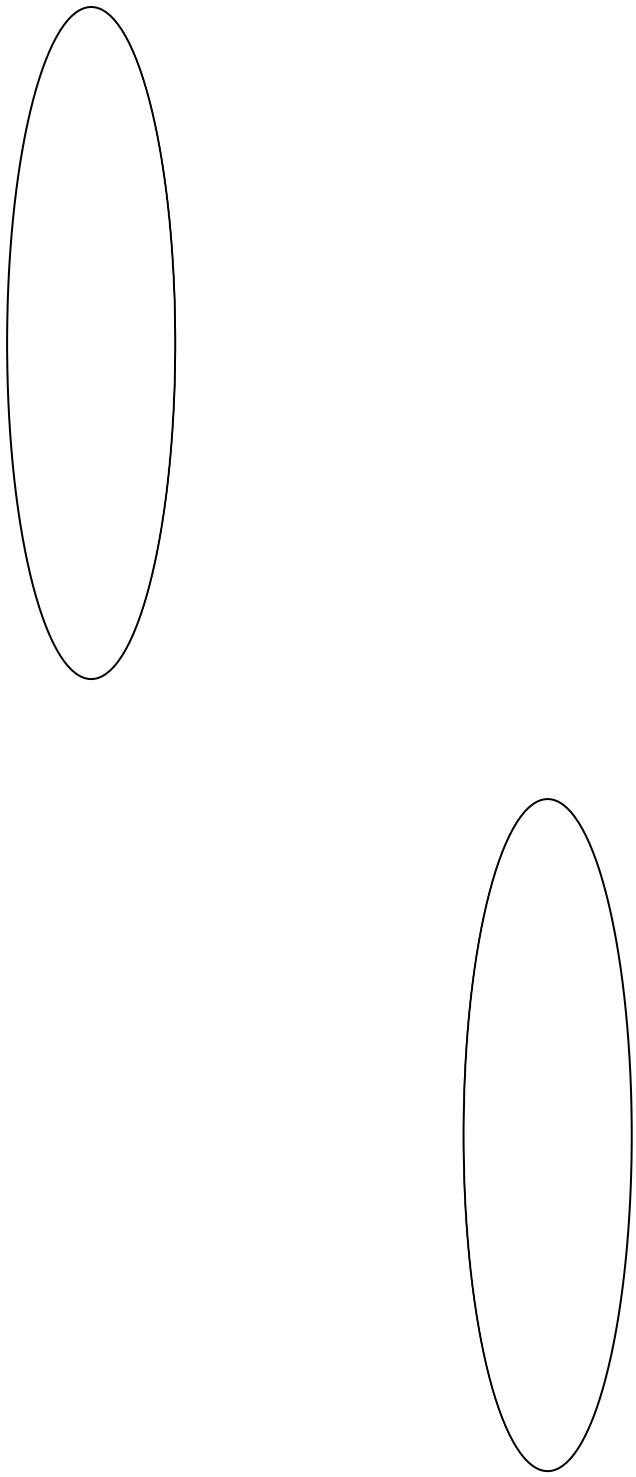


Figure E.2 Size of lateral-impact dummy (1)

Table 3 Major size of dummy unit: mm

Serial No.	Parameter	Size
1	Height of seat	904.0 ± 0.7
2	From seat to shoulder joints	557 ± 5
3	From seat to the lowest surface of rib	357 ± 5
4	From seat to the lowest surface of upper arm	242 ± 5
5	From seat to H point	98 ± 2
6	From base to seat (sitting gesture)	456 ± 5
7	From H point to centre of gravity of head	687 ± 5
8	From H point to upper rib centre	393 ± 3
9	From H point to central rib centre	337 ± 3
10	From H point to lower rib centre	281 ± 3
11	From H point to the centre of abdomen force sensor	180 ± 3
12	From H point to the centre of pelvis resultant sensor	14 ± 2
13	Width of head	154 ± 2
14	Width of shoulder/arm	482 ± 5
15	Width of chest	330 ± 5
16	Width of abdomen	290 ± 5
17	Width of pelvis	335 ± 5
18	Diameter of neck	80 ± 2
19	Thickness of head	201 ± 5
20	Thickness of chest	276 ± 5
21	Thickness of abdomen	204 ± 5
22	Thickness of pelvis	245 ± 5
23	From the back of hips to H point	157 ± 2
24	From the back of hips to front knees	610 ± 5

E.5 Demarcation of dummy

E.5.1 Impact side

E.5.1.1 According to the impact side of vehicle, the left hand side or the right hand side of the dummy is determined as the demarcation side.

E.5.1.2 The composition of the rib module (including the measurement instruments), abdomen force sensor and pelvis force sensor should be fixed according to the impact side.

E.5.2 Measurement instruments

All the measurement instruments should be demarcated according to the regulations in the User’s Handbook specified in E.1.3.

E.5.2.1 All the measurement passages should meet the requirements of ISO 6487-2000.

E.5.3 Appearance inspection

E.5.3.1 All the parts of the dummy should be inspected in order to determine if it has been damaged. If necessary, it should be replaced before the demarcation test.

E.5.4 Brief description of the testing device

E.5.4.1 Figure E.3 of this Appendix shows all the devices for the demarcation tests of the lateral-impact dummy .

E.5.4.2 The demarcation tests of the head, neck, chest and lumbar vertebra are carried out by using the decomposed parts of the dummy.

E.5.4.3 Use the complete dummy (without the coat on) to do the demarcation tests of the shoulders, abdomen and pelvis. In the tests, the dummy sits on a plane. Between the dummy and the plane, two polytetrafluoroethylene (PTFE) boards at the thickness of 2 mm or below each should be placed.

E.5.4.4 Before the tests, all the demarcation parts should be placed in an environment of 18 ~ 22 ^{o}C for at least 4 hours.

E.5.4.5 The interval between 2 repeated demarcation tests should be at least 30 minutes.

E.5.5 Head

E.5.5.1 The head falls from the height of 200 mm ± 1 mm on a rigid plane.

E.5.5.2 Between the impact surface and the central dividing surface of head should form 35 ± 1^{o} to cause impact to the upper side of the dummy’s head.

E.5.5.3 After the CFC1000 wave filtration, the peak value of synthetic acceleration should be at 100 g ~ 150 g.

E.5.5.4 The altered simulated muscle can be adopted. – By using the friction characteristics between the head bones, the head performance can be adjusted to meet the requirements (such as adding talcum powder or PTFE sprayer to make it lubricated).

E.5.6 Neck

E.5.6.1 The head-neck juncture of the neck is installed on a special demarcated head-shaped object with a mass of 3.9 kg ± 0.05 kg (please see Figure E.4).

E.5.6.2 Turn the head and neck upside down and fix them on the base of the neck's bending pendulum in order that it has lateral movement.

E.5.6.3 On the neck pendulum, a single-direction acceleration sensor is installed at a distance of 1655 mm ± 5 mm from the axis centre.

E.5.6.4 The neck pendulum should fall freely from a position at a certain height so that the acceleration sensor acquires an impact speed of 3.4 m/s ± 0.1 m/s.

E.5.6.5 Use suitable devices to reduce the impact speed of the neck pendulum's movement to zero, and make the curve of speed decrease-time lie in the boundary in Figure E.5 of this Appendix. All the measured values should be recorded after CFC 1000 wave filtration. The wave filtration grade of the figure of measured value is ISO CFC180. The wave filtration grade of the pendulum speed decrease is CFC60.

E.5.6.6 The maximum bending angle of the relative pendulum of head should be 51 ± 5 $^{\circ}$, and it should take place within the range of 50 ms ~ 62 ms.

E.5.6.7 The maximum forward inclination and backward inclination of the neck are 32.0 ± 2.0 $^{\circ}$ and 28.0 ± 2.0 $^{\circ}$ respectively. These maximum values should appear between 50 ms and 60 ms.

E.5.6.8 The neck performance can be adjusted by replacing the ring-shaped buffer part of different supporting hardness.

E.5.7 Shoulders

E.5.7.1 The length of the resin string should be adjusted, making it added to the place at 4 mm ± 1 mm outside the collarbone while the collarbone moves forward. The force in the same movement direction is 27.5 N ~ 32.5 N.

E.5.7.2 The dummy sitting on the rigid plane is not equipped with a seat rest, has its chest vertical, upper arms forward and legs horizontal, and forms 40 ± 2 $^{\circ}$ with the vertical direction.

E.5.7.3 The mass of pendulum is $23.5_{0}^{0.2}$kg. Its diameter is 152 mm ± 2 mm. Use 4 strings to hang it on the rigid supporting frame. The pendulum centre line should be at least 3.5 m below the supporting frame.

E.5.7.4 On the pendulum there should be acceleration sensor installed along its axis line. The measurement direction is the impact direction.

E.5.7.5 The pendulum should freely cause impact on the shoulders of the dummy at an impact speed of 4.3 m/s ± 0.1 m/s.

E.5.7.6 The impact direction is perpendicular to the forward-backward axis line of the dummy. The axis line of pendulum should meet the axis line of the dummy's upper arm turning axis.

E.5.7.7 After CFC180 wave filtration, the acceleration peak value of the pendulum should be at 7.5 g ~ 0.5 g.

E.5.8 Upper arm

E.5.8.1 Unregulated dynamic demarcation test of the upper arm

E.5.9 Chest

E.5.9.1 Each rib module is independently demarcated.

E.5.9.2 The rib module is perpendicularly installed on the falling test equipment. The rib cylinder grips on its top tightly.

E.5.9.3 The impactor is a free falling object. Its surface is a plane, with its mass $7.8_{0}^{+0.1}$kg and diameter 150 mm ± 2 mm.

E.5.9.4 The centre line of the impactor should be aiming at the centre line of the rib piston.

E.5.9.5 The impact speeds are 1.0 m/s, 2.0 m/s, 3.0 m/s and 4.0 m/s respectively. The difference between the impact speed and the regulated value should not exceed 2%.

E.5.9.6 The rib displacement should be measured, such as by using the rib sensor, etc.

E.5.9.7 The demarcation values of rib are shown in Table 4 of this Appendix.

Table 4 Demarcation requirements of rib

Impact Speed	Displacement	
	Minimum Value	Maximum Value
1.0	10.0	14.0
2.0	23.5	27.5
3.0	36.0	40.0
4.0	46.0	51.0

E.5.9.8 The springs of the twisting rods of different rigidities inside the rib module cylinder can be replaced to adjust the performance of the rib module.

E.5.10 Lumbar vertebra

E.5.10.1 The lumbar vertebra is installed on a special balanced head for demarcation. Its mass is 3.9 kg ± 0.05 kg (please see Figure E.4).

E.5.10.2 Turn the head and lumbar vertebra upside down and install them on the base of the neck's bending pendulum giving it horizontal movement.

E.5.10.3 On the neck pendulum, a single-direction acceleration sensor is installed at a distance of 1655 mm ± 5 mm from the axis centre.

E.5.10.4 The neck pendulum should be able to fall freely from a position at a certain height in order for the acceleration sensor to acquire an impact speed of 6.05 m/s ± 0.1 m/s.

E.5.10.5 Use a suitable device to reduce the impact speed of the neck pendulum to zero, and make the curve of speed decrease-time lie in the boundary in Figure E.6 of this Appendix. All the measured values should be recorded after CFC 1000 wave filtration. The wave filtration grade of the figure of measured value is ISO CFC180. The wave filtration grade of the pendulum speed decrease is CFC60.

E.5.10.6 The maximum bending angle of the relative pendulum of head should be $50 \pm 5\ ^{o}$, and happened within the range of 39 ms ~ 53 ms.

E.5.10.7 The maximum forward inclination and backward inclination of the neck are 33.0 ± 2.0^{o} and 29.0 ± 2.0^{o} respectively. These maximum values should appear between 45 ms and 55 ms.

E.5.10.8 The lumbar vertebra performance can be adjusted by changing the length of the vertebral bone.

E.5.11 Abdomen

E.5.11.1 The dummy sitting on the rigid plane has no seat rest, has its chest vertical, upper arms and legs horizontal.

E.5.11.2 The mass of pendulum is $23.5_0^{+0.2}$kg. Its diameter is 152 mm ± 2 mm.

E.5.11.3 On the pendulum there should be a horizontal "arm support" impact surface at 1.0 kg ± 0.01 kg. Its total mass is $24.5_0^{0.2}$ kg. This rigid arm support is at the height 70 mm ± 1 mm, width 150 mm ± 1 mm, and is available for entering the abdomen for above 60 mm. The centre line of pendulum should meet the centre line of the arm support.

E.5.11.4 On the pendulum there should be acceleration sensor installed along its axis line. The measurement direction is the impact direction.

E.5.11.5 The pendulum should freely cause impact on the abdomen of the dummy at an impact speed of 6.3 m/s ± 0.1 m/s.

E.5.11.6 The impact direction is perpendicular to the forward-backward axis line of the dummy. The axis line of pendulum should go through the centre of the central force sensor.

E.5.11.7 The speed decrease signal after CFC180 wave filtration is multiplied by the mass of the pendulum and arm support. The acquired peak value of force received by pendulum should be 9.5 kN ~ 11.1 kN, and take place within the range of 9.8 m/s ~ 11.4 m/s.

E.5.11.8 The force-time process is acquired by the synthesis of 3-direction sensors after CFC600 wave filtration. Its resultant peak value should be within the range of 5.9 kN ~ 7.9 kN.

E.5.12 Pelvis

E.5.12.1 The dummy sitting on the rigid plane has no seat rest, has its chest vertical, upper arms and legs horizontal.

E.5.12.2 The mass of pendulum is $23.5_0^{+0.2}$ kg. Its diameter is 152 mm ± 2 mm.

E.5.12.3 On the pendulum there should be an acceleration sensor installed along its axis line. The measurement direction is just the impact direction.

E.5.12.4 The pendulum should freely cause impact on the pelvis of the dummy at an impact speed of 4.3 m/s ± 0.1 m/s.

E.5.12.5 The impact direction is perpendicular to the forward-backward axis line of the dummy. The axis line of pendulum should form a straight line with the centre of the H point foam cylinder.

E.5.12.6 The speed decrease signal after CFC180 wave filtration is multiplied by the mass of pendulum. The acquired peak value of force received by pendulum should be 4.4 ~ 5.4 kN, and happened within the range of 10.3 m/s ~ 15.5 m/s.

E.5.12.7 The pelvis resultant after CFC180 wave filtration should be 10.4 ~ 1.64 kN, and take place within the range of 9.9 m/s ~ 15.9 m/s.

E.5.13 Legs

E.5.13.1 Unregulated dynamic demarcation procedures of legs.

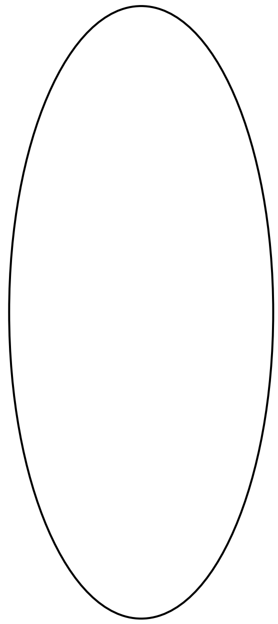


Figure E.3 Equipments for demarcation tests of the lateral-impact dummy

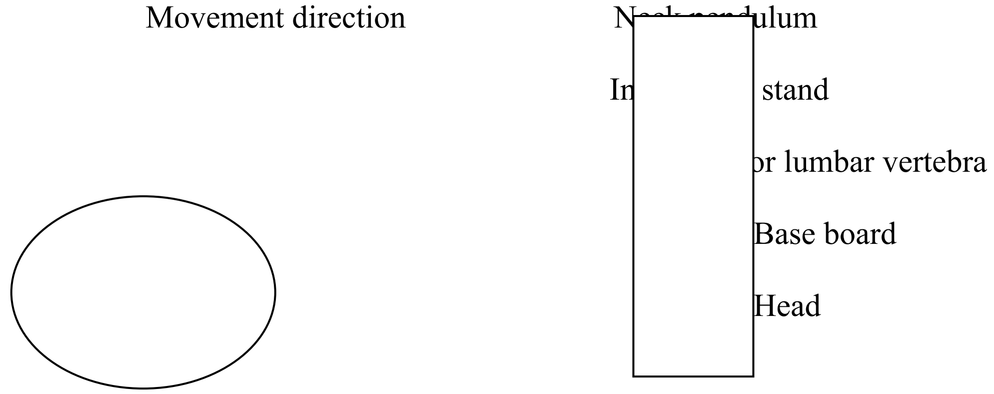


Figure E.4 Demarcation device of neck and lumbar vertebra

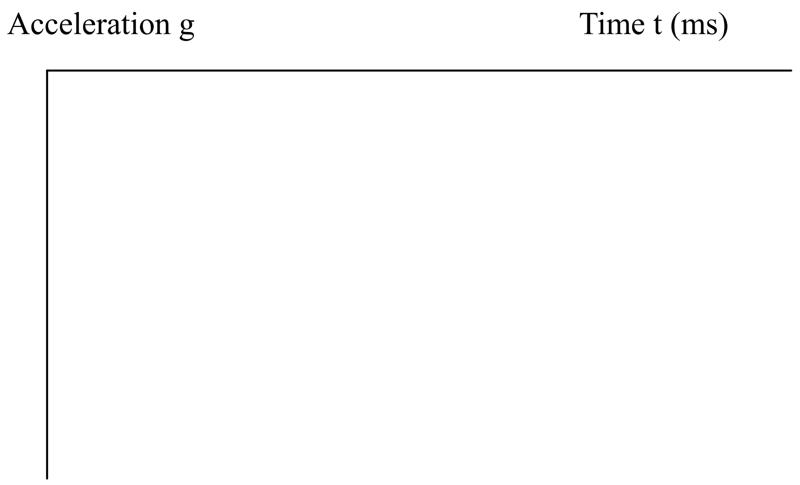


Figure E.5 Pendulum speed decrease-time boundary curves of neck demarcation test

Figure E.6 Pendulum speed decrease-time boundary curves of lumbar vertebral demarcation test

E.6 Placement of lateral-impact dummy

E.6.1 Adjust the leg joint, making it support the horizontally placed leg exactly (1~2 g).

E.6.2 The dummy should be dressed in tight cotton clothes stuffed with foam materials (short-sleeved, trousers length reaching the middle of the legs), with shoes on both feet.

E.6.3 According to the regulated procedures of lateral impact, the dummy is placed on the front-row outer side seat by the impact side.

E.6.4 The balanced central plane of the dummy and the seat have to meet each other at the vertical centre when they are in the regulated positions.

E.6.5 Position the dummy's pelvis correctly. Let the horizontal line going through the H point of dummy and ensure that is perpendicular to the perpendicular bisecting plane of the seat. The straight line going through the H point of dummy should be horizontal, and the error should not exceed $\pm 2^{o}$.

E.6.6 Bend the upper part of the trunk forward first, and then make it lean backwards on the seat. The shoulders of the dummy should be placed at the position furthest back.

E.6.7 The dummy's sitting gesture is not considered. An included angle 35 ± 1^{o} should be formed between the upper arm of each side of the dummy and the reference line of the arm on the trunk. The reference line of the arm on the trunk is defined as the intersecting line between the cutting plane of the front surface of the ribs and the vertical perpendicular plane of the dummy.

E.6.8 Regarding the driver seat, provided that the pelvis and trunk are not moved, the right foot of the dummy is placed on the accelerator pedal so that it is not being pressed down. The heel should be placed on the floor as forward as possible. The left foot is perpendicular to the leg. Its rear heel and the heel of the right foot are on the same horizontal line. The outer surface of the knee is 150 mm ± 10 mm from the balanced central plane of the dummy. When satisfying the above requirements, the thigh and the seat should be in contact.

E.6.9 As to the positions of other seats, provided that the pelvis and trunk are not moved, the heel of the dummy should be placed on the floor as forward as possible. However the compression on the seat cushion should not exceed the compression caused by the weight of thigh. The outer surface of the knee is 150 mm ± 10 mm from the balanced central plane of the dummy.

Appendix F
(Regulatory Appendix)
Technical Regulations and Placement procedures of Lateral-Impact Dummy (II)

F.1 Outline

F.1.1 The lateral-impact dummy regulated in this Appendix includes the detailed description and illustration of the demarcation and measurement equipments as shown in the User's Handbook of EuroSID Type II Lateral-Impact Dummy .

F.1.2 The size and mass of a lateral-impact dummy represents a lower-arm-free adult man of the 50^{th} percentile.

F.1.3 The lateral-impact dummy is composed of metallic and plastic frame covered by simulated muscle made of resin, plastic and foam.

F.2 Structure

F.2.1 The general description of EuroSID Type II lateral-impact dummy is specified in Figure F.1 and Table F.1 of this Appendix.

F.2.2 Head

F.2.2.1 The details of the head are specified in the part No. 1 in Figure F.1 of this Appendix.

F.2.2.2 The head is composed of an aluminium shell covered by a layer of plastic ethylene skin. Three-axial acceleration sensor and weight distribution object can be installed in the shell.

F.2.3 Neck

F.2.3.1 The details of the neck are specified in the part No. 2 in Figure F.1 of this Appendix.

F.2.3.2 The neck is composed of the head/neck juncture part, neck/chest juncture part and the central connecting part of the two juncture parts.

F.2.3.3 The head/neck juncture part (part No. 2a) and the neck/chest juncture part (part No. 2c) are composed of 2 aluminium discs connected by a screw with semi-spherical head and 8 resin buffer weights.

F.2.3.4 The central part (part No. 2b) of the cylinder is made of resin. Each of its two ends has a fixed whole aluminium disc.

F.2.3.5 The neck is installed on the neck frame. Please see the part No. 2d in Figure F.1 of this Appendix. The supporting frame of the neck can be replaced by the lower neck load sensor.

F.2.3.6 The two surfaces of the supporting frame of neck forms an angle of 25 ^{o}. Since the shoulder board has an inclination of 5 ^{o}, the neck and trunk forms an angle of 20 ^{o}.

F.2.4 Shoulders

F.2.4.1 The details of shoulders are specified in the part No. 3 in Figure F.1 of this Appendix.

F.2.4.2 A shoulder is composed of a shoulder board, 2 collarbones and a foam shoulder blade.

F.2.4.3 The shoulder board (part No. 3a) is composed of an aluminium-made spacer, an aluminium-made cover board and an aluminium-made base board. The aluminium-made board is covered by a PTFE coat.

F.2.4.4 The collarbone (3b) made of polypropylene is designed to evolve the aluminium-made board. It has two resin strings (part No. 3c) hooking backwards to the rear part of the shoulder board. The outer edges of the two collarbones should be able to accommodate the standardised upper arm.

F.2.4.5 The shoulder blade (part No. 3d) is made of low-density PU foam, and fixed on the shoulder board.

F.2.5 Chest

F.2.5.1 The details of the chest are specified in the part No. 4 in Figure F.1 of this Appendix.

F.2.5.2 The chest is composed of a rigid thoracic vertebra and 3 same rib modules.

F.2.5.3 The thoracic vertebral cavity (part No. 4a) is made of steel. A steel-made spacer PU resin vertebral back board (part No. 4b) is fixed on the rear surface.

F.2.5.4 The upper surface of the thoracic vertebral cavity inclines backwards at 5^{o}.

F.2.5.5 The T12 load sensor or any substitute (part No. 4j) is fixed on the lower part of the thoracic vertebra.

F.2.5.6 The rib module (part No. 4c) is composed of the steel-made rib (part No. 4d) covered by muscle-simulated PU foam, a linear-guided system assembly joining the rib and the thoracic vertebral cavity (part No. 4e), a hydraulic shock absorber (part No. 4f) and a rigid shock-absorbing spring component (part No. 4g).

F.2.5.7 The linear-guided system (part No. 4e) allows the measurement side of the rib (part No. 4d) as well as the relative thoracic cavity and non-measurement side to bend and deform. The guiding system is installed with linear needle bearing.

F.2.5.8 The spring of twisting rod is located inside the guiding system assembly (part No. 4h).

F.2.5.9 The rib displacement sensor (part No. 4i) is installed inside the thoracic cavity with guiding system (part No. 4e). It connects with the outer-side end of the guiding system at the measurement side of rib.

F.2.6 Upper arm

F.2.6.1 The details of the upper arm are specified in the part No. 5 in Figure F.1 of this Appendix.

F.2.6.2 The upper arm is composed of plastic bone covered by muscle-simulated PU and PVC skin. The muscle is composed of high-density PU material in the upper part and PU foam in the lower part.

F.2.6.3 Discontinued angles of 0 ^{o}, 40 ^{o} and 90 ^{o} are formed between the upper arm and trunk line at the shoulder/arm joint.

F.2.6.4 The shoulder/arm joint is only allowed to have bending/stretching rotational movements.

F.2.7 Lumbar vertebra

F.2.7.1 The details of the lumbar vertebra are specified in the part No. 6 in Figure F.1 of this Appendix.

F.2.7.2 The lumbar vertebra is composed of solid resin bowl body. The upper and lower surfaces of the bowl body are two steel boards with a steel wire inside.

F.2.8 Abdomen

F.2.8.1 The details of abdomen are specified in the part No. 7 in Figure F.1 of this Appendix.

F.2.8.2 The abdomen is composed of metallic casting (part No. 7a) covered by PU foam.

F.2.8.3 The central part of the abdomen is the metallic casting (part No. 7a) with a cover board installed at its top.

F.2.8.4 The covering object (part No. 7b) is made of PU foam. The foam on the two sides is connected by a bending resin weight stuffed with lead balls.

F.2.8.5 Between the foam covering object and rigid casting on each side, 3 force sensors (part No. 7c) and 3 non-measurement substitute parts can be installed.

F.2.9 Pelvis

F.2.9.1 The details of pelvis are specified in the part No. 8 in Figure F.1 of this Appendix.

F.2.9.2 The pelvis is composed of a sacrum, 2 bone wings, 2 arm joints and a foam skin.

F.2.9.3 The sacrum (part No. 8a) is composed of a metallic weight and a metallic board fixed on its top. The empty cavity by the rear side of the metallic weight can accommodate a measurement instrument.

Side view Front view

Front view Vertical view

Side view Vertical view

Front view

Front view

Figure F.1 Structure of lateral-impact dummy

F.2.9.4 The bone wing (part No. 8b) is made of PU.

F.2.9.5 The hip joint (part No. 8c) is made of steel. It is composed of upper thighbone and spherical joint. The spherical joint connects with the axis going through the H point of dummy. The outer extension and inner contraction abilities of the upper thighbone are alleviated by the resin weight, and stop at the top of the movement area.

F.2.9.6 The muscle-simulated system (part No. 8d) is composed of PU foam and PVC skin. At point H, the skin is replaced by a piece of PU foam (part No. 8e), which is installed on a steel board. An axle going through the spherical hinge fixes the steel board on the bone wing.

F.2.9.7 At the convergence of sacrum, the bone wings are linked together by force sensor (part No. 8f) or “dummy” sensor.

F.2.10 Leg

F.2.10.1 The details of leg are specified in the part No. 10 in Figure F.1 of this Appendix.

F.2.10.2 The leg is made by a metallic frame covered by the muscle-simulated PU foam and PVC skin.

F.2.10.3 The knee and ankle joints may have bending/stretching rotational movements.

F.2.11 Coat

F.2.11.1 The coat is not shown in Figure F.1 of this Appendix.

F.2.11.2 The coat is made of resin, covering the shoulders, chest, upper arms, abdomen, lumbar vertebra and upper pelvis.

Table 1 Components of the lateral-impact dummy

Part	Serial No.	Name	Quantity
1		Head	1
2		Neck	1
	2a	Head/neck juncture board	1
	2b	Central part	1
	2c	Neck/chest juncture board	1
	2d	Neck frame	1
3		Shoulder	1
	3a	Shoulder board	1
	3b	Collarbone	2
	3c	Resin string	2
	3d	Shoulder blade	1
4		Chest	1
	4a	Thoracic vertebra	1
	4b	Vertebral back board	1
	4c	Rib module	3
	4d	Muscle-covering rib	3
	4e	Piston module	3
	4f	Shock absorber	3
	4g	Shock-absorbing spring	3
	4h	Spring of twisting rod	3
	4i	Displacement sensor	3
	4j	T12 load sensor or substitute	1
5		Upper arm	2
6		Lumbar vertebra	1
7		Abdomen	1
	7a	Central casting	1
	7b	Muscle-simulated covering object	1
	7c	Force sensor	3
8		Pelvis	1
	8a	Sacrum	1
	8b	Bone wing	2
	8c	Hip joint	2
	8d	Muscle covering object	1
	8e	H point foam weight	2
	8f	Force sensor	1
9		Leg	2
10		Coat	1

F.3 Assembling of dummy

F.3.1 Head-neck

F.3.1.1 The screw with semi-spherical head for assembling the neck should be applied with 10 Nm torque.

F.3.1.2 The head and the load sensor of upper neck are fixed on the head-neck juncture board by 4 bolts.

F.3.1.3 The neck/chest juncture board is fixed on the neck frame by 4 bolts.

F.3.2 Neck-shoulders-chest

F.3.2.1 The neck frame is fixed on the shoulder board by 4 bolts.

F.3.2.2 The shoulder board is fixed on the surface of the thoracic vertebral cavity by 3 bolts.

F.3.3 Shoulder-arm

F.3.3.1 The upper arm is fixed on the collarbone by a bolt and bearing, and adjusted to 1g 2g.

F.3.4 Chest-lumbar vertebra-abdomen

F.3.4.1 The installation direction of the dummy's rib module should be according to the required preset of the impact side.

F.3.4.2 The lumbar vertebral joint is fixed by 2 bolts on the T12 load sensor or substitute at the lower part of the thoracic vertebra

F.3.4.3 The lumbar vertebral joint is fixed at the top board of lumbar vertebra by 4 bolts.

F.3.4.4 The convex edge on the central casting of abdomen is placed between the lumbar vertebral joint and lumbar vertebra.

F.3.4.5 The abdomen force sensor should be positioned according to the required preset of the impact side.

F.3.5 Lumbar vertebra-pelvis-leg

F.3.5.1 The lumbar vertebra is fixed on the lumbar vertebral base board by 3 bolts. If the lower lumbar vertebral load sensor is applied, it should be fixed by 4 screws.

F.3.5.2 The lumbar vertebral base board is fixed on the sacrum of pelvis by 3 bolts.

F.3.5.3 The leg is fixed on the upper thighbone-hip joint of the pelvis by a bolt.

F.3.5.4 Use the knee and ankle joints to assemble the leg and make adjustment to 1 g~2 g..

F.4 Major parameters

F.4.1 Mass

F.4.1.1 The mass of the major parts of the dummy is shown in Table 2 of this Appendix.

Table 2 Mass of the parts of dummy

Name of Part	Mass (kg)	Major Constituent Parts
Head	4.0 ± 0.2	Entire head, including 3-direction acceleration sensor and upper neck load sensor or substitute
Neck	1.0 ± 0.05	Neck (excluding neck frame)
Chest	22.4 ± 1.0	Neck frame, shoulders, upper arm connecting bolt, thoracic vertebral cavity, trunk back board, rib module, rib deformation sensor, T12 load sensor or substitute, lumbar vertebral joint, shoulder blade, central casting of abdomen, abdomen force sensor, ⅔ of coat
Arm (1)	1.3 ± 0.1	Upper arm (including the placed board of each part of arm)
Abdomen and Lumbar Vertebra	5.0 ± 0.25	Abdomen muscle covering object and lumbar vertebra
Pelvis	12.0 ± 0.6	Sacrum, lumbar vertebral base board, hip spherical joint, upper thighbone, bone wing, pelvis force sensor, pelvis muscle covering object, ⅓ of coat
Leg (1)	12.7 ± 0.6	Legs, hips and thighs and the muscle from each leg to the upper thighbone
Total	72.0 ± 1.2	

F.4.2 Major size

F.4.2.1 The major size of the lateral-impact dummy (including coat) is shown in Figure F.2 and Table 3 of this Appendix.

Figure F.2 Size of the lateral-impact dummy (I1)

Table 3 Major size of dummy unit: mm

Serial No.	Parameter	Size
1	Height of seat	909 ± 9
2	From seat to shoulder joints	565 ± 7
3	From seat to the lowest surface of thoracic vertebra	351 ± 5
4	From seat to H point	100 ± 3
5	From feet to seat (sitting gesture)	442 ± 9
6	Width of head	155 ± 3
7	Width of shoulder/arm	470 ± 9
8	Width of chest	327 ± 5
9	Width of abdomen	280 ± 7
10	Width of pelvis	366 ± 7
11	Thickness of head	201 ± 5
12	Thickness of chest	267 ± 5
13	Thickness of abdomen	199 ± 5
14	Thickness of pelvis	240 ± 5
15	From the back of hips to H point	155 ± 5
16	From the back of hips to front knees	606 ± 9

F.5 Demarcation of dummy

F.5.1 Impact side

F.5.1.1 According to the impact side of vehicle, the left hand side or the right hand side of the dummy is determined as the demarcation side.

F.5.1.2 The installation direction of the dummy’s rib module as well as the positioning of the abdomen force sensor and pelvis force sensor should be fixed according to the required preset of the impact side.

F.5.2 Measurement instruments

F.5.2.1 All the measurement instruments should be demarcated according to the regulations of F.1.3.

F.5.2.2 All the measurement passages should meet the requirements of data passage records regulated in ISO 6487-2000 or SAE J211 (March 1995).

F.5.2.3 The minimum quantity of measurement passages required in the Standards is 10 passages: 3 measurement passages for head acceleration, 3 measurement passages for thoracic rib displacement, 3 measurement passages for abdomen load, and 1 measurement passage for pubis synthetic load.

F.5.2.4 Besides, the recommended quantity of measurement passages to be adopted is 38 passages: 6 for upper neck load, 6 for lower neck load, 3 for collarbone load, 4 for trunk back board load, 3 for T1 acceleration, 3 for T12 acceleration, 6 for rib acceleration (2 for each rib), 4 for T12 vertebral load, 3 for lower lumbar vertebral load, 3 for pelvis acceleration and 6 for thigh load. In addition, there should be 4 position-indicating passages: 2 for thoracic rotation and 2 for pelvis rotation.

F.5.3 Appearance inspection

F.5.3.1 All the parts of dummy should be inspected to determine if it has been damaged. If necessary, it should be replaced before the demarcation test.

F.5.4 Brief description of the testing device

F.5.4.1 Figure F.3 of this Appendix shows all the devices for the demarcation tests of the lateral-impact dummy.

F.5.4.2 The test methods and test procedures of demarcation should be carried out according to the regulations of F.1.3.

F.5.4.3 The tests of the head, neck, chest and lumbar vertebra are carried out by using the decomposed parts of the dummy.

F.5.4.4 Use the complete dummy (without coat and shoes on) to do the tests of shoulders, abdomen and pelvis. In the tests, the dummy sits on a plane. Between the dummy and the plane, two PTFE boards at the thickness of no greater than 2 mm each should be placed.

F.5.4.5 Before the tests, all the demarcation parts should be placed in an environment at a temperature 18 ~ 22 ^{o}C and relative humidity 10% ~ 70% for at least 4 hours.

F.5.4.6 The interval between 2 repeated demarcation tests of the same part should be at least 30 minutes.

F.5.5 Head

F.5.5.1 The substitute of the upper neck load sensor should be included in the head assembly. It falls from the height of 200 mm ± 1 mm on a rigid plane.

F.5.5.2 Between the impact surface and the central dividing surface of head should form 35 ± 1^{o} to cause impact to the upper side of the dummy’s head. (It can be implemented by using the suspension method or the head-falling supporting frame with the mass 0.075 kg ± 0.005 kg.)

F.5.5.3 After the CFC1000 wave filtration according to ISO6487: 2000, the peak value of synthetic acceleration should be at 100g ~ 150g.

F.5.5.4 The altered simulated muscle can be adopted – By using the friction characteristics between the head bones, the head performance can be adjusted to meet the requirements (such as adding talcum powder or PTFE sprayer to make it lubricated).

F.5.6 Neck

F.5.6.1 The head-neck juncture of neck is installed on a special demarcated head-shaped object with the mass 3.9 kg ± 0.05 kg (please see Figure F.6). A connecting disc with the thickness 12 mm and mass 0.205 kg ± 0.05 kg is served as the auxiliary device.

F.5.6.2 Turn the head and neck upside down and install them on the base of the neck pendulum [the neck pendulum should be based on the American Code of Federal Regulation 49CFR 572.33 (10-1-00 version) Chapter V (please also see Figure F.5)], allowing it have lateral movement.

F.5.6.3 On the neck pendulum, a single-direction acceleration sensor (please see Figure F.5) is installed according to the description of pendulum.

F.5.6.4 The neck pendulum should be able to fall freely from a position at a certain height so as for the acceleration sensor to acquire an impact speed of 3.4 m/s ± 0.1 m/s.

F.5.6.5 Use suitable device [6-inch beehive aluminium (please see Figure F.5) is recommended] to reduce the impact speed of the neck pendulum to zero. As specified in the description of neck pendulum (please see Figure F.5), the curve of speed decrease-time is made to lie in the boundary in Figure F.7 and Table 4 of this Appendix. All the passage data should be recorded according to the description of passage records specified in ISO6487: 2000 or SAE J211 (March 1995). Numeral wave filtration should be done by using CFC 180 (ISO6487: 2000).

Table 4 Speed-time boundary of pendulum in neck demarcation test

Upper Limit		Lower Limit	
Time (ms)	Speed (m/s)	Time (ms)	Speed (m/s)
1.0	0.0	0	-0.05
3.0	-0.25	2.5	-0.375
14.0	-3.2	13.5	-3.7
		17.0	-3.7

F.5.6.6 The maximum bending angle (d $^{\theta}$A + d $^{\theta}$C angles in Figure F.6) of the relative pendulum of head should be 49.0^{o} ~ 59.0^{o}, and happened within the range of 54.0ms ~ 66.0ms.

F.5.6.7 The maximum displacement is measured through the d θ A angle and d θ C angle: The basic angle of front pendulum, d θ A should be between 32.0 ^{o} and 37.0 ^{o}, and happened within the range of 53.0 ms ~ 63.0 ms. The basic angle of rear pendulum, d θ B should be between 0.81 × 32.0^{o} + 1.75^{o} and 0.81 × 37.0^{o} + 4.25 ^{o}, and happened within the range of 54.0 ms ~ 64.0 ms.

F.5.6.8 The neck performance can be adjusted by replacing the ring-shaped buffer part of 8 different supporting hardness.

F.5.7 Shoulders

F.5.7.1 The length of the resin string should be adjusted, adding it o the place at 4 mm ± 1 mm outside the collarbone while the collarbone moves forward. The force in the same movement direction is 27.5 N ~ 32.5 N.

F.5.7.2 The dummy sitting on the rigid plane has no seat rest, has its chest vertical, upper arms forward and legs horizontal, and forms 40 ± 2 ^{o} with the vertical direction.

F.5.7.3 The impact device is the pendulum. The mass of pendulum is 23.4 kg ± 0.2 kg. Its diameter is 152.4 mm ± 0.25 mm. The diameter of its round angle is 12.7 mm [the pendulum should be based on the American Code of Federal Regulation 49CFR 572.36 (10-1-00 version) Chapter V (please also see Figure F.4)]. Use 4 strings, at the length of at least 3.5 m, going through the central line of impact device to connect it with the rigid hinge suspension (please see Figure F.4).

F.5.7.4 On the pendulum there should be an acceleration sensor installed along its axis line. The measurement direction is just the impact direction.

F.5.7.5 The pendulum should freely cause impact on the shoulders of the dummy at an impact speed of 4.3 m/s ± 0.1 m/s.

F.5.7.6 The impact direction is perpendicular to the forward-backward axis line of the dummy. The axis line of the pendulum should meet the axis line of the dummy's upper arm turning axis.

F.5.7.7 After ISO6487: 2000 CFC180 wave filtration, the acceleration peak value of pendulum should be at 7.5 g ~ 0.5 g.

F.5.8 Upper arm

F.5.8.1 Unregulated dynamic demarcation test of the upper arm

F.5.9 Chest

F.5.9.1 Each rib module is independently demarcated.

F.5.9.2 The rib module is perpendicularly installed on the falling test equipment. The rib cylinder grips on its top tightly.

F.5.9.3 The impactor is a free falling object. Its surface is a plane, with its mass 7.78 kg ± 0.01 kg and diameter 150 mm ± 2 mm.

F.5.9.4 The centre line of the impactor and the centre line of the rib guiding system should form a straight line.

F.5.9.5 The falling heights are 815 mm, 204 mm and 459 mm respectively. The relative impact speeds are 4.0 m/s, 2.0 m/s, and 3.0 m/s respectively. The accuracy of the falling height is 1 %.

F.5.9.6 The rib displacement should be measured by using the rib sensor.

F.5.9.7 The demarcation requirements of the ribs are shown in Table 5 of this Appendix.

Table 5 Demarcation requirements of rib

Serial No. of Test	Falling Speed	Displacement	
		Minimum Value	Maximum Value
1	815	46.0	51.0
2	204	23.5	27.5
3	459	36.0	40.0

F.5.9.8 The springs of the twisting rods of different rigidities inside the module cylinder can be replaced to adjust the performance of the rib module.

F.5.10 Lumbar vertebra

F.5.10.1 The lumbar vertebra is installed on a special balanced head for demarcation. Its mass is 3.9 kg ± 0.05 kg (please see Figure F.6). A connecting disc with the mass 0.205 kg ± 0.05 kg and thickness of 12 mm is served as the auxiliary device.

F.5.10.2 Turn the head and lumbar vertebra upside down and install them on the base of the neck pendulum [the neck pendulum should be based on the American Code of Federal Regulation 49CFR 572.33 (10-1-00 version) Chapter V (please also see Figure F.5)] to ensure horizontal movement.

F.5.10.3 According to the description of the pendulum, a single-direction acceleration sensor is installed on the neck pendulum.

F.5.10.4 The neck pendulum should fall freely from a position at a certain height so that the acceleration sensor measures an impact speed of 6.05 m/s ± 0.1 m/s.

F.5.10.5 Use suitable device [6-inch beehive aluminium (please see Figure F.5) is recommended] to reduce the impact speed of the neck pendulum to zero. As specified in the description of the neck pendulum (please see Figure F.5), the curve of speed decrease-time is made to lie in the boundary in Figure F.8 and Table 6 of this Appendix. All the passage data should be recorded according to the description of the passage records specified in ISO6487: 2000 or SAE J211 (March 1995). Numeral wave filtration should be done by using CFC 180 (ISO6487: 2000).

Table 6 Speed-time boundary of pendulum in lumbar vertebra demarcation test

Upper Limit		Lower Limit	
Time (ms)	Speed (m/s)	Time (ms)	Speed (m/s)
1.0	0.0	0	-0.05
3.7	-0.2397	2.7	-0.425
27.0	-5.8	24.5	-6.5
		30.0	-6.5

F.5.10.6 The maximum bending angle (d $^{\theta}$A angle + d $^{\theta}$C angle in Figure F.6) of the relative pendulum of head should be 50 ± 5^{o}, within the range of 39 ms ~ 53 ms.

F.5.10.7 The maximum displacement is measured through the d θ A angle and d θ B angle: The basic angle of the front pendulum, d θ A should be between 31.0 ^{o} and 35.0 ^{o}, within the range of 44.0 ms ~ 52.0 ms. The basic angle of the rear pendulum, d θ B should be between 0.8 × 31.0 ^{o} + 2.00 ^{o} and 0.8 × 35.0 ^{o} + 4.50 ^{o}, within the range of 44.0 ms ~ 52.0 ms.

F.5.10.8 The lumbar vertebra performance can be adjusted by changing the intensity degree of the steel wire in the vertebral bone.

F.5.11 Abdomen

F.5.11.1 The dummy, sitting on the horizontal rigid plane without seat-back support, should have the upper arms and legs in the horizontal position.

F.5.11.2 The impact device is the pendulum. The mass of the pendulum is 23.4kg ± 0.2kg. Its diameter is 152.4 mm ± 0.25 mm. The diameter of its round angle is 12.7 mm [the pendulum should be based on the American Code of Federal Regulation 49CFR 572.36 (a) (10-1-00 version) Chapter V (please also see Figure F.4)]. Use 8 strings, at the length of at least 3.5 m, going through the centre line of impact device to connect it with the rigid hinge suspension (please see Figure F.4).

F.5.11.3 On the pendulum there should be an acceleration sensor installed along its axis line. The measurement direction is the impact direction.

F.5.11.4 On the pendulum there should be a horizontal "arm support" impact surface at 1.0 kg ± 0.01 kg. The total mass of the pendulum installed with arms to support the impact surface is 24.4 kg ± 0.1 kg. This rigid arm support is at the height 70 mm ± 1 mm, width 150 mm ± 1 mm, and available for entering the abdomen for above 60 mm. The centre line of pendulum should meet the centre line of the arm support.

F.5.11.5 The pendulum should freely cause impact on the abdomen of the dummy at an impact speed of 4.0 m/s ± 0.1 m/s.

F.5.11.6 The impact direction is perpendicular to the forward-backward axis line of the dummy. The axis line of the pendulum should go through the centre of the central force sensor of the abdomen.

F.5.11.7 The speed decrease signal after ISO6487:2000 CFC180 wave filtration is multiplied by the mass of pendulum and arm support. The acquired peak value of the force received by the pendulum should be 4.0 kN ~ 4.8 kN, within the range of 10.6 m/s ~ 13.0 m/s.

F.5.11.8 The force-time process is acquired by the synthesis of 3 abdomen force sensors after ISO6487:2000 CFC600 wave filtration. Its resultant peak value should be within the range of 2.2 kN ~ 2.7 kN, within the range of 10.0 ms ~ 12.3 ms.

F.5.12 Pelvis

F.5.12.1 The dummy, sitting on the horizontal rigid plane without seat-rest support, has its upper arms and legs horizontally and its chest vertically placed.

F.5.12.2 The impact device is the pendulum. The mass of pendulum is 23.4 kg ± 0.2 kg. Its diameter is 152.4 mm ± 0.25 mm. The diameter of its round angle is 12.7 mm [the pendulum should be based on the American Code of Federal Regulation 49CFR 572.36 (a) (10-1-00 version) Chapter V (please also see Figure F.4)]. Use 8 strings, at the length of at least 3.5 m, going through the centre line of impact device to connect it with the rigid hinge suspension (please see Figure F.4).

F.5.12.3 On the pendulum there should be an acceleration sensor installed along its axis line. The measurement direction is just the impact direction.

F.5.12.4 The pendulum should freely cause impact on the pelvis of the dummy at an impact speed of 4.3 m/s ± 0.1 m/s.

F.5.12.5 The impact direction is perpendicular to the forward-backward axis line of the dummy. The axis line of the pendulum should form a straight line with the centre of the H point.

F.5.12.6 The speed decrease signal after ISO6487:2000 CFC180 wave filtration is multiplied by the mass of the pendulum. The acquired peak value of the force received by the pendulum should be 4.4 ~ 5.4 kN, within the range of 10.3 m/s ~ 15.5 m/s.

F.5.12.7 The pelvis resultant after ISO6487:2000 CFC180 wave filtration should be 10.4 ~ 1.64 kN, within the range of 9.9 m/s ~ 15.9 m/s.

F.5.13 Legs

F.5.13.1 Unregulated dynamic demarcation procedures of legs.

Figure F.3 General description of demarcation tests of later-impact dummy

Figure F.4 Suspension method of pendulum impact device at 23.4 kg

Left: 4-string suspension (cross lines removes) Right: 8-string suspension

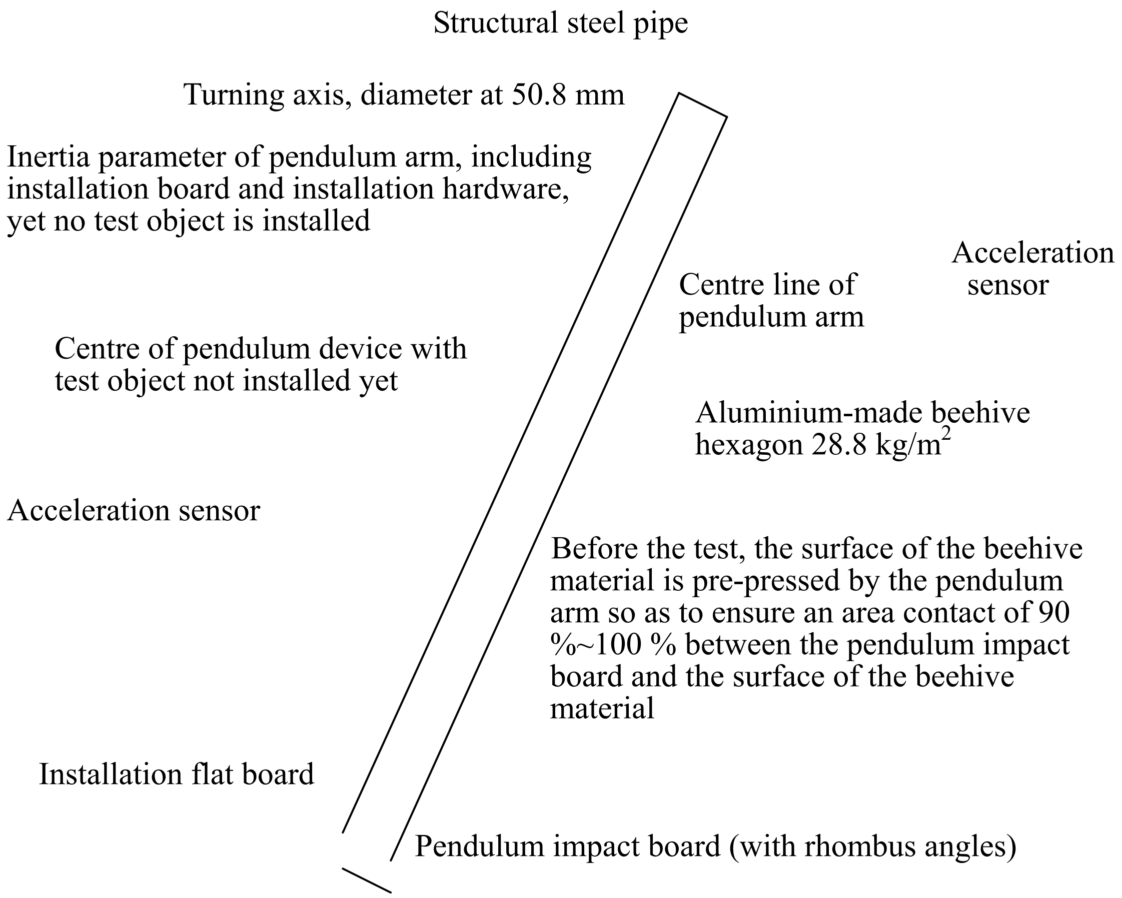


Figure F.5 Description of neck pendulum according to American Code of Federal Regulation 49CFR 572.33, Chapter V

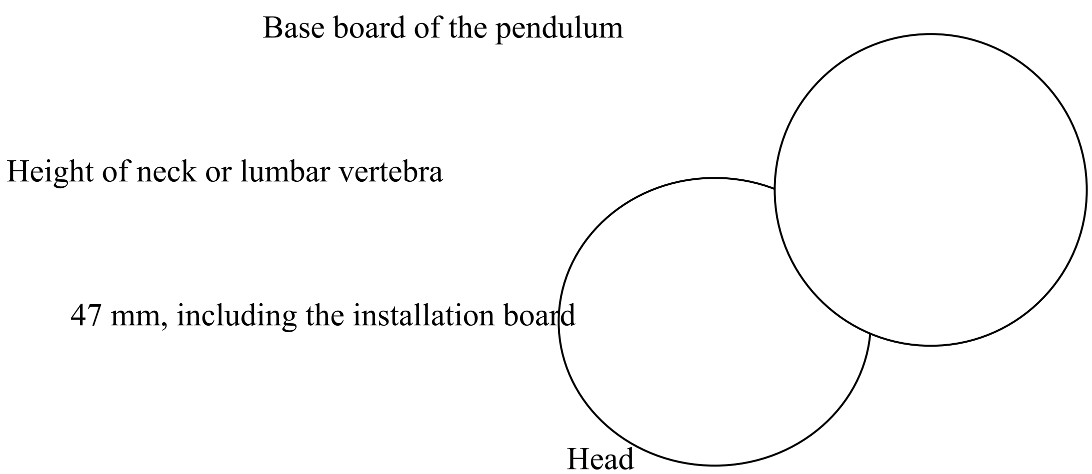


Figure F.6 Demarcation device of neck and lumbar vertebra (please see d θ A, d θ B and d θ C angles for head measurement)

Figure F.7 Pendulum speed-time boundary curves of neck demarcation test

Figure F.8 Pendulum speed -time boundary curves of

lumbar vertebral demarcation test

F.6 Placement of the lateral-impact dummy

F.6.1 Adjust the tightness and firmness of the linking bolt between the knee joint and ankle joint, making them exactly support the horizontally placed leg and foot (1~2 g).

F.6.2 Confirm the appropriate impact direction for the dummy.

F.6.3 Place the dummy in short-sleeved cotton clothes at the length reaching the middle of the legs.

F.6.4 Place shoes on both feet.

F.6.5 According to the regulated procedures of lateral impact, the dummy is placed on the front-row outer side seat by the impact side.

F.6.6 The balanced central plane of the dummy and the seat have to meet each other at the vertical centre when they are at the regulated positions.

F.6.7 Place the dummy's pelvis correctly. Let the horizontal line going through the H point of dummy and ensure that it is perpendicular to the perpendicular bisecting plane of the seat. The straight line going through the H point of dummy should be horizontal, and the error should not exceed $\pm 2^{o}$. (An inclination sensor can be installed in the chest and the pelvis of the dummy. This instrument can help acquire the needed position of placement.) Through the M3 hole inside the two lateral H-point back boards of the ES-2 dummy's pelvis, the pelvis position of the dummy and its relative position of the H point of the H-point device can be inspected. M3 hole is indicated by "Hm." The position of "Hm" should be within the circle at the radius 10 mm with H point as the centre of circle of the H-point device.

F.6.8 Bend the upper part of the trunk forward first, and then make it lean backwards on the seat. (Inclination sensor can be installed at the chest and pelvis of the dummy. This instrument can help acquire the needed position of placement.). The shoulders of the dummy should be placed at the position furthest back.

F.6.9 The dummy's sitting gesture is not considered. An included angle 35 ± 1^{o} should be formed between the upper arm of each side of the dummy and the reference line of the arm on the trunk. The reference line of the arm on the trunk is defined as the intersecting line between the cutting plane of the front surface of rib and the vertical perpendicular plane of the dummy.

F.6.10 Regarding the seat of driver, provided that the pelvis and trunk are not moved, the right foot of the dummy is placed on the accelerator pedal and does not press down. The heel should be placed on the floor as forward as possible. The left foot is perpendicular to the leg. Its rear heel and the heel of the right foot are on the same horizontal line. The outer surface of the knee is 150 mm ± 10 mm from the balanced central plane of the dummy. When satisfying the above requirements, the thigh and the seat should be kept contacting.

F.6.11 As to the positions of other seats, provided that the pelvis and trunk are not moved, the heel of the dummy should be placed on the floor as forward as possible. However the compression on the seat cushion should not exceed the compression caused by the weight of the thigh. The outer surface of the knee is 150 mm ± 10 mm from the balanced central plane of the dummy.

Appendix G
(Informative Appendix)

Comparison between Reference Nos. of Main Articles of the Standards and Reference Nos. of Articles of ECE R95

Ref. Nos. of Articles of the Standards	**Relative Ref. Nos. of Articles of ECE R95**
3	2
3.2	2.3
3.3	2.4
3.4	2.5
3.5	2.6
3.6	2.7
3.7	2.8
3.8	2.9
3.9	2.10
3.10	2.11
3.11	2.12
3.12	2.13
4.1	5.2
4.2	5.3
5	6
5.1	6.1
Appendix A	Appendix 3
Appendix B	Appendix 4
Appendix C	Supplement 3 of Standard 02 Series
Appendix D	Appendix 8
Appendix E	Appendices 6, 7
Appendix F	Standard 02 Series
Appendix G	-

Contents

Introduction

All the technical contents of the Standards are mandatory.

The Standards employ the legal regulations of ECE R95 (including Supplement of 01 Series, Supplement of 01 Series) “United Regulations for the Protection of Passengers in the Event of Lateral Impact of Vehicle” (English Version).

A comparison list between the Reference Nos. of part of the articles of the Standards with the Reference Nos. of articles of ECE R95 is shown in Appendix G.

The contents of Application for Certification, Certification Procedures and Certification Signs, Production Consistence and Production Non-Consistence in ECE R95 are deleted because of the difference in forms between the system of standards and the system of legal regulations.

For the sake of convenience in use, the following amendments have been made to the legal regulations of ECE R95:

a) “The legal regulations” are revised as “the Standards”:

b) An informative appendix, Appendix G, is added.

Appendix A, Appendix B, Appendix C, Appendix D, Appendix E and Appendix F are regulatory appendices, and Appendix G is an informative appendix.

The suggested implementation date of the Standards is:

a) For new vehicle types: To be implemented as from 1st July, 2006.

b) For production vehicle types: To be implemented after 36 months upon the promulgation.

c) It is suggested that the regulations regarding the materials and specifications of beehive aluminium weights in Appendix C of the Standards are to be officially implemented after 36 months upon the promulgation.

The Standards are proposed by National Development and Reform Commission.

The Standards are collated by National Automobile Standardisation Technical Committee.

Major drafting units of the Standards: Tsinghua University, Shanghai Motor Vehicles Inspection Centre, Volkswagen Shanghai, National Automobile Supervision and Test Centre (Xiangfan), Dongfeng Peugeot Citroen Automobile Co., Ltd., Guangzhou Honda Automobile Co., Ltd., Chery Automobile Co., Ltd., Chongqing

Changan Automobile (Group) Co., Ltd., Volkswagen Automobile (China) Investments Co., Ltd., Pan Asia Technical Automotive Centre, and National Heavy-Automobile Supervision and Test Centre

Major drafters of the Standards: Xiaojun Liu, Yang Wang, Yuguang Liu, Peng Bai, Zhendong Sun, Xichan Zhu, Wei Wu, Weijing Li, Jinhuan Zhang, Shilin Huang, Zudan Zheng, Zhenwei Bao, Hongpo Jia, Lishou Xiao, Sanhong Li, Yi Ling, Yiming Li, Shihai Ye, Fujun Lu, She Zheng, Hong Zhao, Xingye Feng, Fei Hou, Haidong Shen, Hao Sun, Xiaodong Zhu.