This is a translation to English for reference purpose of JNCAP test method which is originally prescribed in Japanese language.
Please be sure to refer to the Japanese test method if you need to be precisely correct.

OFFSET FRONTAL COLLISION SAFETY PERFORMANCE TEST PROCEDURE

Created: April 1, 2000
Revised: March 20, 2018
March 24, 2017

1. Effective Dates:

This testing method will go into effect on April 1, 2000. However, the changes made on March 20, 2018 will go into effect starting April 1, 2018.

2. Scope of Application:

This test procedure applies exclusively to the “Offset Frontal Collision Safety Performance Test” of passenger vehicles with 9 occupants or less and commercial vehicles with a gross vehicle mass of 2.8 tons or less conducted by the National Agency for Automotive Safety and Victims’ Aid (NASVA) in the information supply project of the new car assessment program. However, if the test rear seat is equipped with a type 1 seatbelt or no seatbelt, the evaluation shall not be conducted for rear occupants. In this case, the test may be conducted as stated previously, with the adult male 50 percentile dummy placed in the front passenger seat.

3. Definition of Terms

The terms in this testing method are defined as follows:

(1) **Deformable Barrier:** A deformable barrier attached to the front of a rigid block against which the test vehicle collides. (See Attachment 4).

(2) **Dummy:** Models simulating the human bodies of adult males and adult females to be placed in the test vehicle. In this test, Hybrid III dummies are used, which are specified in the US/CFR (Code of Federal Regulations), Title 49, Part 572, subpart E for a 50 percentile adult male and Title 49, Part 572, subpart O for a 5 percentile adult female.

(3) **HIC (Head Injury Criterion):** An index showing the degree of injury to the dummy’s head.

(4) **Chest Resultant Acceleration:** The resultant acceleration that occurs in the chest of the dummy at the time of collision.

(5) **Femur Load:** a load applied to parts of the dummy corresponding to the right and left femurs in the axial direction of the femurs at the time of collision.

(6) **NIC:** Neck Injury Criterion.

(7) **ThCC:** Thorax Compression Criterion.

(8) **TCFC:** Tibia Compressive Force Criterion.

(9) **TI:** Tibia Index.

(10) **Vehicle Width:** The horizontal measurement between the right and left outer sides of the vehicle parallel to the longitudinal plane of the vehicle. However, side-view mirrors, side marker lamps, tire pressure indicators, turn signals, position lamps, flexible mud guards, and the distorted part of tire side-walls directly above the part contacting the ground surface are excluded.

(11) **Overlap:** The width of the vehicle in the area facing the surface of the barrier.

(12) **Design Hip Point:** The base point of each seat, which is determined in accordance with the method specified in Attachment 2.

(13) **Hip Point:** The vehicle manufacturer specifies where the dummy's hip points are in the test vehicle.

(14) **Ilium Load:** A belt-restraining load applied on the right and left sides of the ilium on the pelvis of the dummy during the crash.

(15) **Lap belt riding up from the ilium on the pelvis:** The phenomenon in which the iliac spine on the pelvis is not properly restrained by the lap belt due to the belt riding up from the ilium on the dummy.

(16) **Type 1 Seatbelt:** A seatbelt intended to restrain a passenger on a seat concerned from moving forward; also called a lap belt.

4. Test Conditions

4.1 Condition of Test Vehicle

4.1.1 Provision of Data by Vehicle Manufacturer and Importer:

The vehicle manufacturer and importer shall provide NASVA with the following data necessary for preparing the test vehicle:

(1) Appendix 1

(2) Points to be specially checked during the preparations for the test. (Points to be checked for test preparations specific to the model concerned or, certain models including the model concerned.)

4.1.2 Mass of Test Vehicle

(1) The mass of the test vehicle shall be adjusted between 100% and 101% of the mass of the test vehicle when brought in*, including the mass of the measuring instruments (40 kg), with no dummy placed in the driver seat or rear seat (the front-most parallel seat behind the driver 's seat) adjacent to the side of the vehicle and on the same side as the front passenger seat (seat adjacent to the side of the vehicle among front seats parallel to the driver’s seat), called the rear test seat hereafter.

However, this shall not apply to cases where the mass of the test vehicle cannot be adjusted in this range even after removing parts which will not affect the test results. In the case of a vehicle equipped with a spare tire and tools, etc., the test may be conducted with these installed in the test vehicle.

*Mass of the test vehicle when brought in: Upon receiving the test vehicle, the testing institute shall fill all fluid containers to the maximum level of the specified range, and fill the fuel tank (see Appendix 1-3) to 100% capacity (for gasoline cars: fuel tank capacity x 0.745g/ml, for diesel cars: fuel tank capacity x 0.840g/ml) and then measure the mass of the test vehicle. This mass shall be regarded as the mass of the test vehicle when brought in. Furthermore, presuming that the loaded weight will be positioned on the upper equivalent of the fuel tank, the vehicle manufacturer may designate the loading position. These conditions are outlined in Appendix 1-3.

(2) If it is necessary to adjust the mass of the test vehicle in order to install measuring instruments, components that will not affect the test results may be removed.

[Examples of components that will not affect the test results]

Parts located to the rear of the anchorage point of the shoulder webbing for the rear test seat, such as rear bumper, rear window glass, trunk lid, muffler, and lights.

4.1.3 Vehicle Posture

The test vehicle with the dummies placed in the driver seat and the rear test seat shall have an inclination of ±3° relative to the vehicle manufacturer and importer specified values on the horizontal plane in the fore-and-aft direction and an inclination of ±1° relative to the horizontal plane in the lateral direction.

4.1.4 Test Vehicle Fluids

(1) Fluids such as oils may be drained.

(2) Battery electrolytes shall be drained (this does not apply to cases where the battery electrolytes will not leak at the time of collision such as cases where the battery is installed in the rear trunk). If the test vehicle is equipped with electrically controlled restraint devices such as air bags or seat belts with a pre-tensioner, a substitute power supply shall be provided in a location where the test results are not affected, as required, so that these restraint devices may function properly.

(3) The fuel tank shall be filled with a substitute fluid with a specific gravity similar to that of the fuel. The fuel tank shall be filled to 90% capacity or more.

4.1.5 Seat Adjustments

4.1.5.1 Front Seats:

The driver seat and front passenger seat (hereafter referred to as "front seats") shall be adjusted to the required positions defined in the following (1) to (5). Details for each adjusting device, including the composite type adjusting device, are shown in Exhibit 5.

(1) If the front seats are adjustable in the fore-and-aft direction by the seat rail, the seats shall be adjusted to the middle position in the fore-and-aft direction. However, if the seats cannot be adjusted to the middle position in the fore-and-aft direction, they shall be adjusted to the nearest adjustable position rearward from the middle position. However, if the dummy cannot be positioned properly and the designated hip point of the driver's seat or the front passenger seat satisfies the following formula (i.e., the coordinates (x_1, z_1) of the position of the designated hip point are to the left of the straight line A in the coordinate surface shown in Figure 1), the front seats may be adjusted until the dummy can be placed properly* so that the coordinates of the position of the hip point are located on the right of the straight line A on the coordinate surface shown in Figure 1 and as close to the straight line A as possible:

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

Where,

X is the horizontal distance between the designated hip point and a horizontal line which passes through the center of the accelerator pedal surface and is perpendicular to the longitudinal plane of the vehicle in the fore-and-aft direction (unit: mm).

Z is the distance between the hip point and a horizontal straight line, which passes through the center of the accelerator pedal surface and is parallel to the longitudinal plane of the vehicle in the vertical direction (unit: mm).

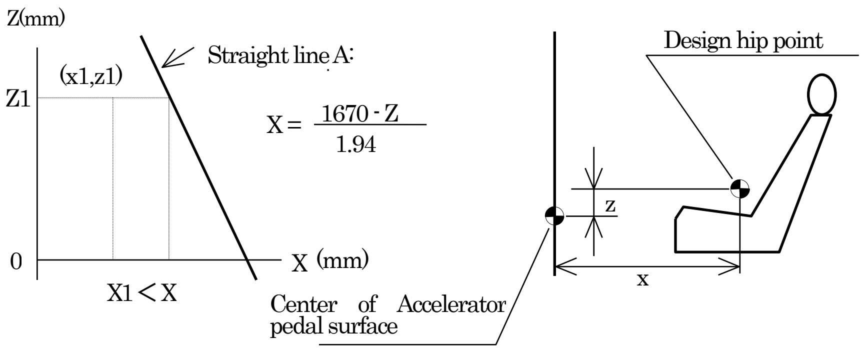

Figure 1

*"Until the dummy can be placed properly" means fitting the following requirements:

① The head angle is within the range of ±0.5° from the horizontal.

② The pelvis angle is within a range of 22.5° ± 2.5°.

③ The amount of depression of the accelerator pedal by the foot of the dummy is 20mm or less.

④ The distance between the thigh and the steering wheel is 20mm or more, and the distance between the thigh and the seat's surface is 30mm or less.

⑤ The distance between the lower leg and the instrument panel or the steering column cover is 10mm or more.

(2) The front seats shall be adjusted to the lowest position if they can be adjusted in the vertical direction (excluding those whose seat lower, seat cushion surface, and seatback angle change at the same time).

(3) If the seatback angle can be adjusted, it shall be adjusted to the design standard angle. If the lumbar support of the seatback can be adjusted, it shall be adjusted to the rearmost (fully retracted) position.

(4) If the head restraints of the front seats can be adjusted in the vertical direction, they shall be adjusted to the highest locking position in the vertical direction.

(5) If the front seats have adjustment mechanisms other than the abovementioned (1) through (4), the adjustment position or adjustment angle shall be adjusted to the design standard position or the design standard angle, respectively.

4.1.5.2 Rear Test Seats

(1) If the rear seats are adjustable in the fore-and-aft direction by the seat rail, the seats shall be adjusted to the design standard position. However, if the knees of the dummy on the rear test seat contact the seatback of the front seat, the seatback of the front seat shall be moved forward using the fore-and-aft

adjusting mechanism, and shall be re-adjusted to the proper position where the knees of the dummy do not contact the seatback of the front seat. The range of adjustment is shown below. In this case, other adjusting mechanisms shall not be used. If the front seat is moved forward using the fore-and-aft adjustment mechanism, this position shall be recorded in the record sheet.

① Manual operation: The first rearward notch position where the knees do not contact the seatback of the front seat.

② Electric operation: Keep the distance between the knees of the dummy and the seat back of the front seat to within 5mm.

(2) If the rear seat is adjustable in the vertical direction, the seat shall be adjusted to the design standard position.

(3) If the seatback angle of the rear seat is adjustable, it shall be adjusted to the design standard angle. If the seatback also has an adjustable lumbar support, this device shall be adjusted to the rearmost position.

(4) If the rear seat has an adjustable head restraint system in the up-and-down direction, the middle point of the head restraint itself shall be adjusted to the same height as the center of gravity of the dummy head. If the middle point of the head restraint cannot be adjusted to the same height as the center of gravity of the dummy head, it shall be adjusted to the nearest position below the center of gravity of the dummy head.

(5) If the rear seat has adjustment mechanisms other than the devices mentioned in (1) through (4), these devices shall be adjusted to the design standard position or angle.

4.1.6 Adjusting the Steering System

(1) If the steering system can be adjusted in the vertical direction, it shall be adjusted to the geometric center of the adjustment range. However, if the steering system cannot be adjusted to the center, it shall be adjusted to the nearest adjustable position below the center.

(2) If the steering system can be adjusted in the fore-and-aft direction, it shall be adjusted to the geometric center of the adjustment range. If the steering system cannot be adjusted to the center, it shall be adjusted to the nearest adjustable position rearward from the center.

4.1.7 Adjustment of Anchorage for the Seat Belt Shoulder Webbing

If the position of the anchorage for the seat belt shoulder webbing can be adjusted, it shall be adjusted to the design standard position.

4.1.8 Other Vehicle Conditions

4.1.8.1 Ignition

The engine of the test vehicle shall be in the stalled state. However, the ignition switch shall be in the ON position.

If the test vehicle is equipped with electrically controlled restraint devices such as air bags or seat belts with a pre-tensioner, the proper function of the devices shall be confirmed by warning lamps, etc. when the ignition switch is turned to the on position. Furthermore, the test institute will consult with the vehicle manufacturer, and the electric power supply to the motor may be disconnected if the test vehicle has a mechanism such that this action does not influence the abovementioned devices.

4.1.8.2 Side Windows and Doors

The side windows of the test vehicle (excluding the windows rearward from the rear test seat) shall be opened if it is possible.

The doors shall be closed securely, but shall not be locked.

Additionally, if the test vehicle is equipped with a vehicle-speed-sensitive or vehicle-speed- and engine-speed-sensitive door locking system and when it’s arming and disarming methods are described in the owner’s manual and the driver can operate it easily without using a tool, etc., the system shall be in the disarmed state.

4.1.8.3 Roof

If the roof is removable, the roof shall be installed.

If the roof is a sunroof, the sunroof shall be closed.

If the vehicle is a convertible, the top shall be closed.

4.1.8.4 Drive Axle, Transmission, and Parking Brake

If the drive axle can be selected, the standard drive axle shall be selected.

The transmission shall be in neutral.

The parking brake shall be released.

4.1.8.5 Tires

The air pressure of the tires shall meet the requirements of the specification sheet.

4.1.8.6 Other

(1) Installation of Stroboscope, etc.

The test vehicle shall be equipped with a stroboscope, etc. for identifying the moment of collision in photographs taken using a high-speed photography device. However, this provision shall not apply to cases where the stroboscope, etc. is installed in ground facilities within the visual field of the high-speed photography device.

(2) Remodeling the Test Vehicle

The structure and devices of the test vehicle forward from the rear test seat shall not be remodeled. However, such prohibitions do not apply to remodeling necessary for towing the test vehicle, installation of the stroboscope used to identify the moment of collision, installation of the on-board camera used to photograph the movement of the rear test seat dummy, and attachment of instruments for measuring the speed of the test vehicle, insofar as the test results are not affected.

When remodeling is necessary for towing the test vehicle, the hook, lower suspension arms, stabilizers, tension rods, front cross member, and floor cross member may be remodeled.

(3) Attaching Target Marks

In order to grasp the state of deformation in the test, marks (hereafter referred to as "target marks") shall be attached to the test vehicle at points that are not deformed during the test.

When attaching the target marks, the positions of each target mark and intervals between the target marks shall be recorded in the data sheet (dimensions shall be recorded using the key holes and the side sill of the vehicle as a reference).

(4) Coloring of Compartment Interior Trim

The interior trim of the compartment shall be colored using colors other than liquid chalk colors, etc.

applied to the dummy so that the position at which the dummy collides with the interior trim can be easily identified.

(5) Adjusting Vehicle Height

The test vehicle shall be in the normal running attitude prescribed in Paragraph 4.1.2. If the vehicle has a mechanism for adjusting the height depending on the vehicle speed, the height of the vehicle shall be adjusted to the height specified by the vehicle manufacturer when traveling at 64km/h.

(6) Crash Position Confirmed Line

In order to confirm the location of the collision of the test vehicle against the edge of the barrier, a line shall be drawn on the front of the test vehicle in the area where the horizontal distance from the longitudinal plane of the vehicle to the driver's seat is 10% of the vehicle width.

4.1.9 Dummy and Seatbelt

4.1.9.1 Dummy Placement

The dummies shall be placed in the test vehicle under the conditions prescribed in Paragraphs 4.1.5 through 4.1.7 according to Attachment 1-1 for the driver dummy and Attachment 1-2 for the rear test seat dummy. The positions of the seats may be adjusted or parts such as the steering wheel, etc. may be removed, as required, in order to position the dummy in accordance with the provision. After the dummy has been placed in the specified position properly, the positions of the seats shall be returned to the condition prescribed in Paragraphs 4.1.5 through 4.1.7 and the removed parts shall be reinstalled in the original positions.

The seat positions that may be adjusted as prescribed in the above proviso are the seat position in the vertical direction, seatback angle, and lumbar support position of the seatback, installation angle of the lower seat, position of the head restraint in the vertical direction and in the fore-and-aft direction, and axial direction and angle of the steering column. The parts that may be removed are the covers of the devices for adjusting the positions and angles of the seats (seat positions in the vertical direction, angle of the seatback, lumbar support position of the seatback, and installation angle of the lower seat), head restraints, steering wheel, doors, tops of convertible vehicles, and removable roof.

4.1.9.2 Fastening the Seatbelt

After placing the dummies in the seats of the test vehicle, the seat belts shall be fastened in their design standard position, and they shall be tightened thoroughly. However, if the seatbelt is equipped with a device for eliminating the feeling of compression when the wearer fastens the seatbelt, the design standard slack shall be provided at the webbing for the shoulder.

For AM 50 percentile dummies, this means that the belt does not completely cover the dummy's adjustment hole on the chest. If the seatbelt completely covers the adjustment hole when the seatbelt is placed properly, pull the belt horizontally from the dummy's center 4 times so that the dummy's chest region will settle naturally. After these actions, ① a witness confirms that the belt is not covering the dummy's chest adjustment hole, and the dummy's position is set. If the seatbelt conditions in ① cannot be confirmed, the belt shall be adjusted again to the design standard position so that the adjustment hole is not completely covered. Additionally, if after 4 adjustment repeats, the seatbelt is still completely covering the adjustment hole, place the seatbelt back to the design standard position and move the belt to a position where it will not completely cover the adjustment hole.

For AF 5 percentile dummies, the center of the belt shall be placed between the breasts. If the belt will not fit there, reset it to the design standard position and confirm with a witness.

4.1.9.3 Measuring the Seatbelt Extension Length

The extension length of the seatbelts at the time of the test shall be measured for the driver's seat and the rear test seat, respectively.

If the seatbelt has a pre-tensioner, the amount of retraction of the seat belt shall also be measured. However, if measurement is not possible, this may be omitted.

A simple measuring method using a string can be found in Appendix 2.

4.1.9.4 Dummy Temperature Conditions

The dummy shall be left in a room at a temperature of 20–23°C for at least four hours just before conducting the test to stabilize the temperature of the dummy. Furthermore, operations such as placement of the dummy may be carried out during this time. If there are justifiable reasons such as for making preparations for conducting the test, the dummy may be removed from the room maintained at the above temperature for a maximum cumulative duration of 10 minutes. If the dummies are placed in the test vehicle, the temperature measuring point shall be at the height of the shoulders of the dummies placed in the driver's seat and the rear test seat. In other cases, the temperature measuring point shall be at a height equivalent to that of the shoulders of the dummies.

4.1.9.5 The Dummy's Coloring

To evaluate the secondary collision of the driver dummy head and the rear test seat dummy head with the knees of the dummies and the contact of the rear test seat dummy with the front seatback, paint such as liquid chalk shall be applied to the face and head of the dummies. This paint may also be applied to other parts of the dummy than the head and knees as well as interior components of the test vehicle such as the instrument panel or steering wheel. (The steering angle should be more than 32°)

Areas not covered in the information above cannot be applied. The rear test dummy's head shall be colored as shown in Figure 2.

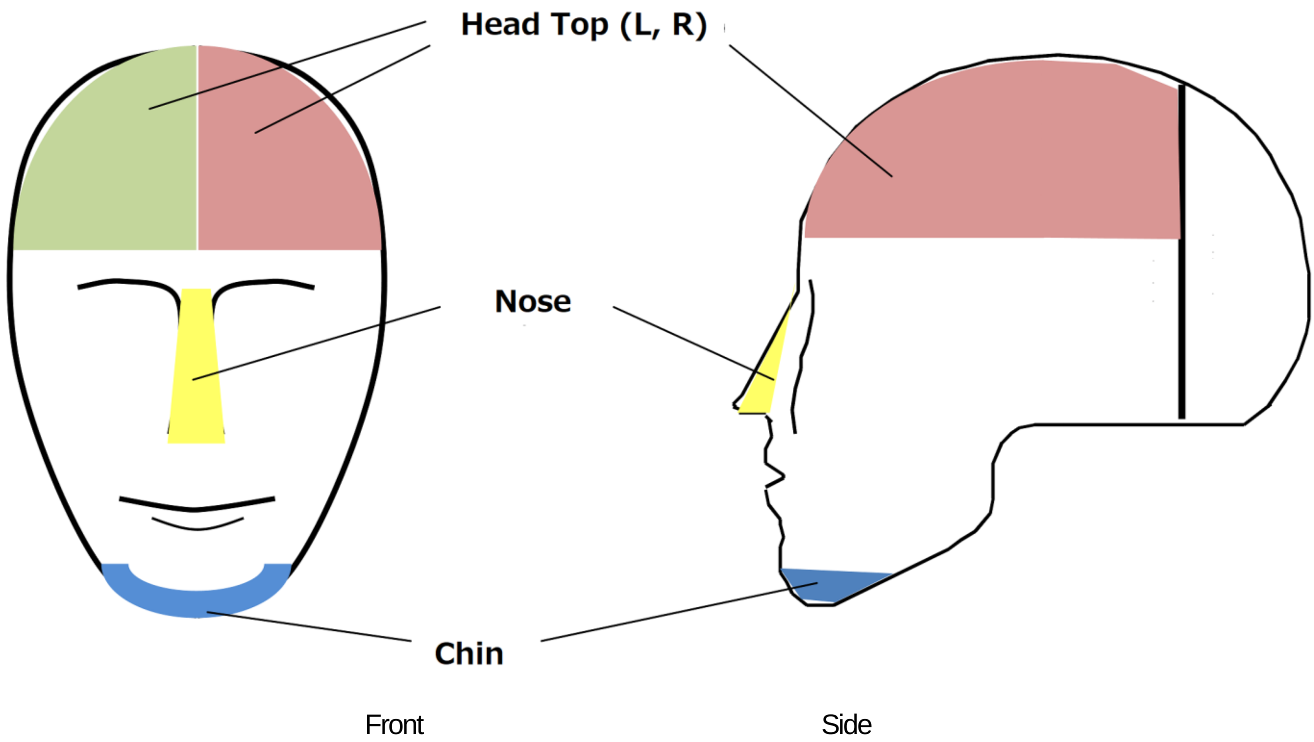

Figure 2: Sample Rear Test Dummy Coloring

4.1.10 Installation of Electric Measuring Instruments

4.1.10.1 Installation of Accelerometers

Accelerometers shall be installed at the following points in the test vehicle to measure acceleration during the collision. However, if it is difficult to install accelerometers at the specified position, the test institute may change the installation position at its discretion.

(1) Tunnel: 3-axes (fore-and-aft direction, lateral direction, and vertical direction)

(2) Inside of side sill to the left of the vehicle: Single-axis (fore-and-aft direction)

(3) Inside of side sill to the right of the vehicle: Single-axis (fore-and-aft direction)

The positions of the accelerometers shall be recorded in Appendix 3.

4.1.10.2 Installation of Measuring Instruments

(1) The measuring instruments shall be firmly secured to the inside of the test vehicle at locations where they are not affected by deformation caused by the collision test. However, if the instruments cannot be installed in the vehicle due to lack of space, they shall be installed in the space outside of the vehicle in the locations recommended by the vehicle manufacturer.

(2) The wiring connecting a transducer (apparatus which transforms a physical amount to be measured into electrical signals) and the measuring instruments secured in the test vehicle shall have an adequate margin so that the movement of the dummy is not affected in the collision test.

4.1.11 Installing the Onboard Camera

An onboard camera meeting the following requirements shall be installed in the test vehicle and shall take photographs of the movement of the rear test seat dummy during the crash.

(1) The main part of the onboard camera and the battery shall be firmly secured to the floor close to the front passenger seat or the trunk compartment of the test vehicle recommended by the vehicle manufacturer. However, if the mentioned areas do not have enough space, the vehicle manufacturer shall provide a proper fixing method and supply the attachments.

(2) The micro camera head separated from the main body shall be firmly secured to the roof aft of the driver seat.

(3) The wire connecting to the micro camera head from its main body shall have sufficient length so as not to affect the movement of the dummy during the collision.

(4) If necessary, an onboard lighting device shall be installed.

4.2 Testing Facility, etc.

4.2.1 Deformable Barrier

The deformable barrier is defined in Attachment 4. The structure on which the deformable barrier is installed shall be capable of measuring the impact load at the time of collision.

4.2.2 Runway

The runway shall be a flat, horizontal, dry road surface.

4.2.3 Towing Device

The towing device shall be capable of causing a vehicle with a mass of 2.8 tons or less to collide perpendicularly against the front face of the barrier at a coasting speed of 64.0 ± 1km/h.

4.2.4 Lighting Device

The lighting device shall be capable of emitting sufficient light for high-speed photography without causing halation. If this device is installed inside the test vehicle, it shall be firmly secured to the body of the test vehicle in a location which does not affect the dummy's movement or performance of the device.

4.2.5 High-Speed Photography Device

The photographing speed of the high-speed photography device shall be set at 500 frames/second or more. Additionally, the time interval between reference time signals (timing pulse) shall be 10ms or less.

The camera may be equipped with polarizing filters to reduce unnecessary light.

4.2.6 Speed Measuring Device

The speed measuring device shall be capable of measuring the time required for the test vehicle to pass through the speed measuring zone in units of 0.1ms or less.

Furthermore, when converting the time into the speed (km/h) of the test vehicle, the speed-measuring device shall indicate the speed to the first decimal place.

The speed-measuring device shall be installed so as to be able to measure the speed of the test vehicle when it is traveling within 2m from the collision point.

4.2.7 Temperature and Humidity Measuring Device

The temperature and humidity of the dummy before conducting the test prescribed in Paragraph 4.1.9.4 and the temperature and humidity at the time of dummy verification shall be recorded at intervals of one minute or less using an automatic recorder. The minimum graduations of the thermometer shall be 0.1°C, and the minimum graduations of the hygrometer (relative hygrometer) shall be 1%.

4.2.8 Electric Measuring Device

The measuring device shall comply with the requirements of ISO 6487:2002*[1] under the condition in which all the devices between the constituent devices and the output devices (including a computer for analysis) are connected (the measuring device under this condition is referred to as “measurement channel”).

(1) The measurement channel shall measure acceleration, load, moment, and displacement according to the following channel classes.

① For collision tests, the channel classes are as follows:

(a) Head acceleration shall be 1,000.

(b) Neck load shall be 1,000.

(c) Neck moment shall be 600.

(d) Chest acceleration shall be 180.

(e) Chest displacement of the AM 50 percentile dummy shall be 180, and for the AF 5 percentile dummy, 600.

(f) Pelvis acceleration shall be 1,000.

(g) Femur load shall be 600.

(h) Knee displacement (AM 50 percentile dummy only) shall be 180.

(i) Tibia load (AM 50 percentile dummy only) shall be 600.

(j) Tibia moment (AM 50 percentile dummy only) shall be 600.

(k) Ilium load (AF 5 percentile dummy only) shall be 180.

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*[1] ISO 6487:2000 is considered as the same requirement

(l) Ilium moment (AF 5 percentile dummy only) shall be 1,000.

(m) Side sill acceleration shall be 60.

(n) Tunnel acceleration shall be 60.

(o) Barrier load shall be 60.

② For dummy verification, channel classes shall be as follows in addition to the provisions of ① above.

(a) Neck pendulum acceleration shall be 60 for AM 50 percentile dummies, and 180 for AF 5 percentile dummies.

(b) Displacement of the neck rotation detector shall be 60.

(c) Acceleration of the chest impactor shall be 180.

(d) Acceleration of the knee impactor shall be 600.

(e) Acceleration of the lower leg impactor (AM 50 percentile dummies only) shall be 600.

③ Acceleration used for calculating velocity shall be 180 even though regulated in ①.

(2) When converting analog values into digital values in the measurement channel, the number of samples per second shall be 8,000 or more in the collision test. When verifying dummies, the number of samples shall be at least 8 times as many as the channel classes specified in ②.

(3) The HIC shall be calculated with the sampling time (time intervals of data sampling conducted according to the abovementioned provision) set to the minimum time interval. The range of this calculation shall be between the collision and 200ms after the collision.

(4) Deletion (filtering) of the high-frequency components in accordance with the channel classes shall be performed before calculating the head resultant acceleration, chest resultant acceleration, HIC, etc.

4.2.9 Accelerometer, Load Meter, Moment Meter and Dummy

4.2.9.1 Accelerometers, Load Meters, and Moment Meter Used in the Test

The measurement ranges of the accelerometers, load meters and moment meter used in the collision test shall be as follows:

(1) The measurement range of the accelerometer to be installed in the head of the dummy shall be -1,960m/s^2 (-200 G) to +1,960m/s^2 (+200 G).

(2) The measurement range of the load meter to be installed in the neck of the dummy shall be -890daN (-907kgf) to +890daN (+907kgf).

(3) The measurement range of the moment meter to be installed in the neck of the dummy shall be -285Nm (-29kgfm) to +285Nm (+29kgfm).

(4) The measurement range of the accelerometer to be installed in the chest of the dummy shall be -980m/s^2 (-100G) to +980m/s^2 (+100G).

(5) The measurement range of the load meter to be installed in the ilium of the dummy shall be -890daN (-907kgf) to +890daN (+907kgf).

(6) The measurement range of the load meter to be installed in the knee of the dummy shall be 0 to 1,960daN (2,000kgf).

(7) The measurement range of the accelerometer to be installed in the side sill shall be -1,960m/s^2 (-200G) to +1,960m/s^2 (+200G).

(8) The measurement range of the accelerometer to be installed in the tunnel shall be -1,960m/s^2 (-200G) to +1,960m/s^2 (+200G).

4.2.9.2 The Dummy

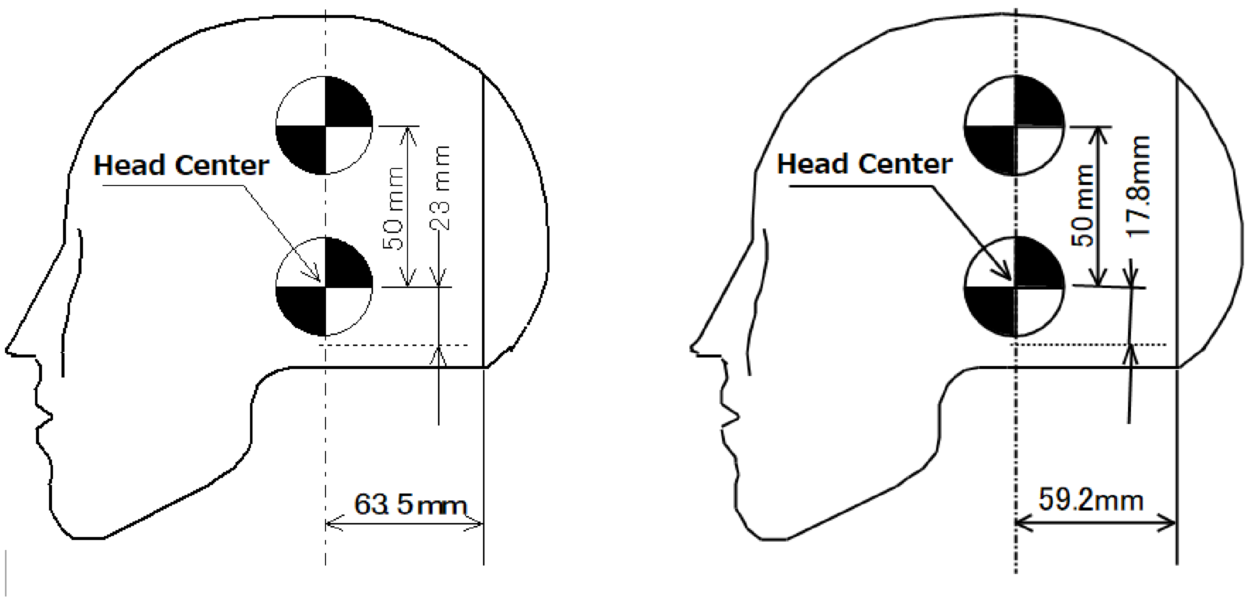
(1) The dummy in the driver's seat shall be a Hybrid III 50 percentile adult male dummy prescribed in US/CFR (Code of Federal Regulations) Title 49, Part 572, subpart E. The dummy in the rear test seat shall be a Hybrid III 5 percentile adult female dummy prescribed in CFR Title 49, Part 572, subpart O.

(2) The characteristics of each part of the dummy in the driver's seat shall conform to the verifications according to Attachment 3-1, and the characteristics of each part of the dummy in the rear test seat shall conform to the verifications according to Attachment 3-2.If adjustment of the shoes is required in the verification of the shoed feet, innersoles may be used.

(3) A neck shield shall be attached to the neck of the dummy. The feet of the dummy in the driver's seat shall be wearing shoes that conform to the MIL-S-13192P (Amendment 1) specification for shape, size and weight, which shall be 0.57 ± 0.1kg with size of 11XW. The dummy in the rear test seat shall be wearing shoes that conform to the MIL-S-21711E specification for shape, size and weight, which shall be 0.41 ± 0.09kg with size of 7 1/2E. The dummies may be clothed in cotton shirts with short sleeves (or sleeveless) and short pants.

(4) The limb joints of the dummy shall be adjusted so as to be able to support the weight of the limbs extended horizontally.

(5) In order to confirm the movement of the dummy during the collision test, the target marks shall be attached to the dummy's head at points where the movement of the dummy can be photographed using the camera during the test. Figure 3 shows a reference example.



Driver's Seat Dummy

Rear test seat Dummy

Figure 3

4.2.9.3 Recording Electronic Results on a Recording Medium

The measurement results of acceleration and load shall be recorded on a recording medium with a channel class of 1,000 or more.

4.2.10 3-D Measuring Device

The accuracy of the three-dimensional measuring device used to measure the dimensions of the test vehicle, seating position of the dummy, and routing of the seatbelts shall be 0.5mm/m or less.

5. Testing Method

The front of the test vehicle traveling at 64.0 ± 1km/h shall be caused to collide perpendicularly against the front face of the barrier in the area 40% ± 20mm of the vehicle width from the side of the driver's seat. The traction acceleration of the device towing the test vehicle shall be $4.9m/s^2$ {0.5 G} or less.

6. Recording and Measuring Items

6.1 Recording Prior to Test

6.1.1 Check and Recording of Received Vehicle for Test

After receiving a vehicle for the test, the test institute shall check the following items and record the results in Appendix 4. At the same time, the test institute must make sure that the received vehicle complies with the vehicle specifications provided by NASVA.

(1) Name/model/classification

(2) Frame number

(3) Body shape

(4) Engine model

(5) Drive system

(6) Transmission type

(7) Type of steering system (steering wheel, steering column, presence or absence of adjustment mechanism)

(8) Type of seatbelt, retractor, and anchorage (the driver's seat and the rear test seat)

(9) Presence of absence of airbags (front or rear)

(10) Type of seat (the driver's seat and the rear test seat, presence or absence of adjustment mechanism)

(11) Presence or absence of air conditioner

(12) Presence or absence of power steering

(13) Presence or absence of vehicle speed sensing door lock system

(14) Presence or absence of ABS/traction control device

(15) Presence or absence of sunroof

(16) Presence or absence of footrests

6.1.2 Recording of Verification Results for Dummy and Deformable Barrier

(1) The test institute shall record the verification results for the dummy and the deformable barrier before the test. The verification results for the deformable barrier may be replaced by the performance results of the manufacturer.

(2) The dummy shall be re-verified after conducting the test three times. However, if the injury criterion reaches or exceeds the acceptable limit (e.g. HIC1000), the part of the dummy concerned shall be

re-verified. If a component of the dummy is damaged, the component concerned shall be replaced by a verified component.

6.1.3 Recording of Measuring Instrument Calibration Results

(1) The calibration results of the measuring instruments (each measurement channel including transducer) conducted before the test shall be recorded. The valid period for the measuring instrument calibration shall be one year. The measuring instruments may be used during that period. However, if any abnormalities, etc. are found in the measuring instruments, the measuring instruments shall be re-calibrated at that time.

(2) To determine whether or not the injury criteria are calculated correctly, verifications shall be made using a calibration signal generation device (waveform generator).

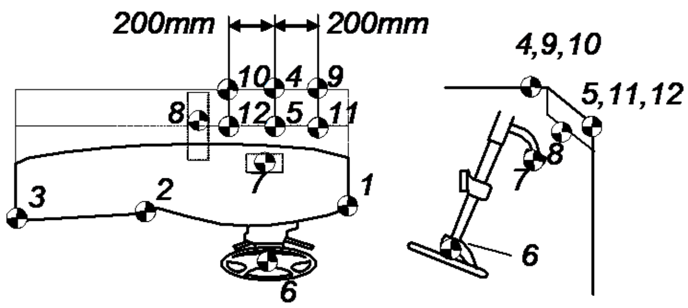
6.1.4 Recording of Measurement Results for Vehicle Dimensions Prior to the Test

Of the positions of the parts of the vehicle given below, compartment No. 6 and door and its surroundings No. 7 shall be measured and recorded using the three-dimensional measuring device before conducting the test. Parts that will not be affected by the collision shall be selected as reference points for measuring the vehicle dimensions. Other parts can be determined by the manufacturer.

(1) Measuring points in compartment (ex.)

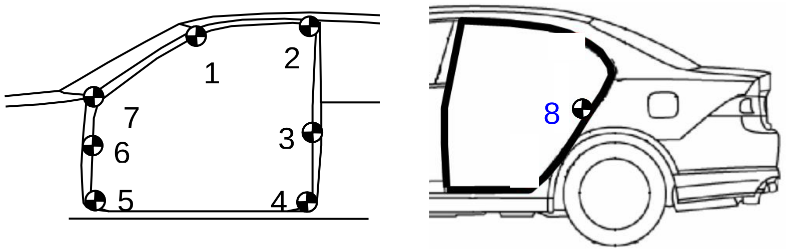
Note: The lateral position of locations No. 4 and 5 shall be the center of the brake pedal.

Part No.	Measuring Point	Part No.	Measuring Point
1	Instrument panel, right	7	Brake pedal
2	Instrument panel, center	8	Footrest
3	Instrument panel, left	9	Driver side toe board A
4	Driver side toe board	10	Driver side toe board B
5	Driver side floor	11	Driver side floor A
6	Steering column end	12	Driver side floor B



(2) Measuring points around the doors (example)

Part No.	Measuring Point
1	Pillar A , upper
2	Pillar B, upper
3	Striker bolt (fr. door)
4	Pillar B, lower
5	Pillar A, lower
6	Pillar A, mid.
7	Pillar A, root
8	Striker bolt (rr. door)



6.1.5 Recording the Measurement Results for Seating Position of Dummy

The seating position of the dummy placed in the vehicle according to Paragraph 4.1.9.1 and the routing position of the seatbelt fastened according to Paragraph 4.1.9.2 shall be measured and recorded according to Paragraph 12-1 of Appendix 1. Additionally, the positioning of the seatbelts shall be photographed.

6.1.6 Recording the Final Vehicle Conditions Prior to Test

After preparing the test vehicle according to the protocol described in Paragraph 4, the following items shall be checked and recorded:

(1) Test vehicle mass

(2) Names and masses of parts removed, and mass after adjustment

(3) Inclination of the test vehicle (fore-and-aft direction and lateral direction)

(4) Adjusted position of the seat (driver’s seat and rear test seat)

(5) Adjusted position of the steering system

(6) Adjusted position of the seatbelt anchorage

(7) Positions of accelerometers in each part of the vehicle body

(8) Positions of target marks attached to the vehicle body

(9) Reference positions for measurement of vehicle dimensions

(10) Position of the collision line (40% of vehicle width) of the test vehicle

6.1.7 Recording the Dummy's Temperature

(1) The start time and the finish time of the dummy soak and the temperatures at those times shall be recorded.

(2) The cumulative time during which the temperature conditions specified in Paragraph 4.1.9.4 could not be maintained shall be recorded.

6.2 Recording During the Test

6.2.1 Recording the Collision Speed and Deviation of Collision Position

The speed of the test vehicle just before the test vehicle collides against the barrier shall be measured and recorded. The overlap amount of the test vehicle with the barrier at the time of collision shall be measured and recorded.

Furthermore, the term "just before the test vehicle collides" shall mean within 2m of the barrier, and the test vehicle shall be coasting.

6.2.2 Recording Electric Measurement Results for Each Part of Dummy, Vehicle Body, etc.

The electric measurement results for the accelerometers, load meters, displacement meters and moment meters, which are installed at each part of the dummy and vehicle body, and load meters in the structure to which the barrier is attached shall be recorded for the period of time from 20ms before the collision to 200ms or more after the collision.

(1) Acceleration of the head of the dummy in the driver’s seat in the fore-and-aft direction
(2) Acceleration of the head of the dummy in the driver’s seat in the lateral direction
(3) Acceleration of the head of the dummy in the driver’s seat in the vertical direction
(4) Load applied to the neck of the dummy in the driver’s seat in the fore-and-aft direction
(5) Load applied to the neck of the dummy in the driver’s seat in the lateral direction
(6) Load applied to the neck of the dummy in the driver’s seat in the vertical direction
(7) Moment of the neck of the dummy in the driver’s seat in the fore-and-aft direction
(8) Moment of the neck of the dummy in the driver’s seat in the lateral direction
(9) Moment of the neck of the dummy in the driver’s seat in the vertical direction
(10) Acceleration of the chest of the dummy in the driver’s seat in the fore-and-aft direction
(11) Acceleration of the chest of the dummy in the driver’s seat in the lateral direction
(12) Acceleration of the chest of the dummy in the driver’s seat in the vertical direction
(13) Displacement of the chest of the dummy in the driver’s seat
(14) Load applied to the right femur of the dummy in the driver’s seat
(15) Load applied to the left femur of the dummy in the driver’s seat
(16) Displacement of the right knee of the dummy in the driver’s seat
(17) Displacement of the left knee of the dummy in the driver’s seat
(18) Load applied to the upper right tibia of the dummy in the driver’s seat in the vertical direction
(19) Moment of the upper right tibia of the dummy in the driver’s seat in the fore-and-aft direction
(20) Moment of the upper right tibia of the dummy in the driver’s seat in the lateral direction
(21) Load applied to the lower right tibia of the dummy in the driver’s seat in the vertical direction
(22) Moment of the lower right tibia of the dummy in the driver’s seat in the fore-and-aft direction
(23) Moment of the lower right tibia of the dummy in the driver’s seat in the lateral direction
(24) Load applied to the upper left tibia of the dummy in the driver’s seat in the vertical direction
(25) Moment of the upper left tibia of the dummy in the driver’s seat in the fore-and-aft direction
(26) Moment of the upper left tibia of the dummy in the driver’s seat in the lateral direction
(27) Load applied to the lower left tibia of the dummy in the driver’s seat in the vertical direction
(28) Moment of the lower left tibia of the dummy in the driver’s seat in the fore-and-aft direction
(29) Moment of the lower left tibia of the dummy in the driver’s seat in the lateral direction
(30) Acceleration of the head of the dummy in the rear test seat in the fore-and-aft direction
(31) Acceleration of the head of the dummy in the rear test seat in the lateral direction
(32) Acceleration of the head of the dummy in the rear test seat in the vertical direction
(33) Load applied to the neck of the dummy in the rear test seat in the fore-and-aft direction
(34) Load of the neck of the dummy in the rear test seat in the lateral direction
(35) Load applied to the neck of the dummy in the rear test seat in the vertical direction
(36) Moment of the neck of the dummy in the rear test seat in the fore-and-aft direction

(37) Moment of the neck of the dummy in the rear test seat in the lateral direction

(38) Moment of the neck of the dummy in the rear test seat in the vertical direction

(39) Acceleration of the chest of the dummy in the rear test seat in the fore-and-aft direction

(40) Acceleration of the chest of the dummy in the rear test seat in the lateral direction

(41) Acceleration of the chest of the dummy in the rear test seat in the vertical direction

(42) Displacement of the chest of the dummy in the rear test seat

(43) Load applied to the right femur of the dummy in the rear test seat

(44) Load applied to the left femur of the dummy in the rear test seat

(45) Load applied to the right ilium of the dummy in the rear test seat in the fore-and-aft direction

(46) Moment of the right ilium of the dummy in the rear test seat in the fore-and-aft direction

(47) Load applied to the left ilium of the dummy in the rear test seat in the fore-and-aft direction

(48) Moment of the left ilium of the dummy in the rear test seat in the fore-and-aft direction

(49) Acceleration applied to the pelvis of the dummy in the rear test seat in the fore-and-aft direction

(50) Acceleration applied to the pelvis of the dummy in the rear test seat in the vertical direction

(51) Acceleration of the right side sill in the fore-and-aft direction

(52) Acceleration of the left side sill in the fore-and-aft direction

(53) Acceleration of the tunnel in the fore-and-aft direction

(54) Acceleration of the tunnel in the lateral direction

(55) Acceleration of the tunnel in the vertical direction

(56) Barrier impact load

6.2.3 Recording the Injury Criteria

The injury criteria for the dummy shall be calculated from the waveform obtained in Paragraph 6.2.2 according to the following method and shall be recorded.

6.2.3.1 Recording Injury Criteria for the Driver Dummy

(1) HIC (Head Injury Criterion)

The maximum value among the values calculated by the following formula shall be determined using the head resultant acceleration of the dummy.

$$HIC = \left[\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{a_R}{9.8} dt \right]^{2.5} (t_2 - t_1)$$

Where,

a_R represents resultant acceleration (m/s^2) of head accelerations in the fore-and-aft direction, in the lateral direction, and in the vertical direction (a_X, a_Y, a_Z)

$$a_R = \sqrt{a_X{}^2 + a_Y{}^2 + a_Z{}^2}$$

t_1 and t_2 represent arbitrary points in time during the collision (unit: s)

provided that $|t_2 - t_1| \leq 0.036$s

For a sharp waveform which can be perceived as having been generated by the occurrence of a secondary collision of the head with the knee in the dummy head resultant acceleration waveform diagram and which has a section in which the positive value of the change rate of the resultant acceleration is 196m/s^2/ms or more and the negative value is -196m/s^2/ms or less, this index shall be calculated by deleting the section exceeding the acceleration when the change rate first exceeds 196m/s^2/ms at a point near the secondary collision start time or the acceleration when the change rate finally drops below -196m/s^2/ms at a point near the secondary collision finish time in the waveform concerned, whichever is the greater. The specific deletion procedure is given below.

① Confirm that the secondary collision has taken place, either by adhesion to the knee of paint such as liquid chalk applied to the dummy before the test, or by the images produced by high-speed photography.

② In the dummy head resultant acceleration waveform diagram, confirm that those portions where the positive value of the change rate of the resultant acceleration is 196m/s^2/ms or more and the negative value of the change rate of the resultant acceleration is -196m/s^2/ms or less are included in the waveform which can be perceived as having been caused by the occurrence of the secondary collision.

③ The deletion of the resultant acceleration shall be carried out, using the deletion procedure described below, only when the secondary collision has been confirmed according to the provision of ① and the head resultant acceleration caused by the collision concerned has complied with the provision of ②.

(a) Using the data of the head resultant acceleration, produce numeric output values of the time, the resultant accelerations, and the change rate of the resultant accelerations from a point near the secondary collision start time to a point near the secondary collision finish time.

(b) Concerning the produced numeric output values, compare the acceleration in which the change rate of the resultant acceleration exceeds 196m/s^2/ms at the earliest time against the acceleration in which the change rate of the resultant acceleration drops below -196m/s^2/ms at the latest time. The greater acceleration shall be the "acceleration to be deleted."

(c) For those accelerations from when the change rate of the resultant acceleration first exceeds 196m/s^2/ms to when the change rate of the resultant acceleration finally drops below -196m/s^2/ms, determine whether there is any acceleration that is greater than the aforementioned "acceleration to be deleted." Only such accelerations shall be replaced by the value of the "acceleration to be deleted."

(2) NIC: Neck Injury Criterion

- NIC is determined by the compressive force in the axial direction where the neck and the head of the dummy are connected, tension in the axial direction, fore-and-aft shear strength, and the period of time (ms) for which these forces continue.
- The bending moment criterion for the neck is determined by the bending moment (Nm) around the horizontal axis where the neck and the head of the dummy are connected.
- The maximum value of the neck flexion bending moment (Nm).

(3) Chest Injury Criterion

- The maximum value of the resultant acceleration of the chest of the dummy during the cumulative time of 3ms.

・The maximum value of the compressed side displacement of the ribs of the dummy (ThCC: Thorax Compression Criterion).

(4) Femur Injury Criterion

The maximum value of the compressive load applied to the right and left thighs of the dummy.

(5) TCFC: Tibia Compressive Force Criterion

The maximum value of the compressive load (kN) transmitted in the direction of each tibia.

(6) TI: Tibia Index

The maximum value calculated according to the flexion moment measured in the tibia and the axial load. Recorded examples of the electric measurement results measured and calculated in Paragraphs 6.2.2 and 6.2.3 are shown in Appendix 5.

6.2.3.2 Recording of injury criteria for the rear test seat dummy

(1) HIC: Head Injury Criterion

The HIC shall be calculated only in the case where the dummy head comes into a secondary collision with the front seat, B-pillar, etc. during forward motion of the dummy.

The maximum value among the values calculated by the following formula shall be determined using the head resultant acceleration of the dummy:

$$HIC = \left[\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{a_R}{9.8} dt \right]^{2.5} (t_2 - t_1)$$

Where,

a_R represents resultant acceleration (m/s^2) of the head in the fore-and-aft direction, lateral direction, and vertical direction (a_X, a_Y, a_Z)

$$a_R = \sqrt{a_X^{\ 2} + a_Y^{\ 2} + a_Z^{\ 2}}$$

t_1 and t_2 represent arbitrary points in time during the collision (unit: s)

provided that $|t_2 - t_1| \leq 0.015$ s.

If the waveforms of the secondary collision of the head contain those from a collision with another part of the dummy itself, such as the head hitting the knee or the chin hitting the chest, this index shall be calculated by deleting such waveforms if they can be separated from the waveforms of the head hitting interior parts of the test vehicle. However, if all the confirmation items in ① below show that there is definitely no contact, or if the load confirmed in ② below does not exceed 500N, then it shall be judged that no secondary collision of the head occurred (Figure 4).

① Confirm that the secondary collision has taken place, either by adhesion of paint such as liquid chalk applied to the dummy head before the test on interior parts of the test vehicle, or by the images produced by high-speed photography with the onboard-camera.

② If a secondary collision has been confirmed according to the provision of ①, confirm that the calculated head contact force exceeded 500N by following the SAE J2052 calculation procedure.

③ The resultant acceleration shall be deleted as described below only when the secondary collision has been confirmed according to the provision of ① and the head contact load caused by the collision concerned has complied with the provision of ②.

(a) Based on an analysis of the high-speed film, identify the time span in which the dummy came into secondary collisions with its own body.

(b) Based on the head contact force data, if the force data shows that the force between the peak of the pulse produced by the dummy head contacting another body part of the dummy and the peak of the pulse produced by the head contacting interior parts of the test vehicle was less than 200N, the pulse produced by the head contacting another body part of the dummy shall be deleted from the calculation time span (Figure 5).

(c) Based on the head contact force data, if the force data shows that the force between the peak of the pulse produced by the dummy head contacting another body part of the dummy and the peak of the pulse produced by the head contacting interior parts of the test vehicle was within 200–500N, the calculation time span of the head contact shall be one half of the time span where both pulses cross the points of 500N (Figure 6).

(d) Based on the head contact force data, if the force data shows that the force between the peak of the pulse produced by the dummy head contacting another body part of the dummy and the peak of the pulse produced by the head contacting interior parts of test vehicle exceeded 500N, the time span shall include the entire head contact time during the crash (Figure 7).

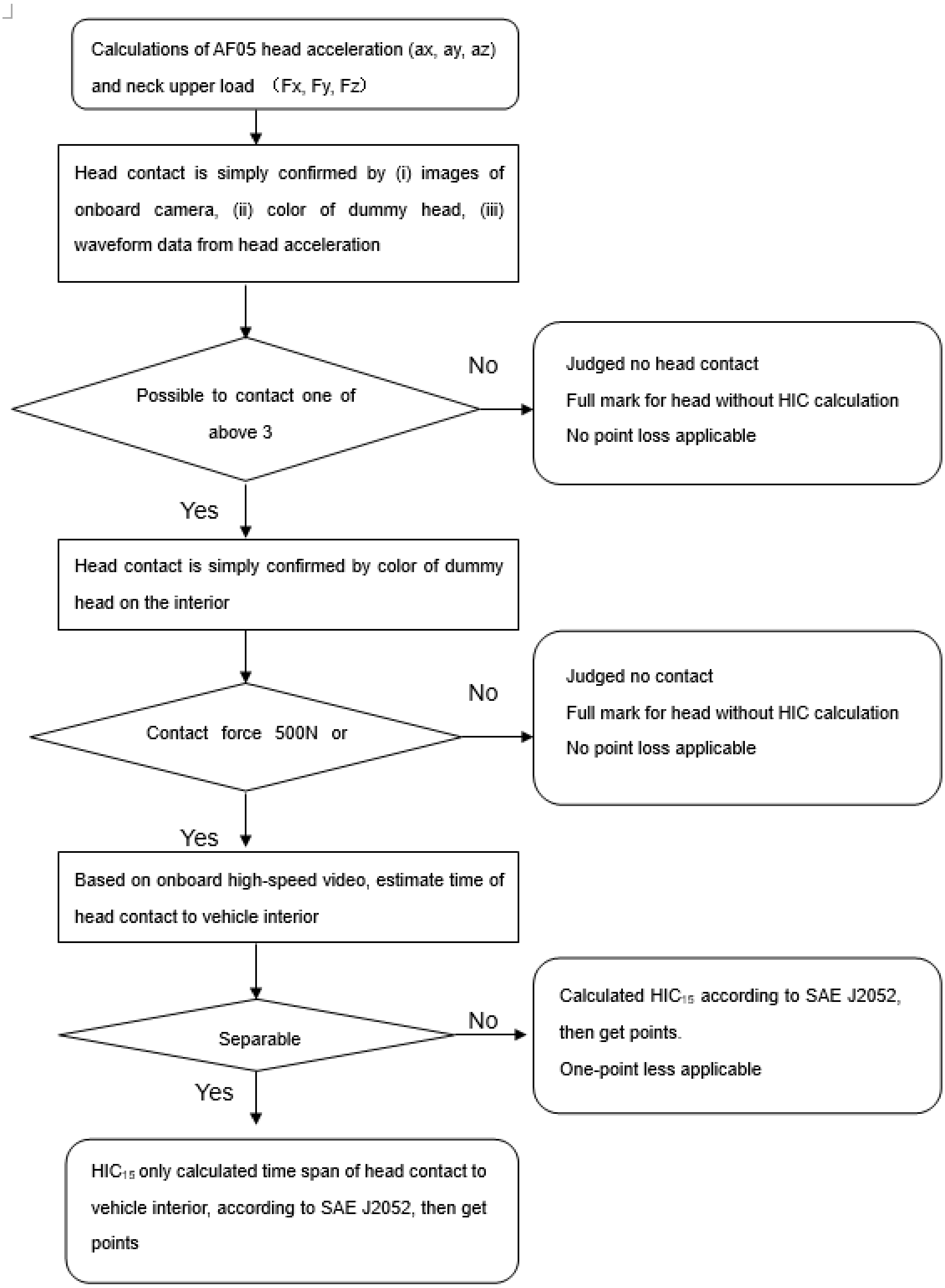


Figure 4: Secondary Head Collision Flowchart

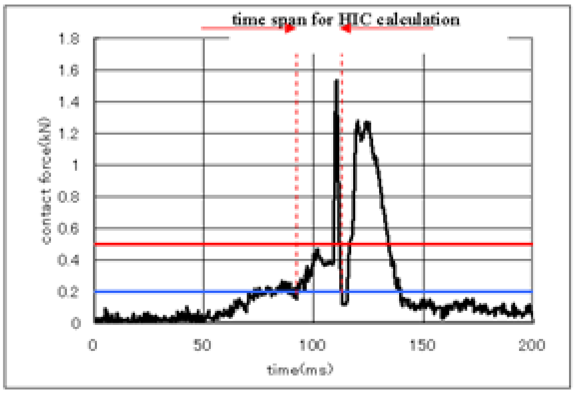


Figure 5　Both Contact Force and Time Span Separable for HIC Calculation

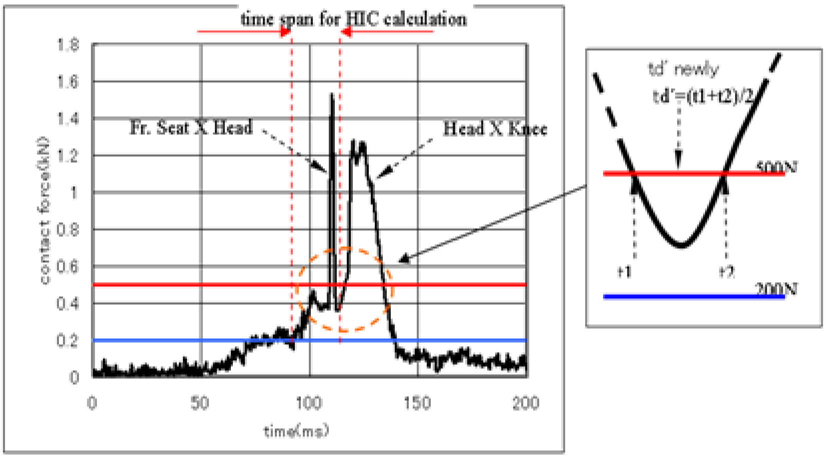


Figure 6　Contact Force Separable but Time not Separable for HIC Calculation

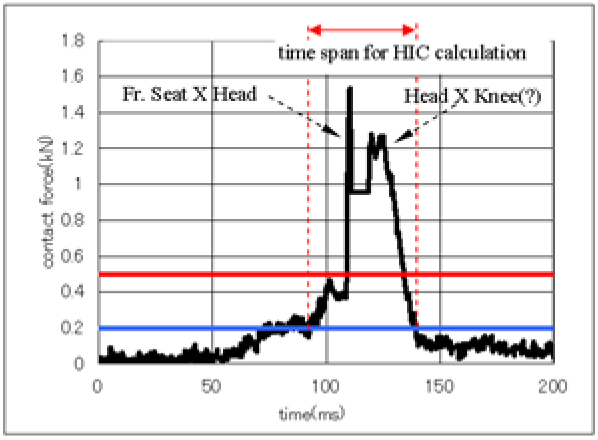


Figure 7: Contact Forces not Separable

(2) Neck Injury Criterion

① Confirm, by the method specified in Paragraph 6.2.3.2 (1), that the secondary collision has taken place.

② If a secondary collision has been confirmed according to the provision of ①, confirm that the calculated head contact force exceeded 500N by following the SAE J2052 calculation procedure.

③ If the secondary collision has been confirmed according to the provision of ① and the head contact force caused by the collision concerned has complied with the provision of ②, the criterion for the neck shall be determined by the maximum values of the tensile strength in the axial direction, shear force in the fore-and-aft direction and flexion moment (tension side) where the neck and the head of the dummy are connected.

④ Other than the above cases, the criterion for the neck is determined by the maximum value of the tensile strength in the axial direction where the neck and the head of the dummy are connected.

(3) Chest Injury Criterion

The maximum value of the compression side displacement applied to the ribs of the dummy (ThCC: Thorax Compression Criterion).

(4) Femur Injury Criterion

The maximum value of the load applied to the right and left femurs of the dummy.

(5) Ilium Load

If the measured ilium load shows a drop of more than 1,000N within 1ms, this phenomenon is defined as the occurrence of the lap belt slipping from the proper position. However, if multiple changes in the ilium load were confirmed, it shall be judged by the force drop just after the final rising load. The images of the onboard camera shall be used for confirmation.

Additionally, if the ilium load is reduced by more than 1,000N within 1ms during the rebound phase, and the iliac load just before the reduction was less than 2,400N, then it is considered that the lap belt did not come off the pelvis. The starting time of rebound shall be defined as the moment the hip moving speed, calculated from the composite hip accelerations in the fore-and-aft direction and in the upward-and-downward direction, relative to the vehicle speed, becomes 0.

6.2.4 High-Speed Photography

The movements of the test vehicle and the dummy shown in Figure 8 shall be photographed during the collision using a high-speed video camera. Strobe lights, etc. for identifying the moment of collision shall be included in each camera angle.

If multiple onboard cameras cannot be installed, a single onboard camera may be installed in a position that can observe the movement of the rear dummy upon mutual consultation between NASVA and the vehicle manufacturer.

Camera No.	Camera Angle
1	Movement of dummy in driver's seat and collapse of vehicle
2	Movement and collapse of vehicle (right side)
3	Movement of dummy in front seat Movement
4	of vehicle and collision position
5,6	Movement of dummy in rear seat (onboard)

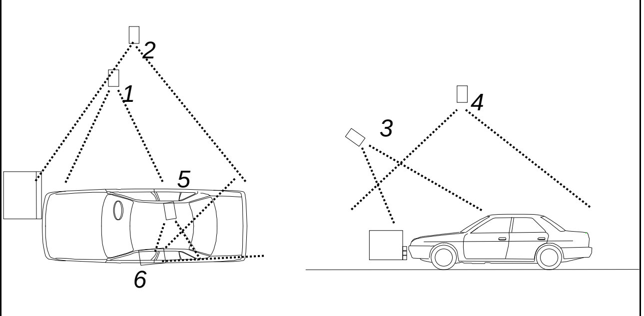


Figure 8: High-Speed Camera Covering Range

6.3 Recording After the Test

6.3.1 Photographing of Vehicle Conditions, Driver Dummy's Secondary Collision with Steering Wheel (for vehicles with the steering angle over 32°) Immediately after Test

(1) Distinctive sections shall be photographed both immediately after the test and after confirming the opening capability of the side doors as prescribed in Paragraph 6.3.2.

(2) For vehicles with the steering angle over 32°, photograph the driver dummy's chest area (whether or not there was contact with the steering wheel/rim), and the condition of the pressure-sensitive paper on the dummy's chest.

6.3.2 Confirmation and Recording of Opening Capability of Side Doors

The opening capability of all the side doors of the test vehicle shall be confirmed, and the results shall be recorded using any of the methods given below. To do so, proceed as follows: If the door latch could not be released by pulling the outer handle in (1), try the inner handle; if the latch has been released, repeat the action (1) to see if the door opens. If it opened, record that the inner handle was used to release the door latch. If the door latch could not be released even with the inner handle, move to the next step and repeat the sequence to check opening of the door.

(1) Openable with one hand.

(2) Openable with both hands.

(3) Openable by using tools.

6.3.3 Recording of Measurement Results of the Amount of Extension of the Seatbelt

The amount of extension the seatbelt shall be measured according to Paragraph 4.1.9.3 and recorded.

6.3.4 Confirmation and Recording of Removability of Dummy

After measuring the amount of extension of the seatbelt according to Paragraph 6.3.3, the removability of each dummy from the test vehicle shall be confirmed and recorded using any of the methods given below.

Provided, however, that, considering that it is difficult to remove the rear test seat dummy from a two-door vehicle without operating the front seat, a case where the dummy was removed without any trouble other than operating the front seat without using tools shall be deemed as falling under case (1) and a remark "The normal operation of the front seat added to accommodate the two-door structure" shall be added.

(1) No tool was used. No adjustment mechanism for the seat and the steering system, etc. was operated.

(2) No tool was used. An adjustment mechanism for the seat or the steering system, etc. was operated.

(3) Tools were used.

Furthermore, when operating the adjustment mechanism for the steering system, marks shall be made indicating the conditions before the operation. The adjustment mechanism shall then be returned to the original position before measuring the vehicle dimensions after the test as prescribed in Paragraph 6.3.5.

6.3.5 Recording the Measurement Results for Vehicle Dimensions after Test

After conducting the test, the dimensions of the test vehicle shall be measured and recorded as follows:

(1) After the test, the vehicle dimensions shall be measured and recorded at the same points as those before the test specified in Paragraph 6.1.4 using the three-dimensional measuring device.

(2) Record the positions of each point of the B-pillar after the collision on the side of the front passenger seat.

(3) Compare the ordinates (in the Z direction) of each point of the B-pillar sill before and after the test.

(4) Find the angle θ that satisfies the following equation for each point of the B-pillar sill.

$$z = -x'\sin\theta + z'\cos\theta$$

(where: z = the vertical measured value before collision, and x' and z' = measured values in the fore-and-aft direction and in the vertical direction after the collision.)

(5) Convert the measured values in the fore-and-aft and vertical directions (x', z') after the collision using the following equation:

$$\begin{pmatrix} X' \\ Z' \end{pmatrix} = \begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix} \begin{pmatrix} x' \\ z' \end{pmatrix}$$

(6) If the coordinate systems of the vehicle before the test cannot be redefined by (1), the coordinate systems of the vehicle shall be determined as follows:

① Set coordinate axes for measurement by setting a basic frame at locations measured before the test or by using points taken in parallel with the axes before the test.

(7) If the steering system has a structure such as a shear capsule, whereby the steering column is removed from the steering system during the collision, the vehicle dimensions shall be measured and recorded after reinstalling the column in the steering system as precisely as possible.

(8) The vehicle dimensions shall be measured and recorded without applying a load to the brake pedal. If the brake pedal is designed to be completely released from the mount during the collision, the measurement results for the brake pedal shall be recorded as "the brake pedal was released and no significant resistance remained in the movement of the brake pedal." In this case, the brake pedal shall be measured and recorded without applying a load to the brake pedal. If the brake pedal is designed to be separated and removed from the mount during the collision, the measurement results for the brake pedal shall be recorded as "the brake pedal was separated and removed from the mount during the test."

6.3.6 Recording Measurement Results for Fuel Leakage

The presence or absence of fuel flowing or dripping from each part of the vehicle after the collision shall be confirmed and recorded.

6.3.7 Calibration and Recording of Accelerometers

The accelerometers used in the test shall be calibrated after the collision, and the calibration results shall be recorded.

6.3.8 Recording of Rear Seatbelt Coming Off from the Normal Position of the Rear Seat Dummy

After the test, confirm the movement of the dummy using images of the onboard camera, and then record whether the seatbelt came off from the normal position or not.

6.4 Handling the Measured Values

The measured values, etc. shall be handled as follows.

(1) The measured values for speed (km/h) shall be rounded to the first decimal place.

(2) The measured values for distance (mm) shall be rounded to the nearest whole number.

(3) The measured values for acceleration (m/s^2) shall be rounded to the second decimal place.

(4) The measured values for load (kN) shall be rounded to the second decimal place.

(5) The measured values for moment (Nm) shall be rounded to the second decimal place.

(6) The measured values for chest displacement shall be rounded to the second decimal place.

(7) The measured values for HIC shall be rounded to the first decimal place.

(8) The measured values for TI shall be rounded to the second decimal place.

Appendix 1: Test Vehicle Specification Data Sheet

[To be completed by vehicle manufacturer]

1. Adjusting Seats and Seatbelts

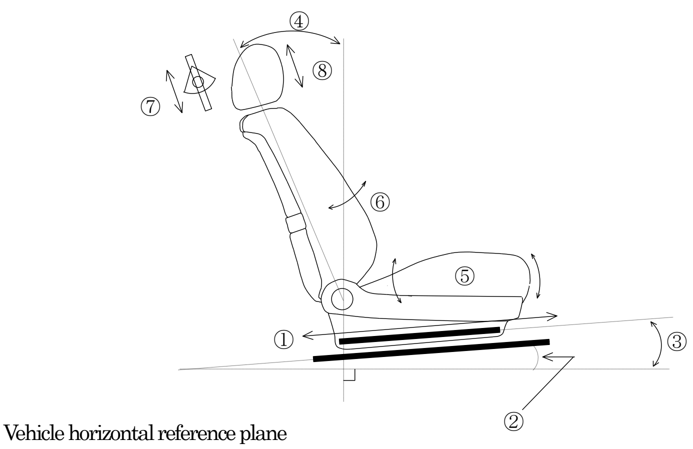
[Row 1]

			Driver Seat	Front Passenger Seat
①Adjustment of seat in fore-and-aft direction	Adjustment amount per stage		mm	mm
	Entire adjustment amount		mm	mm
	Mid. Position	From front edge	mm (stage)	mm (stage)
		From rear edge	mm (stage)	mm (stage)
② Adjustment of seat-slide-rail in attaching angle			°	°
③ Adjustment of seat lower and seatback at once	Design standard position			
	Attachment method			
④ Adjustment of seatback angle	Design standard angle		° (stage)	° (stage)
⑤ Adjustment of seat in vertical direction	Tilt	From the lowest position	mm	mm
	Lifter		mm	mm
	Other		mm	mm
⑥ Adjustment of lumbar support	From the release position			
⑦ Adjustment of anchorage for seatbelt shoulder webbing	Adjustment range		mm (stage)	mm (stage)
	Design standard position		[From top position] mm (stage)	[From top position] mm (stage)
⑧ Adjustment of head-rest height	Adjustment range		mm (stage)	mm (stage)
⑨Other adjustment mechanisms ( )	Design standard position			

[Rows 2, 3]

			3rd (sic) Row	3rd Row
① Adjustment of seat in fore-and-aft direction	Adjustment length per stage		mm	mm
	Total adjustment length		mm	mm
	Standard	From front edge	mm (stage)	mm (stage)
		From rear edge	mm (stage)	mm (stage)
④ Adjustment of seatback angle	Design standard angle		° (stage)	° (stage)
⑦ Adjustment of anchorage for seatbelt shoulder webbing	Adjustment range		mm(stage)	mm(stage)
	Design standard position		[From top position] mm (stage)	[From top position] mm (stage)
⑧ Adjustment of headrest height	Adjustment range		mm (stage)	mm (stage)
	Design standard position		[From top position] mm (stage)	[From top position] mm (stage)
⑨Other adjustment mechanisms ( )	Design standard position			

(Note) The number of stages for adjustment position shall start from the first locking position ("stage 0").



(Note) position of ⑨ other adjustable mechanism shall be shown on the above drawing.

2. Adjustment of Steering System

(1) Vertical direction: (present/absent)

Adjustment range: ____° ~ ______° (______ stage)

Vertical adjustment position: From highest position ____° (______ stage)

(2) Fore-aft direction

Adjustment range: ____________ mm (______ stage)

Fore-aft adjustment position: From foremost position ________ mm (______ stage)

(Note) The number of stages for position adjustment in the vertical direction and the fore-and-aft direction shall start from the uppermost position and foremost position ("stage 0"), respectively.

(3) Distance between steering pad center and forward end of steering shaft: ______ mm

3. Fuel Tank Capacity: ________ L

When specification is needed of the vehicle's mounting position when its mass at vehicle delivery was recorded, diagram it below.

A sketch or a photograph is acceptable.

4. Vehicle Width: ________ mm

5. Reference Points of Measurement of Vehicle Inclination (Enter the inclination of the unloaded vehicle with two dummies placed in their assigned positions.)

(1) Fore-aft Direction

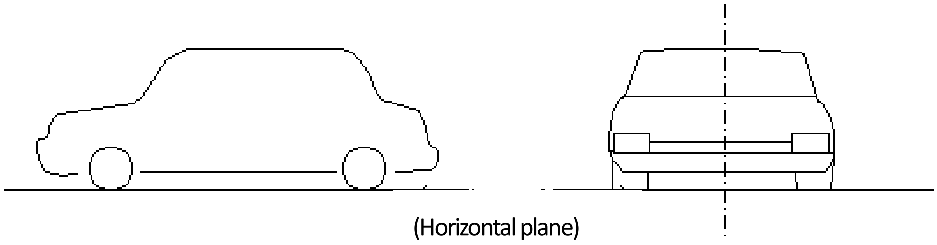
Reference Points (locations):________________________(indicated below)

Angle to Horizontal Plane: □Forward Tilt □Backward Tilt______°

(2) Lateral Direction (in relation to driving direction)

Reference Points (locations):________________________(indicated below)

Angle to Horizontal Plane: □Leftward Tilt □Rightward Tilt______°



6. Relationship Between Straight Line A and Hip Point

The relationship between straight line A and the hip point shall be as illustrated below if the dummy had to be set at a point other than the mid-point in the fore-aft direction in order to position the dummy properly when the hip point is located closer to the accelerator pedal than the straight line A prescribed in Paragraph 4.1.5.1 (1). The amount of adjustment from the middle position shall also be indicated.

Amount of adjustment from middle position:______mm (______stage)

7. Location and Method for Installing Vehicle Accelerometers

The details shall be entered using Appendix 3.

8. Removable Parts

9. Automatic Door-Locking Systems, etc.

Vehicle-speed-sensitive door-locking system: Available (sensitive type)   /   Not Available

Crash-sensitive door-unlocking system: Available /   Not Available

10. Installation of Towing Hook

The towing hook shall be installed at the center of the test vehicle.

A sketch or a photograph is acceptable.

11. Vehicle Body Measuring Reference Points

The vehicle manufacturer shall indicate 3 to 5 reference points that do not deform during the collision test.

A sketch or a photograph is acceptable.

12. Clamping Torque of Bolts

Driver side airbag module : ______________ N

Driver seat anchor bolts : ______________ N

Front passenger seat anchor bolts : ______________ N

Backseat anchor bolts : ______________ N

Other

: ______________ N

: ______________ N

: ______________ N

13. Dummy Seating Position Measurement Recordings

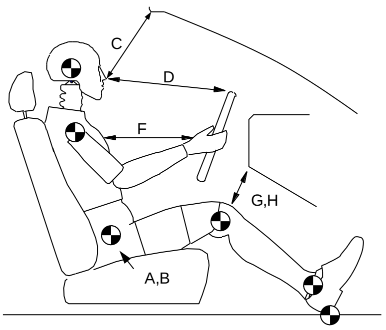
For Offset frontal crash test

For entry by vehicle manufacturer

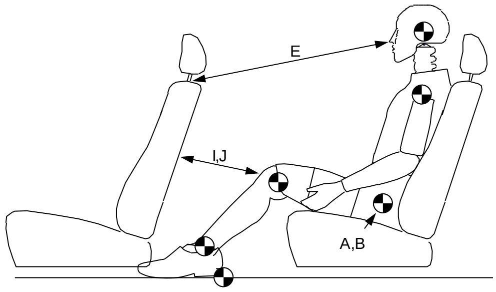
① Recording Sheet for Simple Measurements

Test vehicle name/model:		Test Date:	
Frame Number:		Test Location:	
Dummy Type:		Overseer:	
Dummy Number:		Notes:	

Driver's Seat

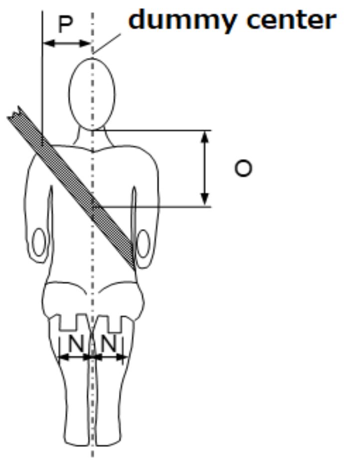


Rear Test Seat

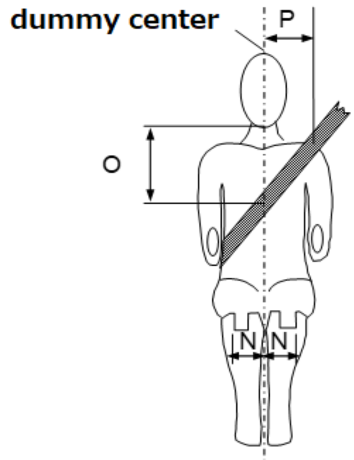


	Measurement Items	Driver's Seat	Rear Test Seat
A	Reference Point ( )～ Hip Point, fore-aft direction		
B	Reference Point ( )～ Hip Point, vertical direction		
C	Top of nose ～ Windshield Header		
D	Top of nose ～ Steering Wheel Rim, upper-center		
E	Top of nose ～ Front seatback, upper-center		
F	Chest ～ Steering, horn, pad surface (horizontal)		
G	Right Knee ～ Under the dashboard		
H	Left Knee ～ Under the dashboard		
I	Right Knee ～ Front Seatback		
J	Left Knee ～ Front Seatback		
K	Head Angle		
L	Pelvis Angle		
M			

Driver's Seat



Rear Test Seat



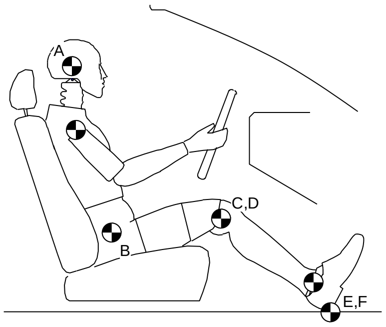
Measurement Items		Driver Seat	Rear Test Seat
N	Knee Gap (dummy center～right, left)	R: L:	R: L:
	Reason why the dummy can't be loaded with a knee gap		
O	Dummy Lower Jaw～Belt Center (vertical line down the dummy's center)		
P	Dummy Center～Belt Center (lateral direction at height of root of neck)		
Q			

(Note) For items A and B, the parts which constitute the reference of the vehicle body shall be entered in parentheses (　　) for the reference point. Then, dimensions of fore-and-aft and vertical components shall be measured. It is not necessary that the same reference points be employed.

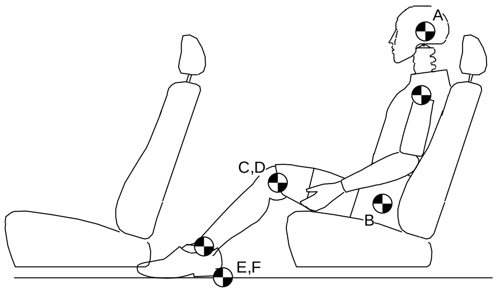
② 3-D Measuring Device Recording Sheet

Test vehicle name/model:	____________	Test Date:	____________
Frame Number:	____________	Test Location:	____________
Dummy Type:	____________	Overseer:	____________
Dummy Number:	____________	Notes:	____________

Driver's Seat



Rear Test Seat



Measurement Items (target value)		Driver Seat			Rear Test Seat		
		X	Y	Z	X	Y	Z
A	Head Center						
B	Hip Point						
C	Knee Joint Center: Right Side (vehicle outer-side)						
D	Knee Joint Center: Left Side (vehicle outer-side)						
E	Heel center: Right side						
F	Heel center: Left side						
G	Head Angle						
H	Pelvis Angle						
I	Neck Bracket Step (if recommended steps are provided)						
J							

Hip Point Design Value

	Driver Seat			Rear Test Seat		
	X	Y	Z	X	Y	Z
Design Hip Point (Y is the dummy center value)						
Hip Point (Y is the dummy center value)						
Vehicle Reference Points ( )						

Vehicle Reference Points

A sketch or a photograph is acceptable.

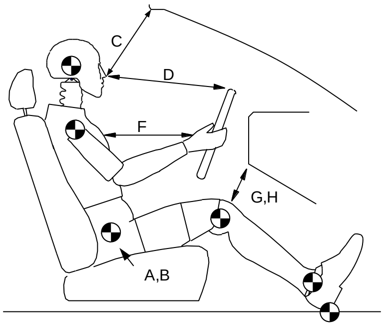
13－1 Measurement Records for Dummy Seating Position

For entry by test institute

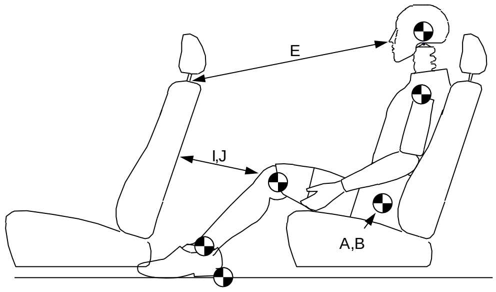
① Simple Measurements Sheet

Test vehicle name/model:	____________________	Test Date:	____________________
Frame Number:	____________________	Test Location:	____________________
Dummy Type:	____________________	Overseer:	____________________
Dummy Number:	____________________	Notes:	____________________

Driver's Seat

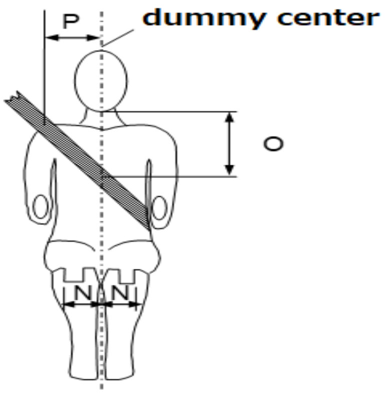


Rear Test Seat

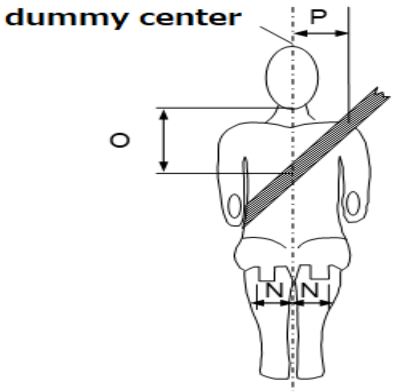


	Measurement Items	Driver's Seat	Rear Test Seat
A	Reference Point (　　　　)～Hip Point, fore-aft direction		
B	Reference Point (　　　　)～Hip Point, vertical direction		
C	Top of Nose～Windshield Header		
D	Top of Nose～Steering Wheel Rim, upper-center		
E	Top of Nose～Front Seatback, upper-center		
F	Chest～Steering Wheel, Horn Pad Surface (horizontal)		
G	Right Knee～Under the Dashboard		
H	Left Knee～Under the Dashboard		
I	Right Knee～Front Seatback		
J	Left Knee～Front Seatback		
K	Head Angle (hybrid III only)		
L	Pelvis Angle (hybrid III only)		
M			

Driver's Seat



Rear Test Seat



	Measurement Items	Driver's Seat	Rear Test Seat
N	Knee Gap (dummy center～right, left)	R: L:	R: L:
O	Dummy Lower-Jaw～Belt Center (vertical line down dummy's center axis)		
P	Dummy Center～Belt Center (lateral direction at root of neck)		
Q			

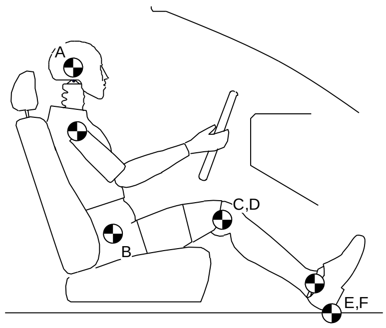
(Note) For items A and B, the parts, which constitute the reference of the vehicle body, shall be entered in parentheses (   ) for the reference point. Then, dimensions of fore-and-aft and vertical components shall be measured. It is not necessary that the same reference points be employed.

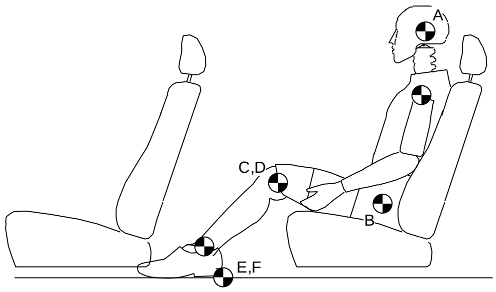
② 3-D Measuring Device Recording Sheet

Test vehicle name/model:	____________	Test Date:	____________
Chassis Number:	____________	Test Location:	____________
Dummy Type:	____________	Overseer:	____________
Dummy Number:	____________	Notes:	____________

Driver's Seat

Rear Test Seat



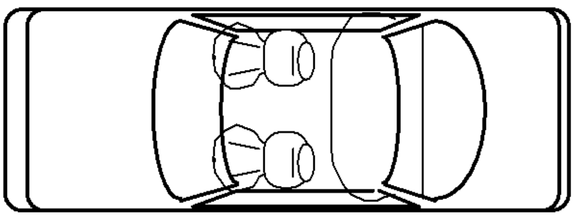


Measurement Items (Actual Value)		Driver's Seat			Rear Test Seat		
		X	Y	Z	X	Y	Z
A	Head Center						
B	Hip Point						
C	Knee Joint Center: Right Side (vehicle outer-side)						
D	Knee Joint Center: Left Side (vehicle outer-side)						
E	Heel Center: Right Side						
F	Heel Center: Left Side						
G	Head Angle						
H	Pelvis Angle						
I	Steps of Neck Bracket						
J							

13−2 Removed Parts and their Weights

Removed Parts	
Mass of Loaded Weight	

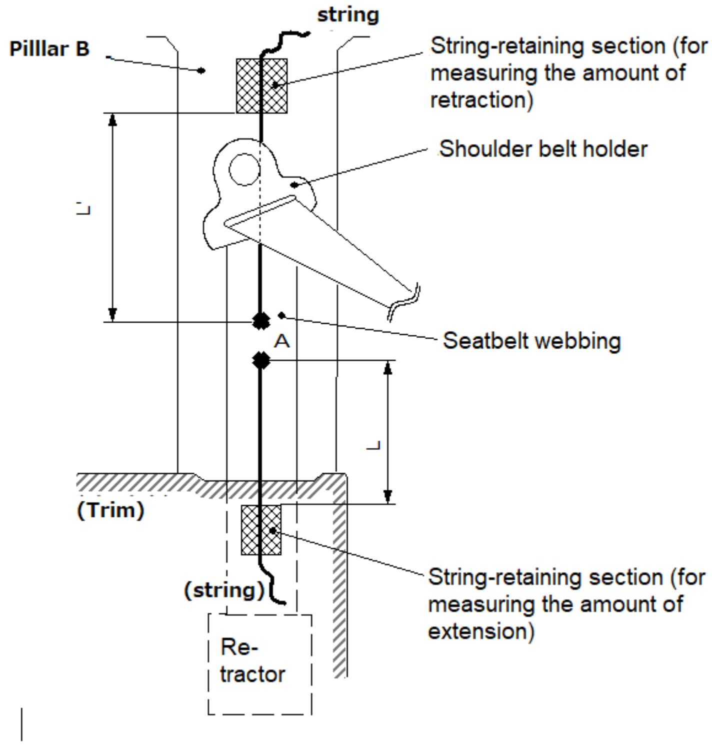
Location of Loaded Weight

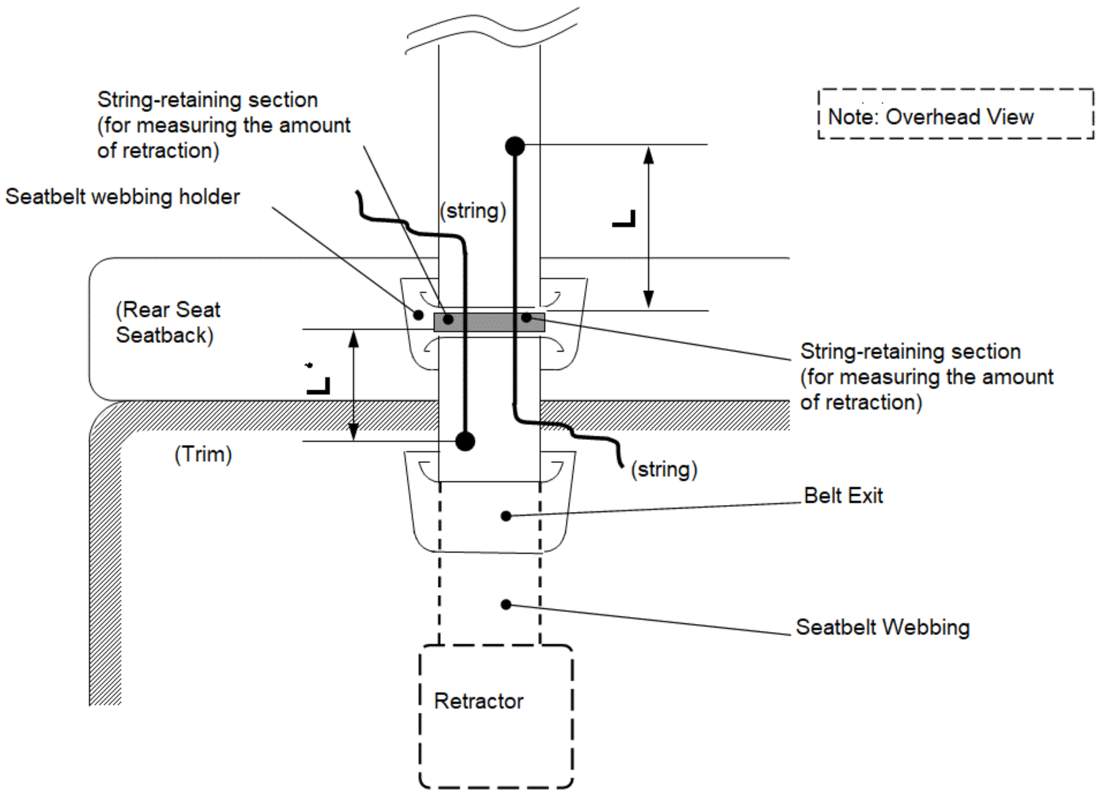


14. Results of Tests by Vehicle Manufacturer

The vehicle manufacturer shall provide the results of their tests in the format specified in Appendix 5.

Appendix 2: Examples of Measuring Methods for Extension and Retraction of Seatbelt





Pillar Mount Example

Parcel Mount Example

① Attach one end of a string to the webbing of the seatbelt (section A in the figure; the string shall be sewn or fixed with tape).

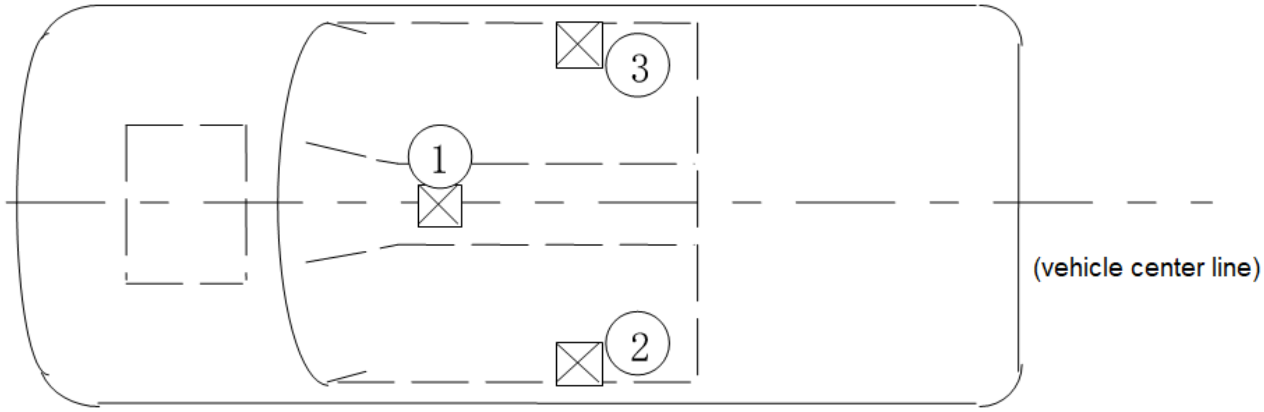
② Attach a string-retaining section (e.g. a piece of Styrofoam provided with a cut) to the trim that covers the retractor, as indicated in the figure. The string shall be held in such a way that it moves smoothly as the seatbelt is pulled out.

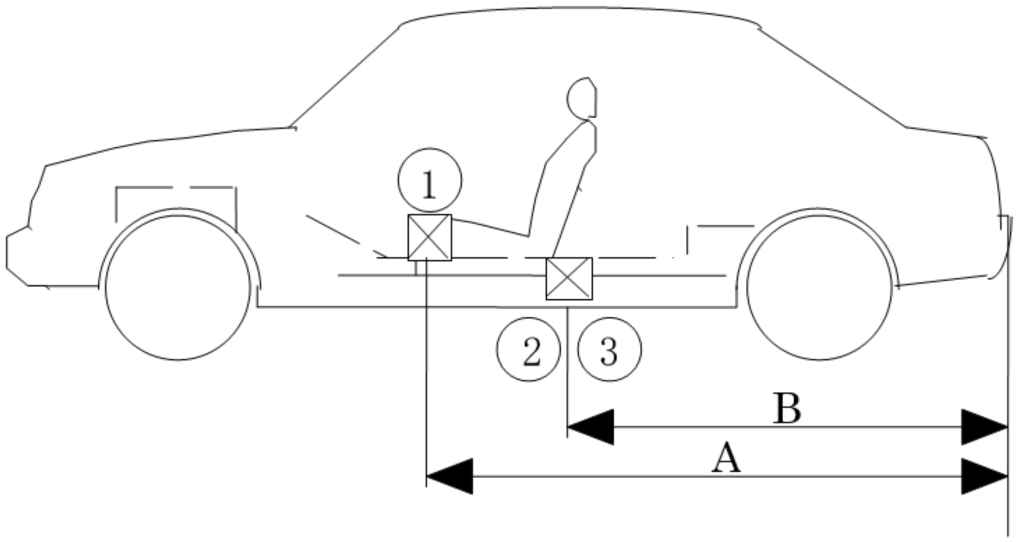
③ Measure the length L in the figure before and after the test. This difference is regarded as the amount of extension.

If the seatbelts are equipped with a pre-tensioner, a string retaining section shall be provided at the pillar side. The length L' in the figure shall be measured before and after the test. This difference is regarded as the amount of retraction.

Appendix 3: Position of Accelerometers in Test Vehicle

［To be filled in by test institute］





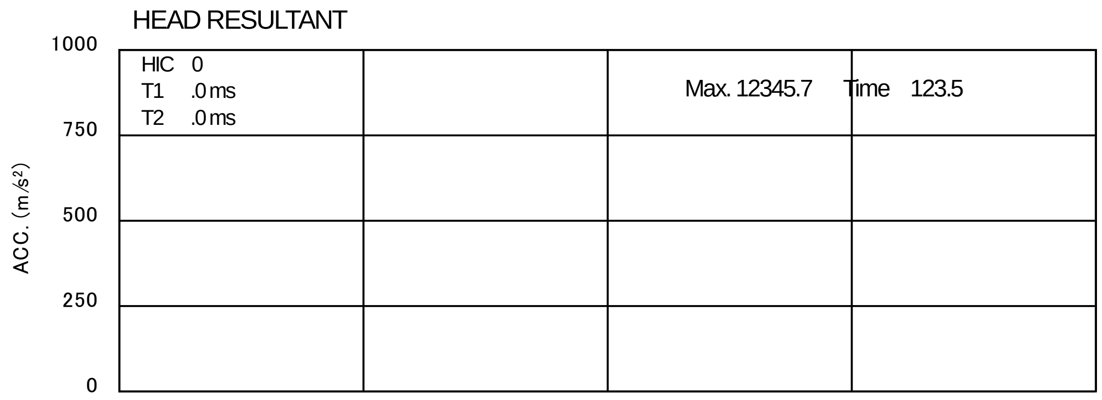
Measuring Points	Distance from reference measuring position of vehicle dimensions (mm)
① Tunnel	A:
② Left Side Sill	B:
③ Right Side Sill	B:

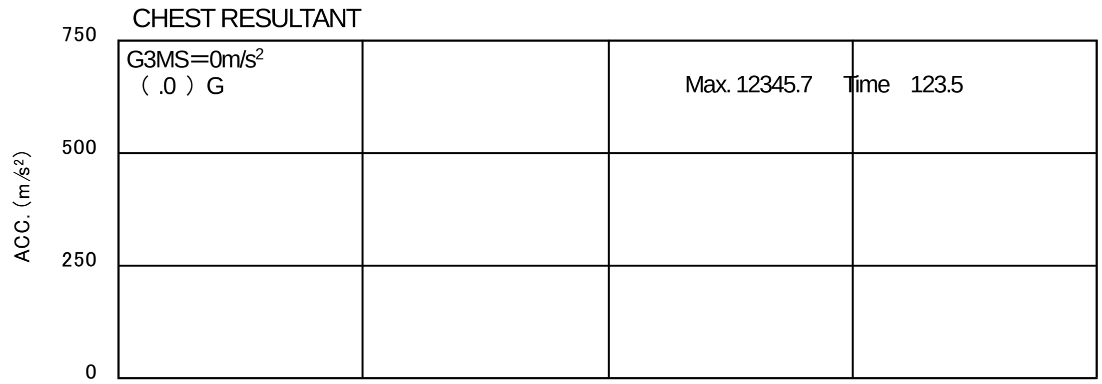
Appendix 4: Test Vehicle Specifications Data Sheet

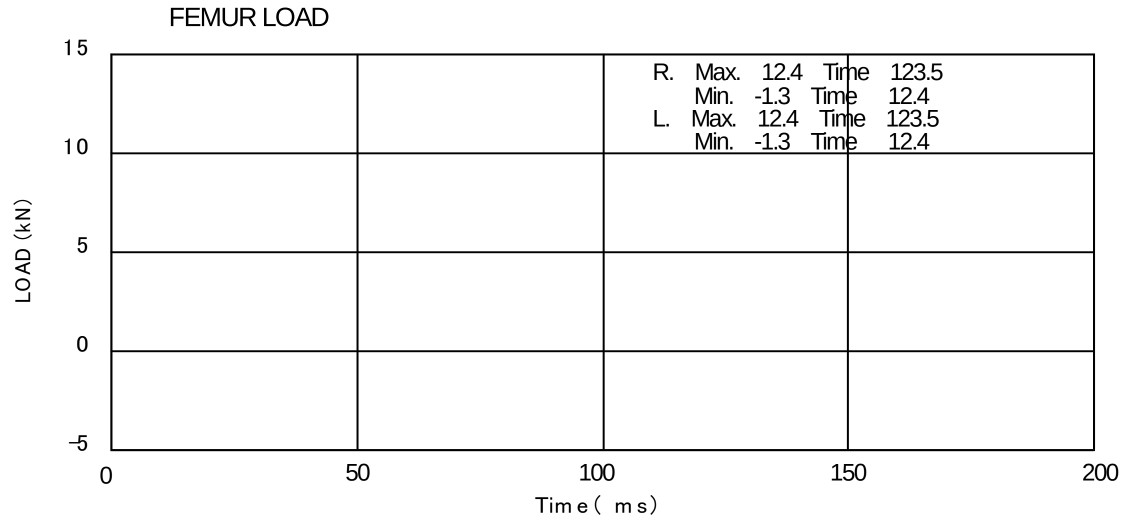
[To be filled in by the test institute]

Vehicle Name/Model/Classification			
Frame Number			
Body Style			
Engine Type			
Drive Type			
Transmission Type			
Steering System		Steering Wheel Type	
		Airbag	Absent / Present
		Vertical Adjustment	Absent / Present (Electric / Manual)
		Fore-Aft Adjustment	Absent / Present (Electric / Manual)
Seat	Front	Fore-Aft Adjustment	Absent / Present (Electric / Manual)
		Seatback Adjustment	Absent / Present (Electric / Manual)
		Lumbar Support Adjustment	Absent / Present (Electric / Manual)
		Height Adjustment	Absent / Present (Electric / Manual)
	Rear	Fore-Aft Adjustment	Absent / Present (Electric / Manual)
		Seatback Adjustment	Absent / Present (Electric / Manual)
		Right-Left Slide	Absent / Present (Electric / Manual)
Seatbelt	Front	Pre-Tensioner	Absent / Present (Shoulder / Inside of Waist)
		Shoulder Adjustment	Absent / Present (Electric / Manual)
	Rear	Pre-Tensioner	Absent / Present (Shoulder / Inside of Waist)
		Shoulder Adjustment	Absent / Present (Electric / Manual)
Other Mechanisms (Circle those that are present)			Air Conditioner / Power Steering / Vehicle Speed-sensing Door Lock / Sunroof / Traction Control / ABS / Airbag for Front Passenger Seat / Footrest / Airbag for Backseat

Appendix 5: Recorded Examples of Electric Measurement Results

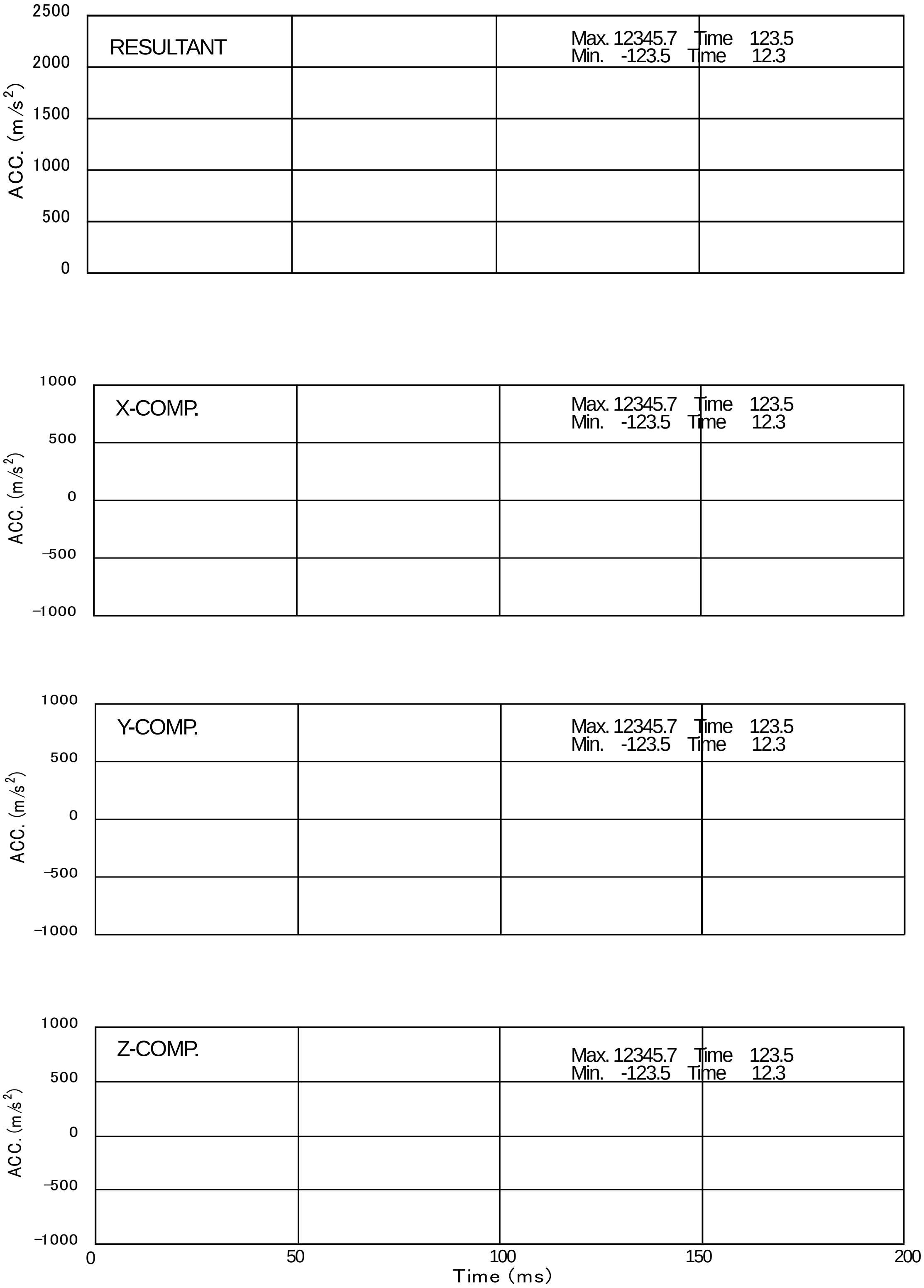






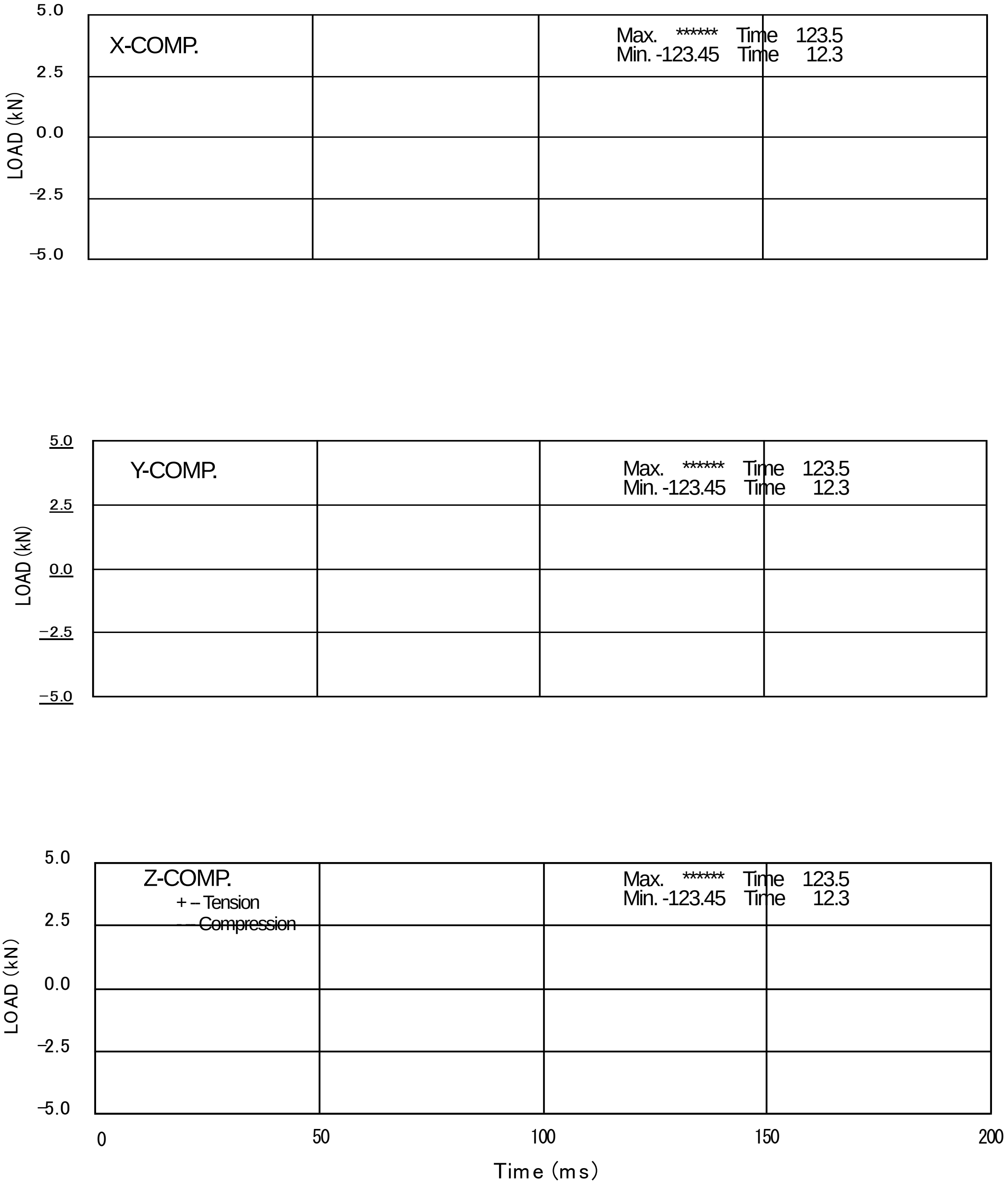
Driver Dummy (or Rear Passenger Dummy)

No. NASVA****-****-***



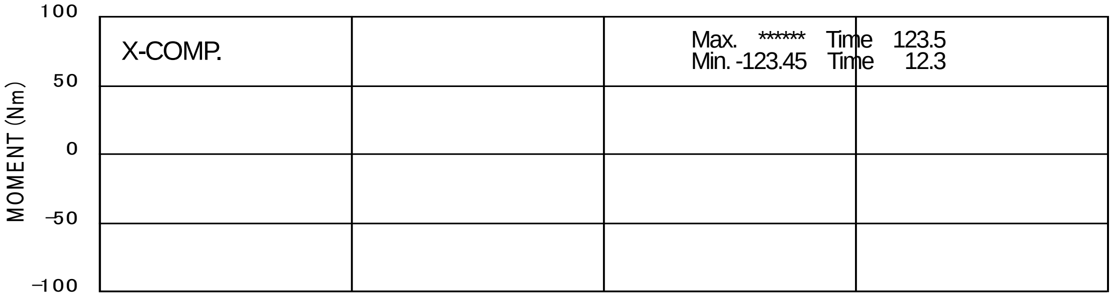
Driver Dummy (or Rear Passenger Dummy) Head Acc.

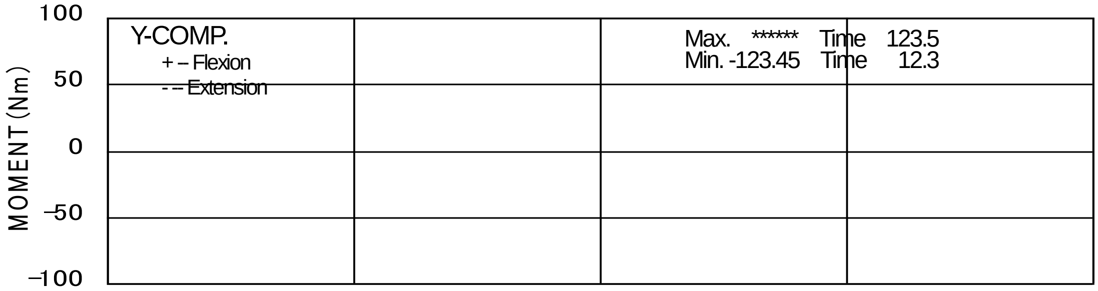
No. NASVA****-****-***

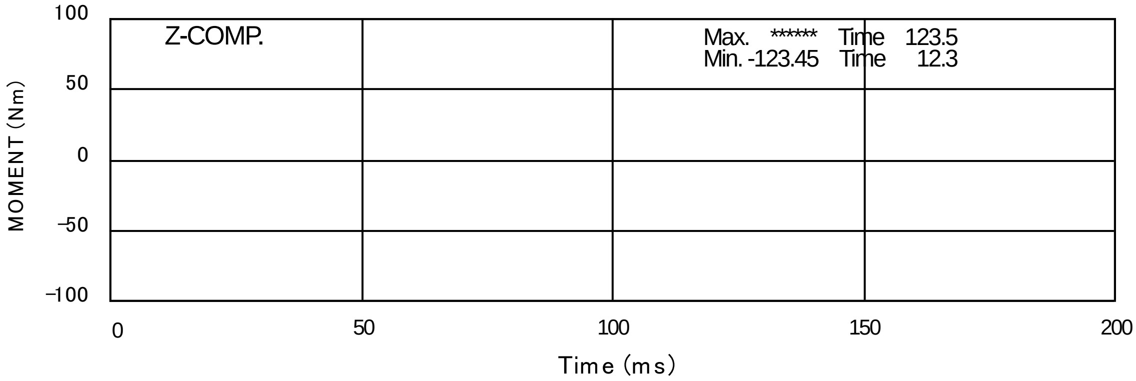


Driver Dummy (or Rear Passenger Dummy) Neck Force

No. NASVA****-****-***

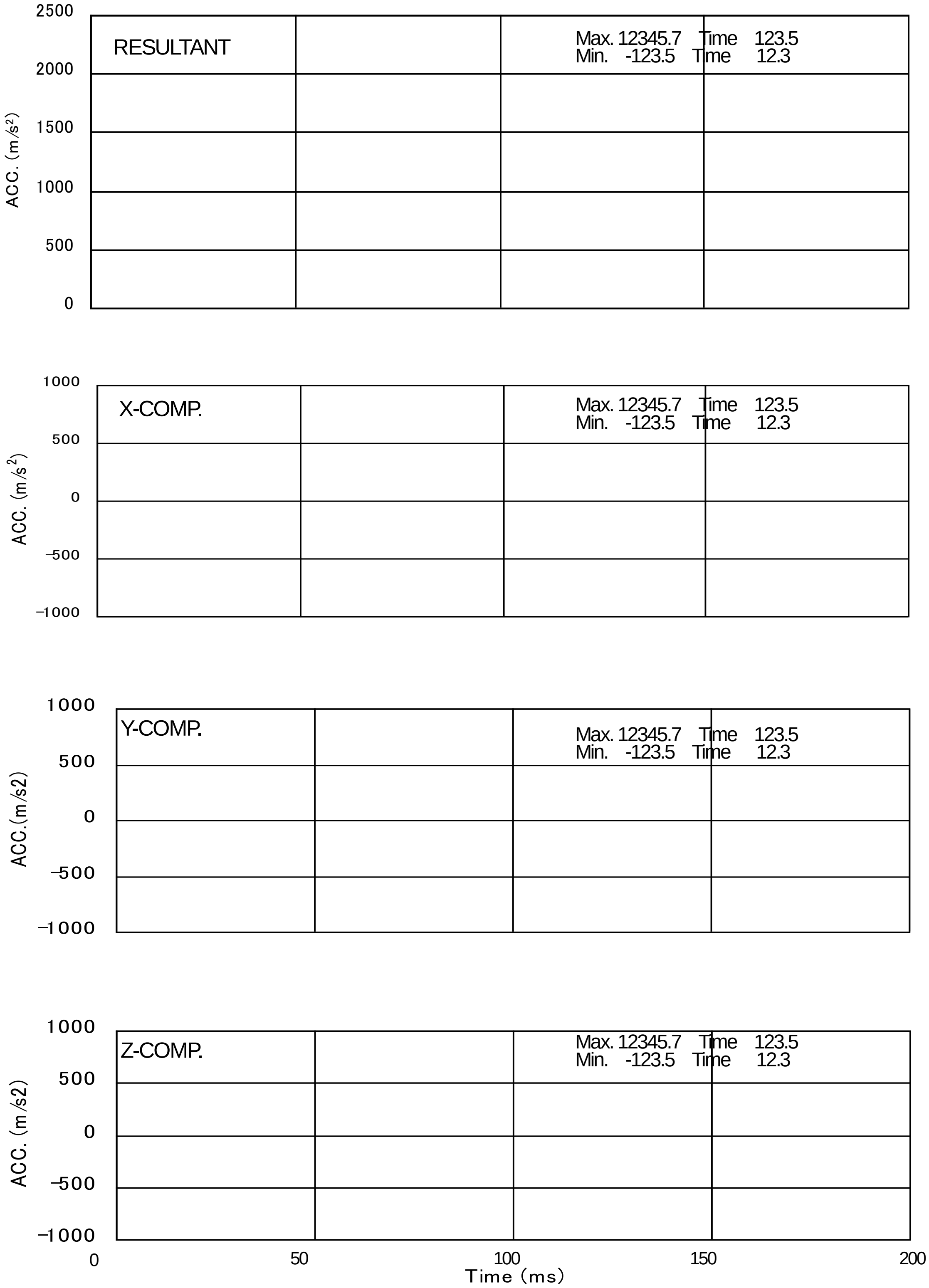






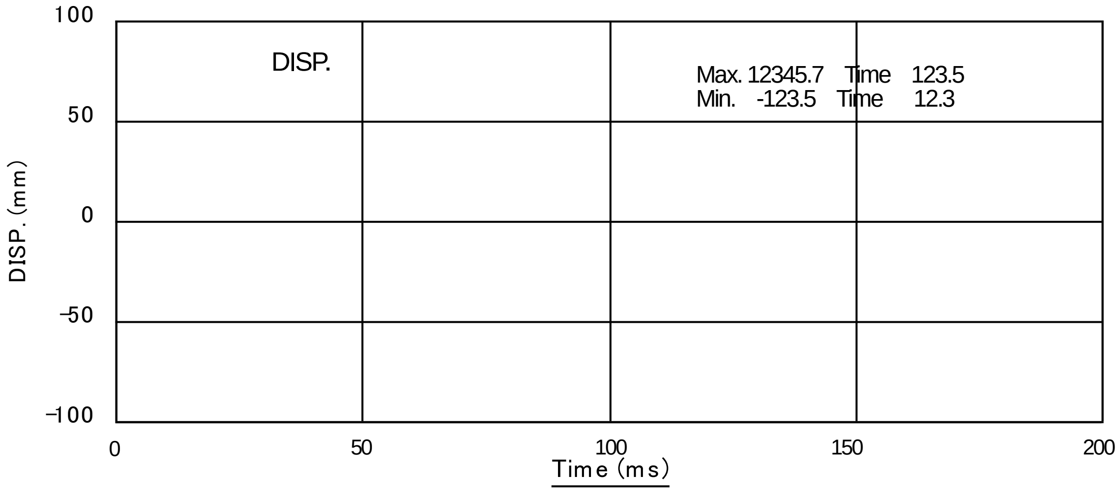
Driver Dummy (or Rear Passenger Dummy) Neck Moment

No. NASVA****-****-***



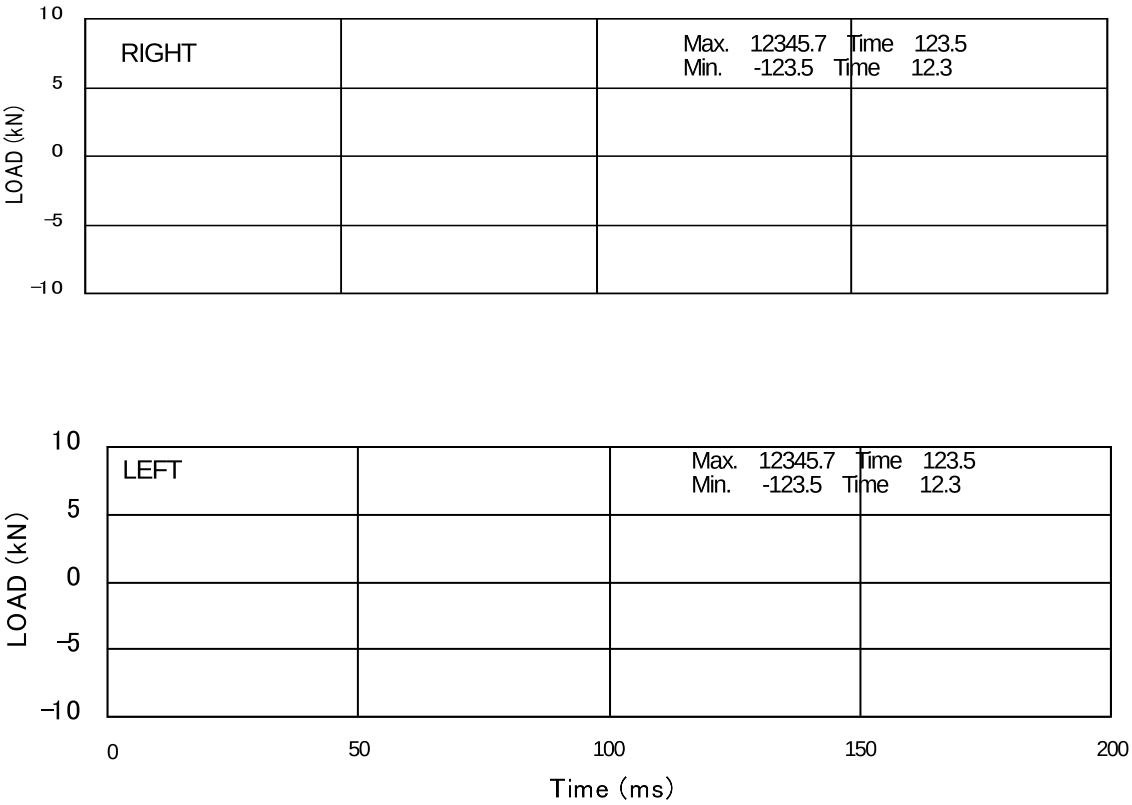
Driver Dummy (or Rear Passenger Dummy) Chest Acc.

No. NASVA****-****-***



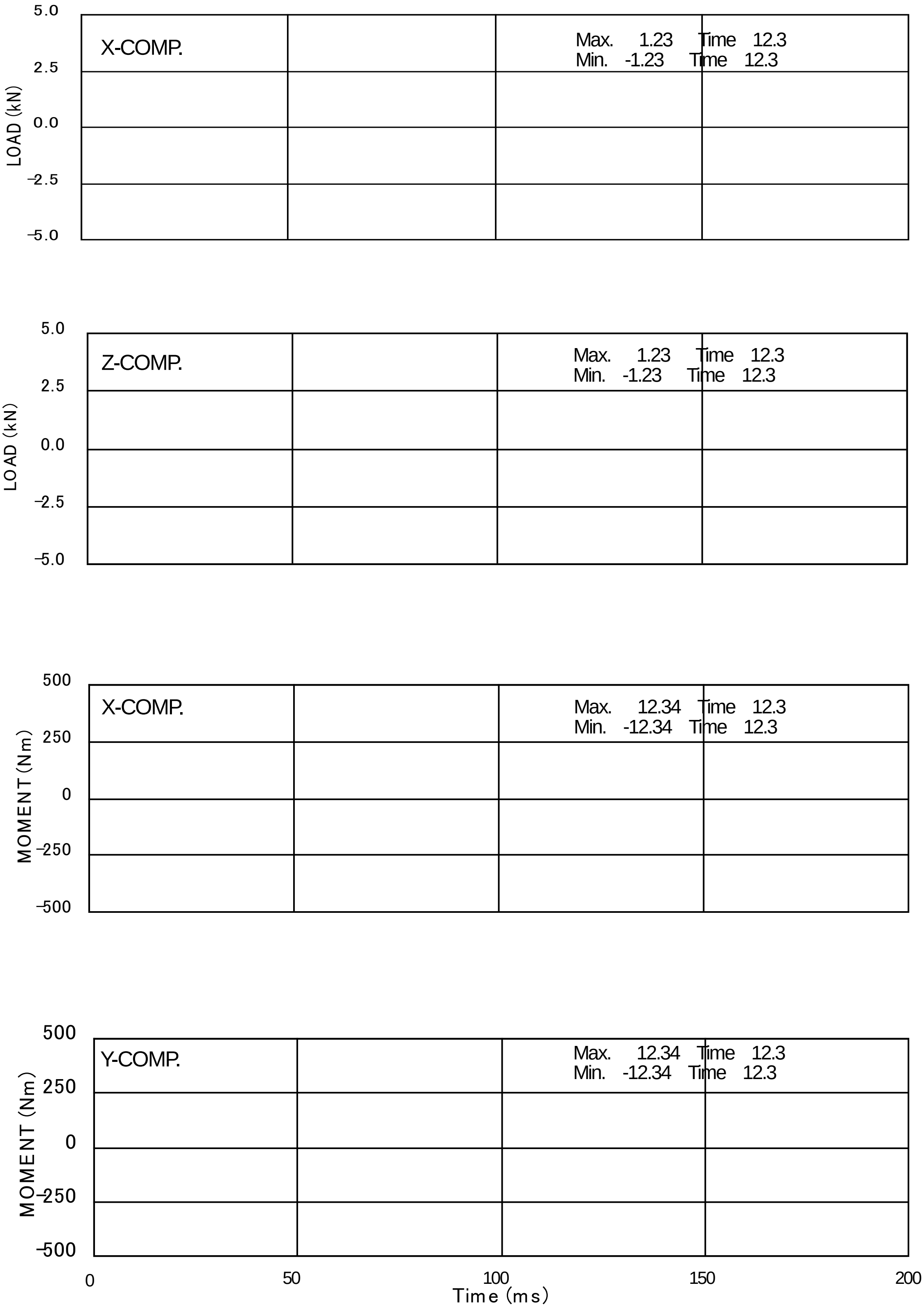
Driver Dummy (or Rear Passenger Dummy) Chest Disp.

No. NASVA****-****-***



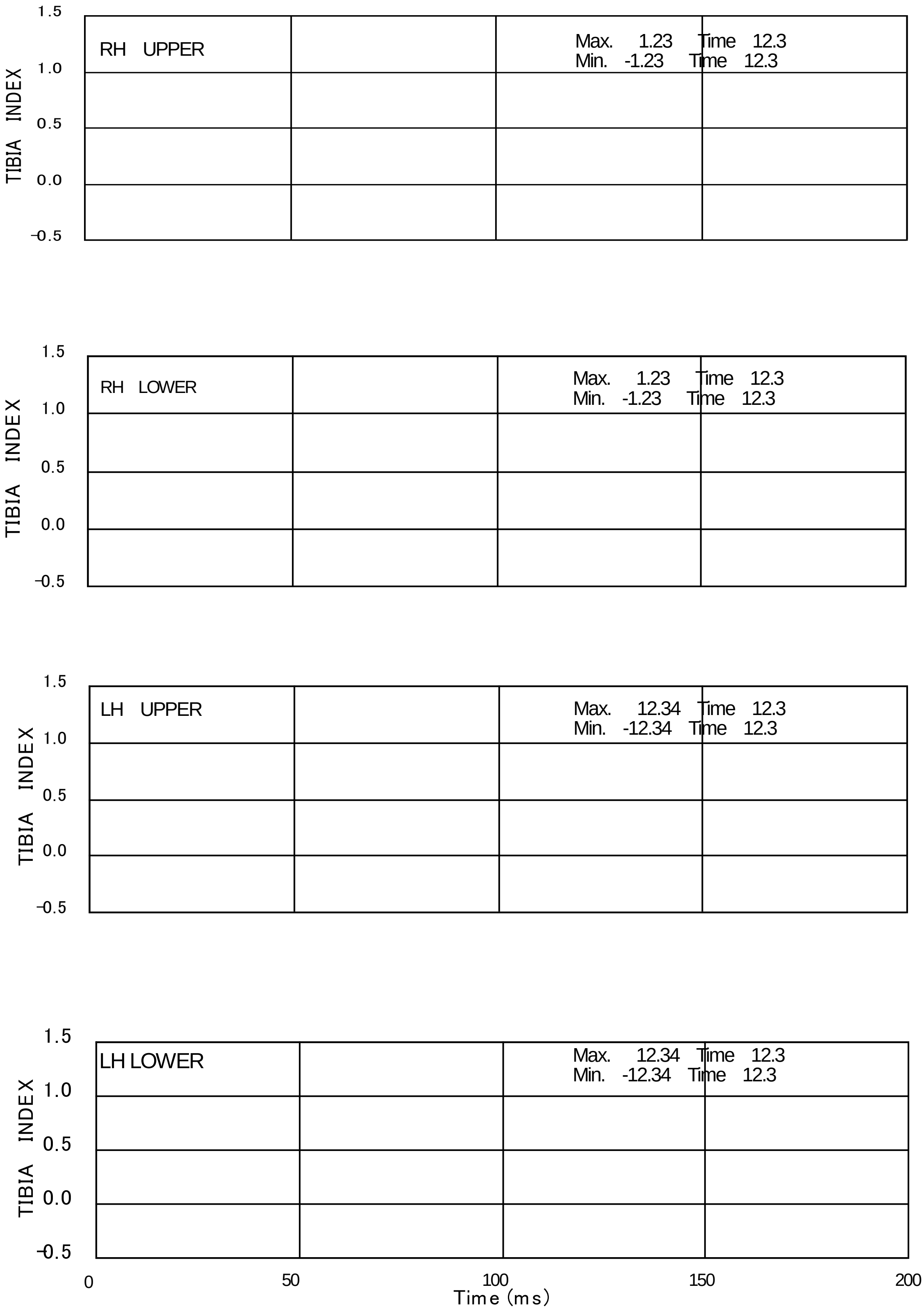
Driver Dummy (or Rear Passenger Dummy) Femur Force

No. NASVA****-****-***



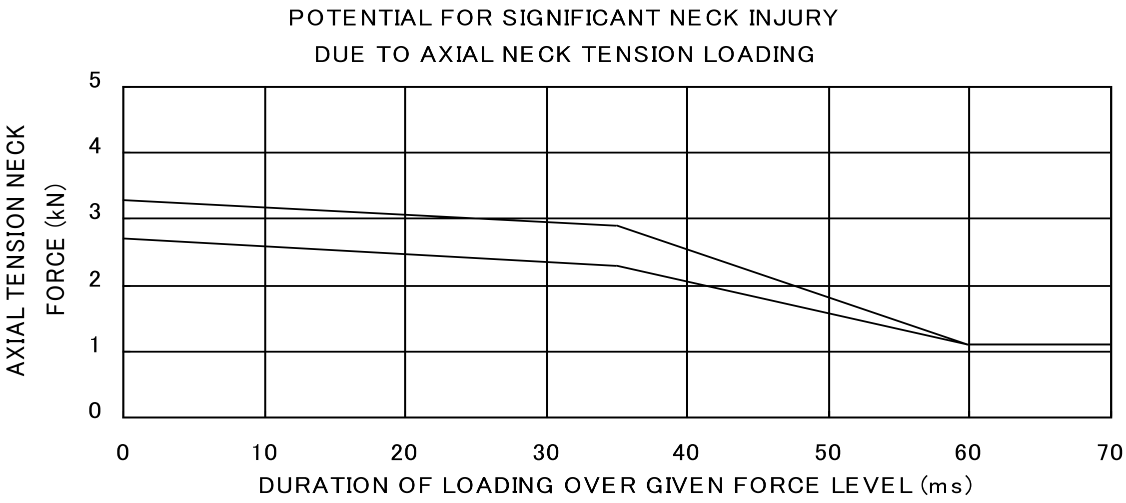
Driver Right Tibia Upper F & M

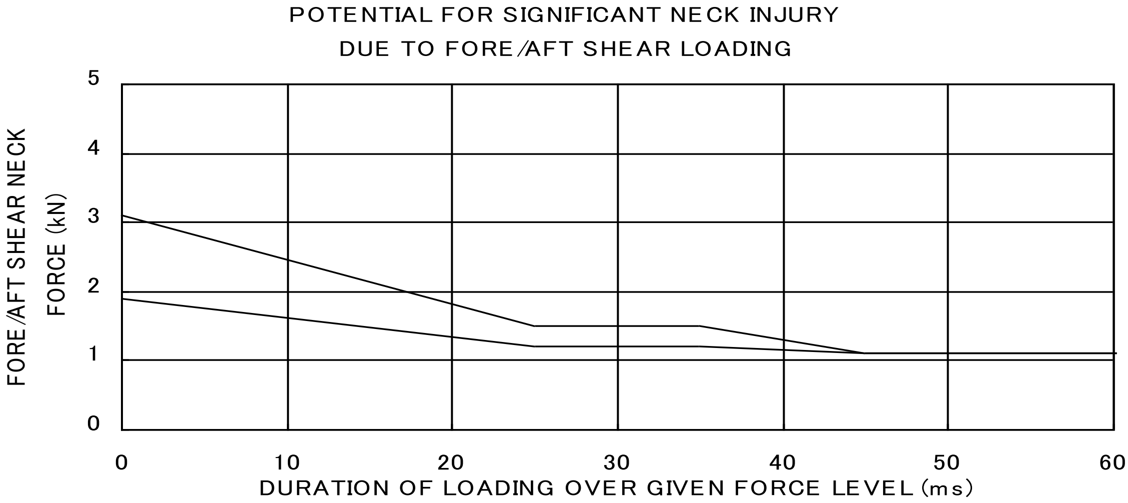
No. NASVA****-****-***

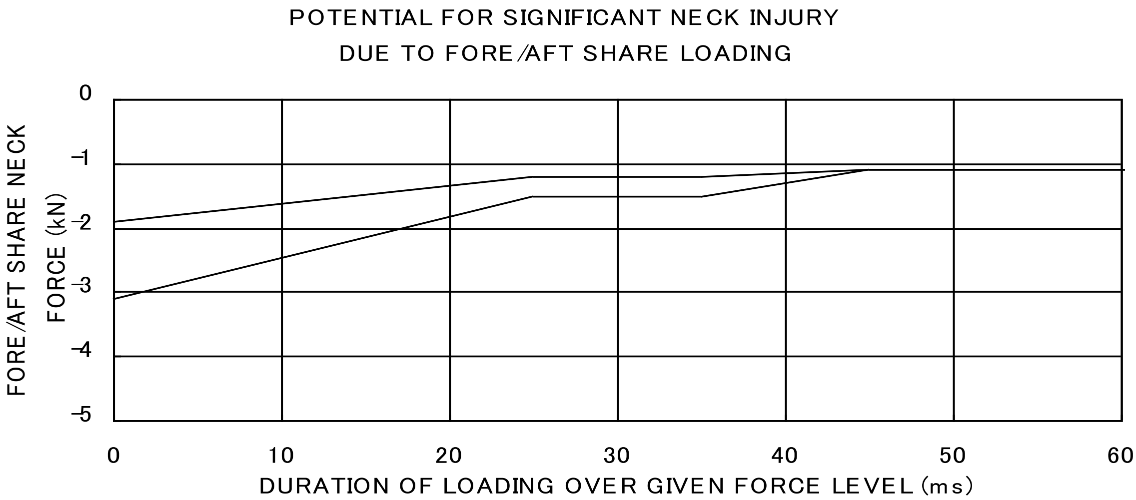


Driver Dummy TI

No. NASVA****-****-***



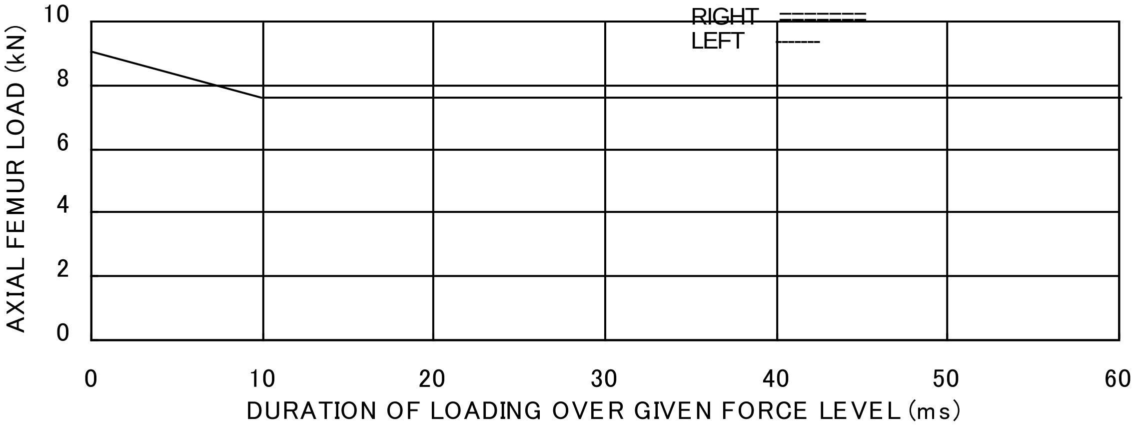




Driver Dummy

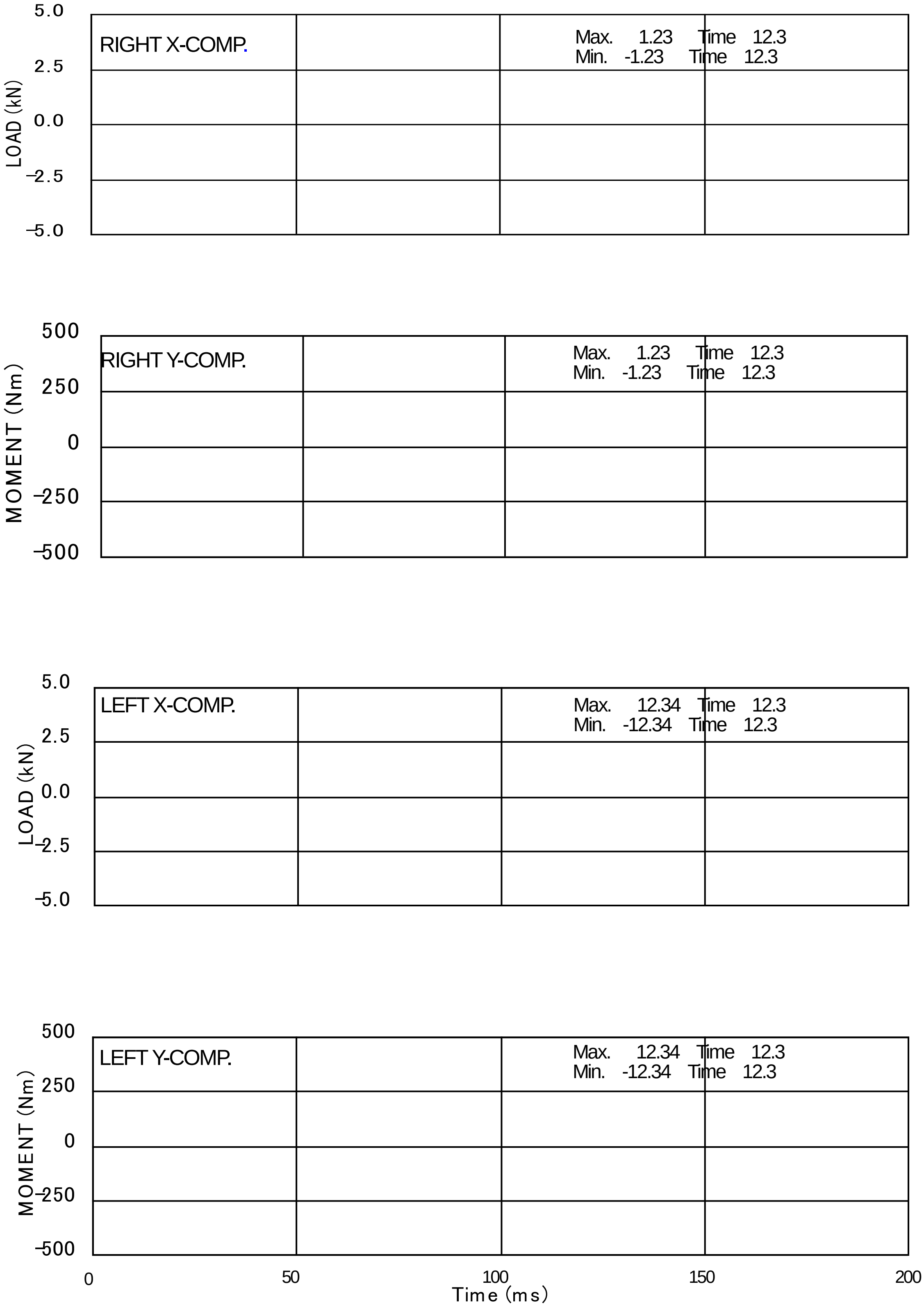
No. NASVA****-****-***

POTENTIAL FOR FRACTURE OF THE FEMUR



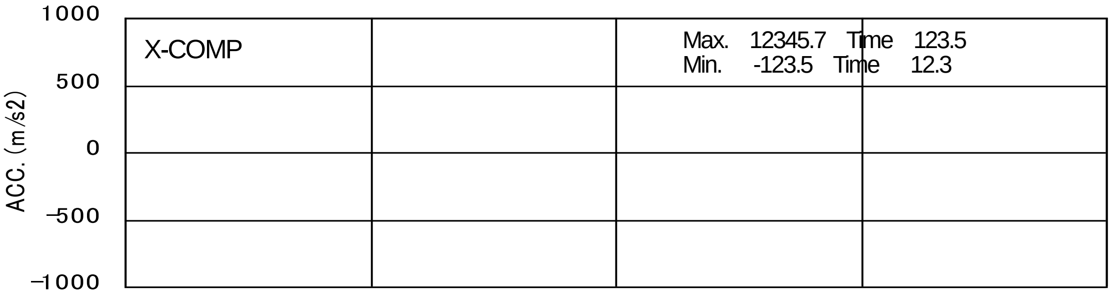
Driver Dummy

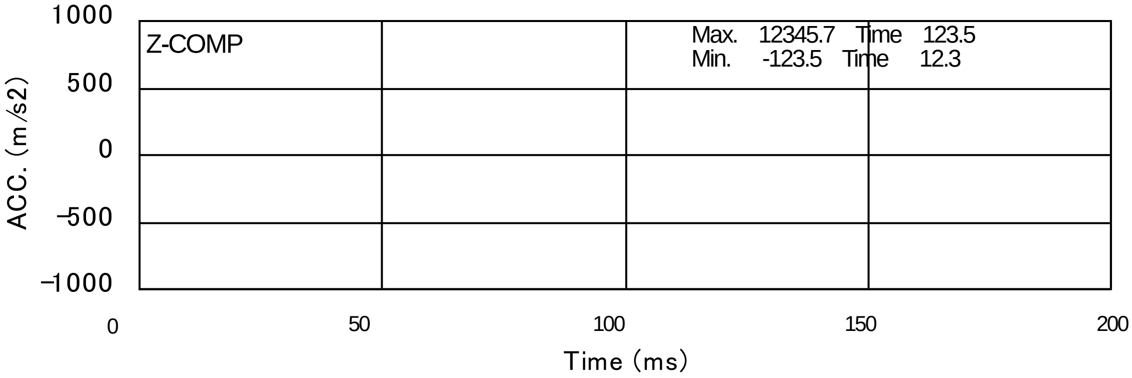
No. NASVA****-****-***



Rear Passenger Dummy iliac F & M

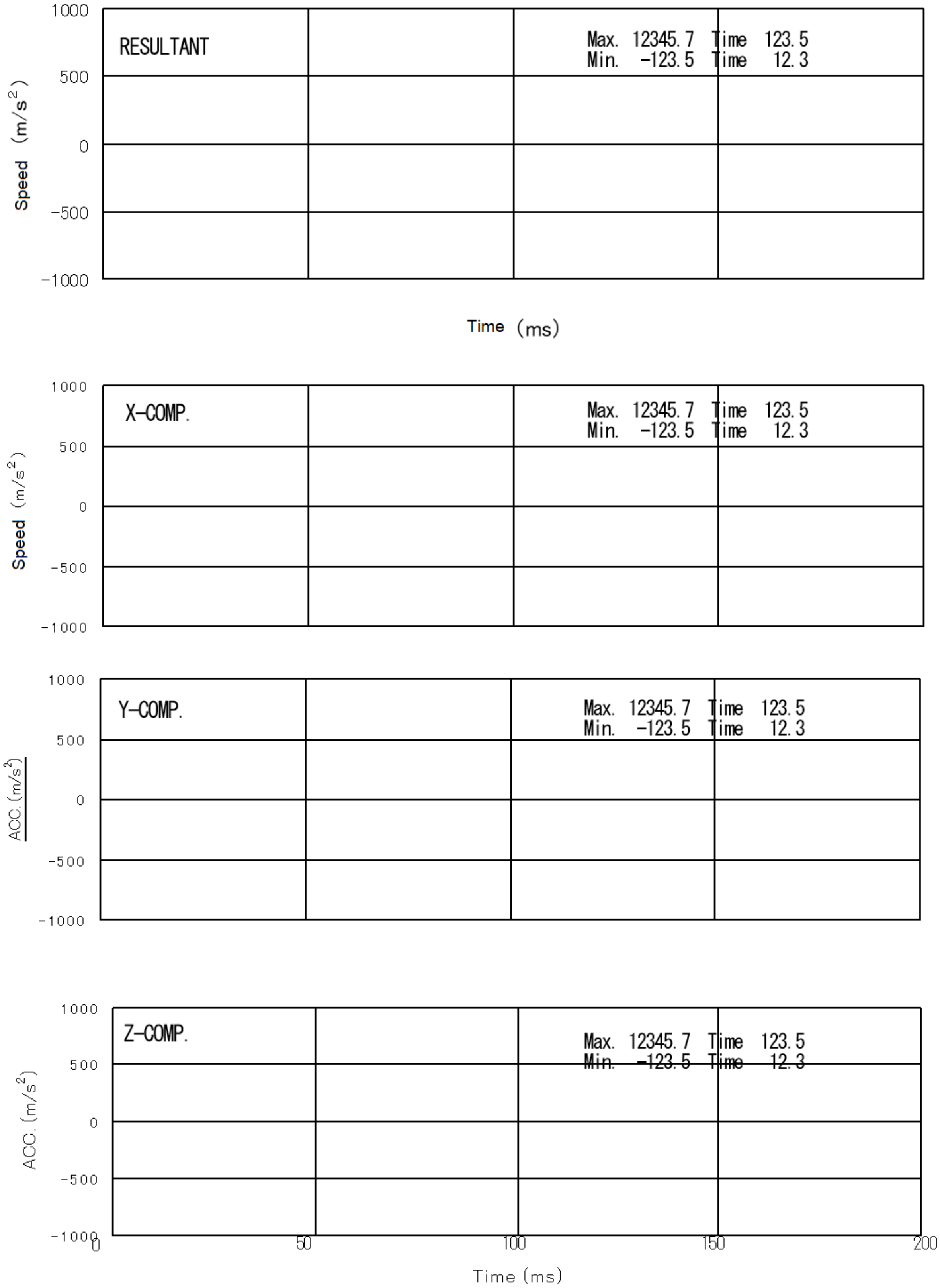
No. NASVA****-****-***





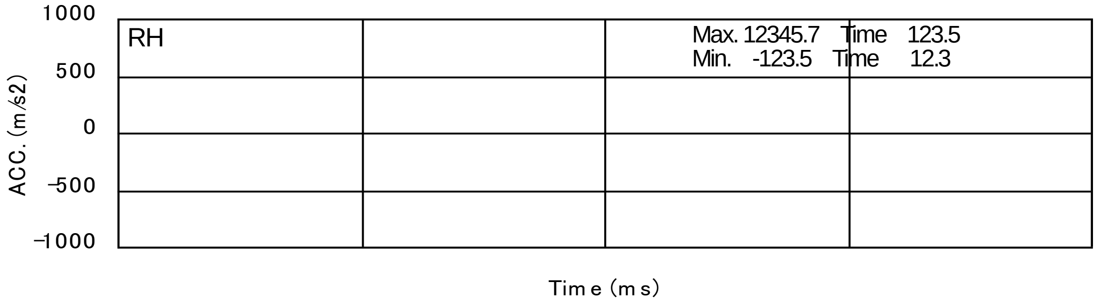
Rear Passenger Dummy Pelvis Acc.

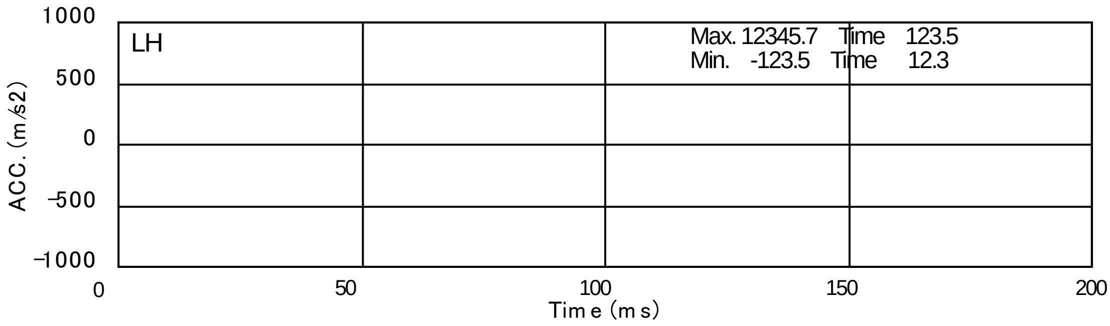
No. NASVA****-****-***



Vehicle Tunnel. Acc.

No. NASVA****-****-***





Vehicle Side Sill Acc.

No. NASVA****-****-***

Appendix 6: Installation Location of Onboard Camera

The head of the onboard camera shall be installed on the roof aft of the driver’s seat. If the vehicle manufacturer suggests a location for installation, they are required to provide the following drawing. If it is impossible to install on the roof, (due to a glass roof, convertible, etc.) the vehicle manufacturer shall specify a suitable location for the onboard camera and installation instructions.

Appendix 7: Installation Location of Main Body of Onboard Camera, Battery, etc.

If the vehicle manufacturer have recommended locations for installing the onboard cameras, batteries, lighting equipment, etc., specify them below in an illustration. If there is no space for installing any device in the compartment, specify alternative locations.

Procedure for Mounting Driver Seat Dummy

The dummy shall be mounted in the test vehicle as follows.

1. Seating Position

(1) Before positioning the dummy, confirm that the through-hole in the dummy's chest is in an appropriate condition (the holes in the jacket, etc., are matched up so that adjustment tools can be inserted.)

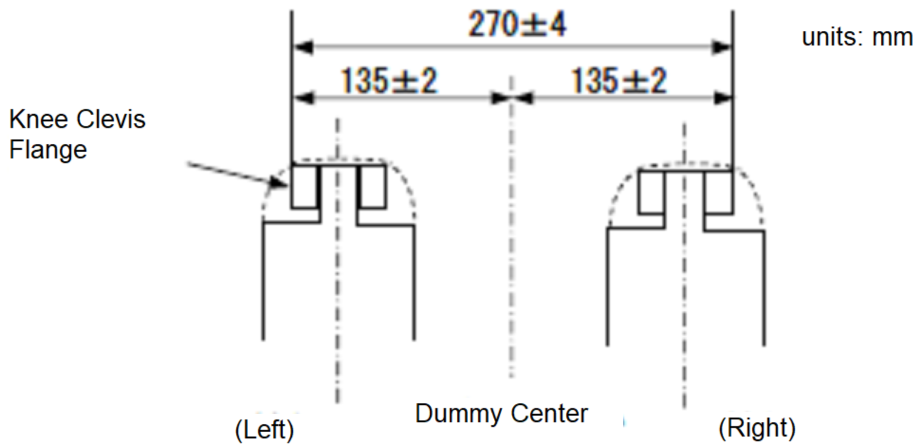
(2) The center between the right and left of the dummy shall be aligned with the center of the designed seating position.

(3) The upper torso of the dummy shall be in contact with the seatback.

2. Position of the Feet

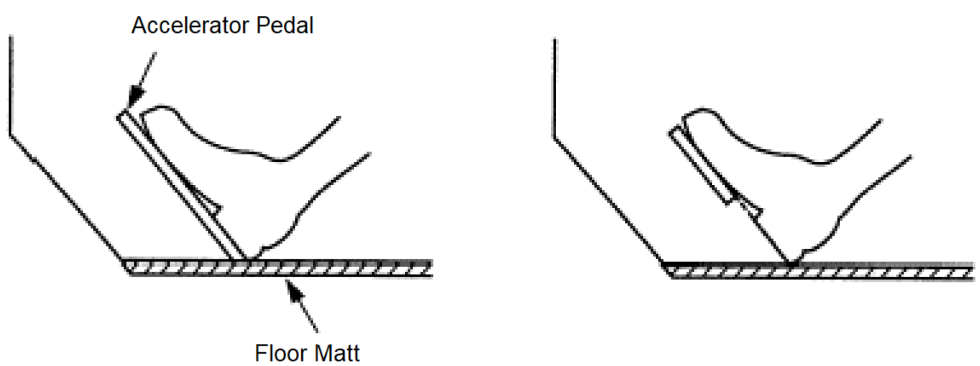
(1) The distance between both knees shall be adjusted as specified in Figure 1, but this measurement does not define the final position.

Figure 1



(2) The right foot shall rest on the undepressed accelerator pedal, and the heel placed on the floor pan at the lower edge of the accelerator pedal. (Figure 2)

Figure 2



(3) When the plane formed by the femur and the tibia of the right leg is not vertical, required adjustment shall be made by moving the knee so that it may be as upright as possible.

(4) The left foot shall be positioned as close as possible to the floor point, where the toe board and the floor pan cross. The foot itself shall rest on the toe board. If the foot does not reach the toe board, the foot shall be made vertical to the tibia and placed at the point as close as possible to the toe board. If there is a footrest, the foot shall be placed on it (Figures 3, 4, and 5).

Figure 3: Able to reach the toe board

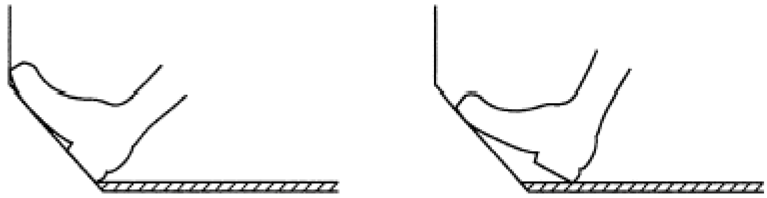


Figure 4: Unable to reach the toe board

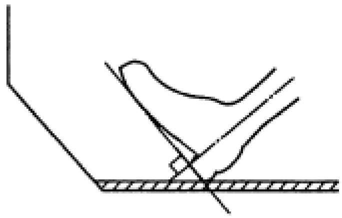
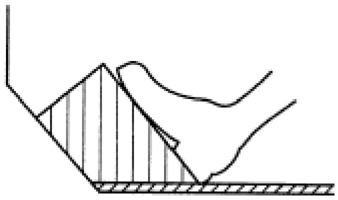


Figure 5: When there is a footrest



(5) When the plane formed by the thigh and the tibia of the left leg is not vertical, the required adjustment shall be made by moving the knee so that it is as vertical as possible. If the leg interferes with the brake pedal or the clutch pedal, the left leg shall be made to rotate by pivoting the tibia to the minimum extent. If interference still occurs, the thigh shall be rotated to minimize such interference.

3. Initial Position of the Hands and Arms

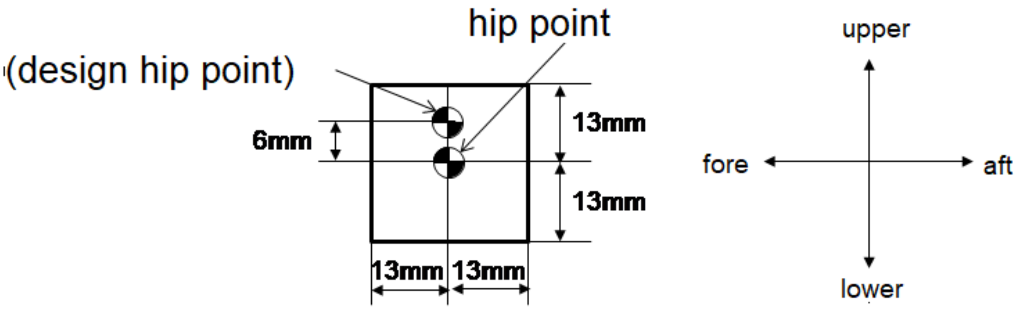
(1) The upper arms shall be in contact with the seatback, and with the sides of the torso.

(2) The lower arms and hands shall be positioned along the outsides of the right and left upper legs.

4. Position of the Upper-Torso

(1) Match the dummy's outer body hip point to the design hip point after adjusting the seat position, with the fore-and-aft direction unchanged and the vertical direction 6 mm below the design hip point. The dummy hip point only needs to be within the range shown in Figure 6 in relation to the design hip point. However, if the dummy hip point cannot meet this requirement, it shall be placed as close as possible to that shown in Figure 6.

Figure 6

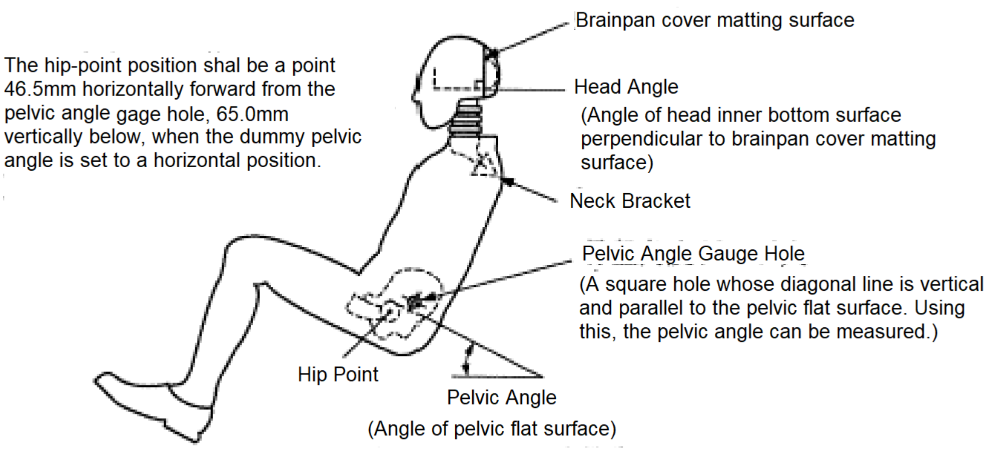


(2) Set the pelvic angle to the range of 22.5° ± 2.5° (Figure 7).

(3) Set the head angle within the range of ±0.5° of the horizontal. If the head angle cannot be set within this range, readjust the upper torso of the dummy in the sequence of the hip point and the pelvic angle. This readjustment shall be carried out within the range given in (1) and (2). If this readjustment still fails to bring the head angle within the range specified in this paragraph, move the neck bracket to bring the head angle within the specified range (Figure 7).

(4) If the pelvic angle fails to be brought within the range given in (2), even after adjusting the position of the dummy upper torso according to the provisions of (1) through (3), the pelvic angle may be adjusted within the range of ±2.5° of the torso angle. However, if the head angle is now beyond the range given in (3) as a result of the aforesaid adjustments, move the neck bracket so that the neck angle becomes as close to the horizontal position as possible.

Figure 7



5. Positioning the Hands and Arms

(1) Place the thumbs on the rim of the steering wheel, and the palms, as far apart as possible, on any line passing through the center of the steering wheel, with the backs directed to the outside of the motor vehicle, and with the armpits closed.

(2) Fix the thumbs on the steering wheel with drafting tape about 12mm wide.

6. Repositioning the Feet

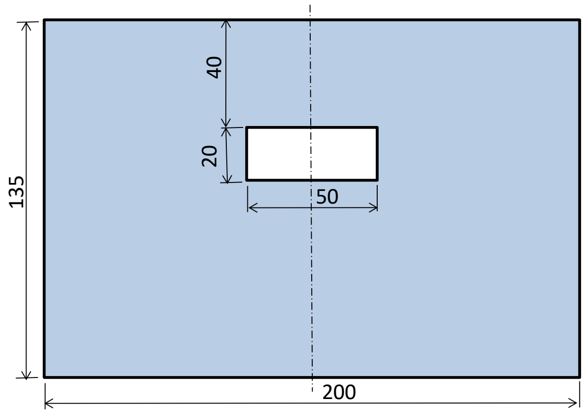
If the foot position is displaced while positioning the upper torso, etc., return the feet to the position determined in accordance with Paragraph 2.

7. Placing the Pressure-Sensitive Paper on the Driver Dummy's Chest

To confirm a secondary collision with the driver dummy's chest and the steering wheel, on a trial basis, pressure-sensitive paper shall be applied to the driver dummy's chest by the procedure outlined below. (Intended for steering wheels over 32° angles.)

(1) The pressure-sensitive paper (pressure-measuring film) shall be capable of measuring between 2.5MPa and 10MPa. The range for confirming a secondary collision between the steering wheel and the dummy's chest shall be 135mm tall by 200mm wide, and the pressure-sensitive paper shall be applied to at least the specifications diagramed in Figure 8. Furthermore, to insure that the through hole in the dummy's chest is not obscured, a hole will be punctured in the paper as shown in Figure 8.

Figure 8: Secondary Collision Evaluation Range and Method for Opening a Through-Hole in the Dummy's Chest



(2) Have a witness confirm that there is no coloring on the paper before it is attached.

(3) If the paper cannot be attached without moving the dummy's arms and/or hands, move the arms and hands as little as possible while flipping up the dummy's clothes to attach the paper.

(4) Attach the pressure-sensitive paper (sometimes 2 papers, according to type) from the dummy's lower-neck to the ribcage, as shown in Figure 9. Place the paper as centered as possible, making sure that the through-holes in the chest are exposed. Secure the pressure-measuring film with tape at both the top and bottom edges.

(5) Once a witness confirms that there is no coloring on the set pressure-measuring film, take a photograph.

(6) After attaching the paper, return the clothes, arms, and hands to their original positions.

Figure 9: Positioning the Pressure-Sensitive Paper

Procedure for Mounting Backseat Dummy

The dummy shall be mounted on the test vehicle as follows.

1. Seating Position

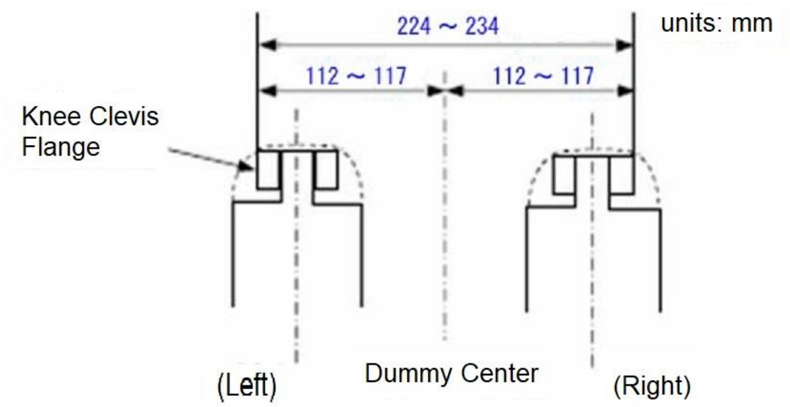
(1) The center between the right and left of the dummy shall be aligned with the center of the designed seating position.

(2) The upper torso of the dummy shall be in contact with the seatback and the hip point shall be adjusted as close as possible to the location of the design hip point after adjusting the seat location.

2. Position of the Legs

(1) The distance between both knees shall be adjusted as specified in Figure 8, but this measurement does not define the final position.

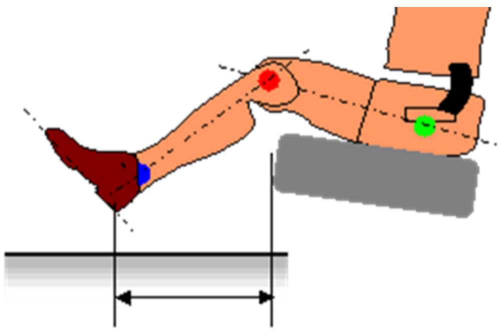
Figure 8



(2) Each of the planes formed by the femur and the tibia of the right and left legs shall be adjusted to the vertical position.

(3) With the femurs contacting the seat cushion, the lower legs shall be located to the foremost position from the seat cushion front edge (see Figure 9).

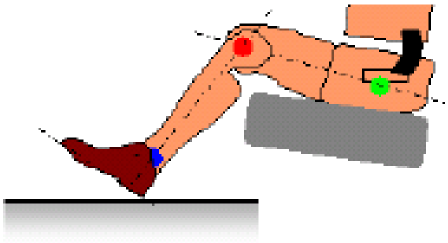
Figure 9



Without changing the femur angle, position the lower legs foremost from the front edge of the rear seat cushion.

(4) The feet and tibias shall be kept at right angles without changing the femur angle, with the feet on the floor (see Figure 10).

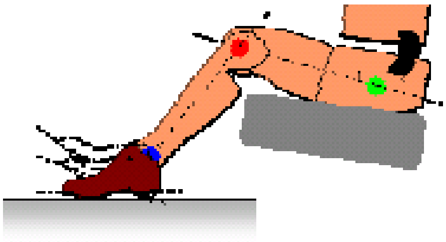
Figure 10



Without changing the femur angle and keeping the feet and tibias at right angles, lower the lower legs until the feet touch the floor.

(5) With the heels in contact with the floor, turn the toes toward the floor as much as possible (see Figure 11).

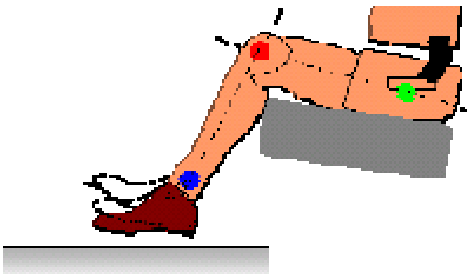
Figure 11



Without changing the position of the heel, turn the toes toward the floor as much as possible.

(6) If the feet are not in contact with the floor, place the calves in contact with the seat cushion front, and turn the feet downward till the rear part of the feet contacts the interior, and the feet are positioned as parallel to the floor as possible (see Figure 12).

Figure 12



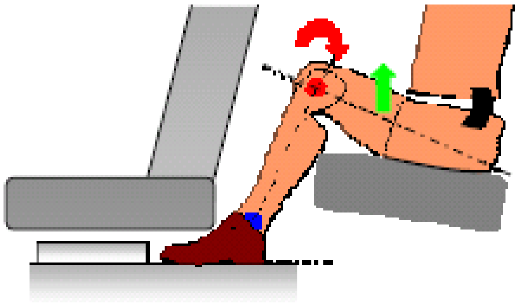
Place the calves in contact with the seat cushion front when the feet are not in contact with the floor, then position the feet as parallel to the floor as possible.

(7) Place the feet in contact with the front seat installation parts or hump of the floor; move the direction of the toes to inward or outward as little as possible and try not to interfere with these parts while maintaining the distance between both knees.

(8) If the feet or legs contact the front seat which is adjusted to the specified position, or the hump

of the vehicle body, lift up the femur and legs and move them rearward, and make the femur contact the rear seat cushion as much as possible (see Figure 13).

Figure 13



If the feet or legs contact the front seat which is adjusted to the specified position, or the hump of the vehicle body, lift up the femur and legs and move them rearward, and make the femur contact the rear seat cushion as much as possible.

3. Initial Positioning of the Hands and Arms

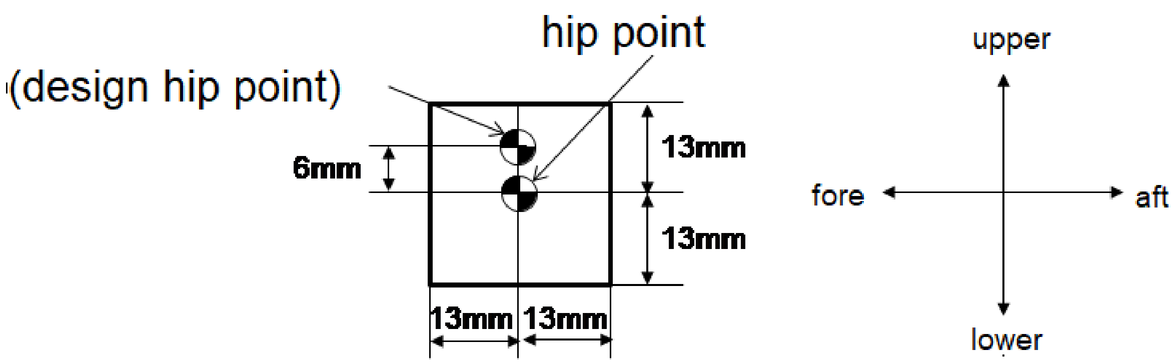
(1) The upper arms shall be in contact with the seatback and with the sides of the torso.

(2) The lower arms and hands shall be positioned along the outsides of the upper legs.

4. Position of the Upper-Torso

(1) Match the dummy's outer body hip point to the design hip point after adjusting the seat position, with the fore-and-aft direction unchanged and the vertical direction 6 mm below the design hip point. The dummy hip point only needs to be within the range shown in Figure 14 in relation to the design hip point. However, if this is not met, the range should be as close to the range as possible.

Figure 14



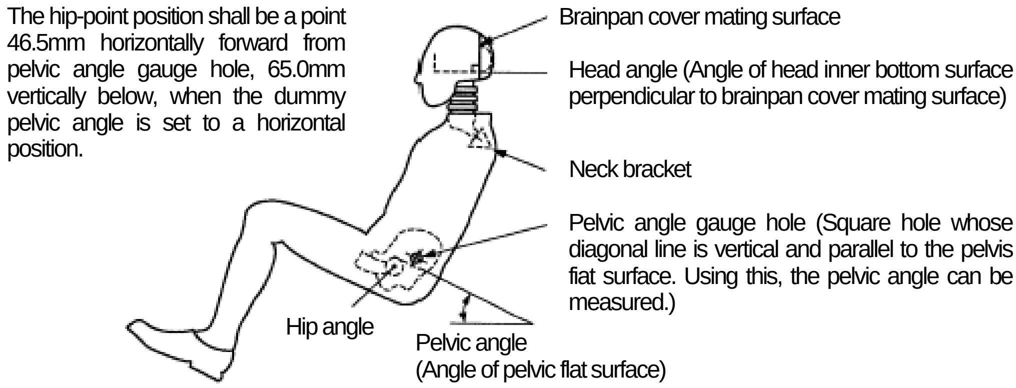
(2) Set the pelvic angle to the range of 20.0° ± 2.5°.

(3) Set the head angle within the range of ±0.5° of the horizontal. If the head angle cannot be set within this range, readjust the upper torso of the dummy in the sequence of the hip point and the pelvic angle. This readjustment shall be carried out within the range given in (1) and (2). If this readjustment still fails to bring the head angle within the range specified in this paragraph, move the neck bracket to bring the head angle within the specified range.

(4) In cases where the position of a dummy's upper body has been adjusted as stipulated in (1) to

(3) and the pelvis angle is not within the range stipulated in (2), the dummy's upper body posture may be moved forward or backward within a range of ±2.5° to adjust the pelvis angle. In cases where, as a result of these adjustments, the head angle no longer falls within the range stipulated in (3), the neck bracket is to be moved to adjust the head angle so that it is as close to level as possible.

Diagram 7



5. Positioning the Arms and Hands

(1) Place the upper arms in contact with the seatback as much as possible and in contact with the torso of the dummy.

(2) The lower arms and hands shall be in contact with the upper legs, and the little fingers shall be positioned so as to slightly touch the seat cushion.

(3) If the hands and arms are in contact with the vehicle trim or other parts after performing procedures (1) and (2), the arm may be placed on the armrest of the trim side to avoid such contact.

6. Repositioning the Legs

If the leg position is displaced while positioning the upper torso, etc., return the legs to the position determined in accordance with Paragraph 2.

Procedure for Measuring the Hip Point and Actual Torso Angle for Seating Positions in Motor Vehicles

1. Objectives

This Attachment describes how to establish the hip point location and actual torso angle for one or several seating positions in a motor vehicle.

2. Definitions

2.1 "Three-dimensional manikin": A device used for measuring hip points and actual torso angles. The device is described in Appendix 1 to this Attachment. The thigh length and lower leg length of the 3-D manikin shall be adjusted to 401mm and 414mm in this measurement process.

2.2 "Hip Point": The pivot center of the torso and the thigh of the 3-D manikin installed in the motor vehicle in accordance with Paragraph 3 below. The hip point is located between the hip point sight buttons on either side of the 3-D manikin. Once determined in accordance with Paragraph 3, the hip point is considered fixed in relation to the seat-cushion structure and to move with it when the seat is adjusted.

2.3 "AM 50 Hip Point": The hip point as specified in Paragraph 2.2 of the Hybrid III male 50% dummy.

2.4 "AF 05 Hip Point": The hip point as specified in Paragraph 2.2 and revised as specified in Paragraph 4 of the Hybrid III female 5% dummy.

2.5 "Torso Line": The centerline of the probe of the 3-D manikin with the probe in the fully rearward position.

2.6 "Actual Torso Angle": The angle measured between the vertical line through the hip point and the torso line using the back angle quadrant on the 3-D manikin.

2.7 "Center Plane of Occupant": The median plane of the 3-D manikin positioned in each designated seating position, represented by the coordinate of the hip point on the "Y" axis. For individual seats, the center plane of the seat coincides with the center plane of the occupant. For other seats, the center plane of the seat coincides with the center plane of the occupant specified by the vehicle manufacturer and importer.

2.8 "Three-Dimensional Reference System": The system as described in Appendix 2 to this Attachment.

2.9 "Fiducial Marks": Physical points (holes, surfaces, marks or indentations) on the vehicle body as defined by the vehicle manufacturer.

2.10 "Vehicle Measuring Posture": The position of the vehicle as defined by the coordinates of fiducial marks in the three-dimensional reference system.

3. Procedure for Determining Hip Point and Actual Torso Angle

3.1 The test vehicle shall be preconditioned at the discretion of the vehicle manufacturer, at a temperature of 20 ± 10ºC to ensure that the seat material reaches the room temperature. If the seat to be checked has never been sat upon, a 70–80kg person or device shall sit on the seat twice for one minute each to flex the cushion and back. All seat assemblies shall remain unloaded for a minimum period of 30 minutes prior to installation of the 3-D manikin.

3.2 The test vehicle shall be at the measuring posture defined in Paragraph 2.10 above.

3.3 The seat, if it is adjustable, shall be adjusted first to the rearmost normal driving or riding position, as specified by the vehicle manufacturer, taking into consideration only the longitudinal adjustment of the seat, excluding seat travel used for purposes other than normal driving or riding positions. Where other modes of seat adjustment exist (vertical, angular, seatback, etc.), these will then be adjusted to the position specified by the vehicle manufacturer. For suspension seats, the vertical position shall be rigidly fixed corresponding to a normal driving position as specified by the vehicle manufacturer.

3.4 The area of the seating position contacted by the 3-D manikin shall be covered by muslin cotton of sufficient size and appropriate texture (18.9 threads/cm^2 and weighing 0.228 km/m^2) or knitted or non-woven fabric having equivalent characteristics.

3.5 Place the seat and back assembly of the 3-D manikin so that the center plane of the occupant coincides with the center plane of the 3-D manikin. The 3-D manikin may be moved inboard with respect to the center plane of the occupant if the 3-D manikin is located so far outboard that the seat edge will not permit leveling of the 3-D manikin.

3.6 Attach the foot and lower leg assemblies, either individually or by using the T-bar and lower leg assembly. A line through the hip point sight buttons shall be parallel to the ground and perpendicular to the longitudinal center plane of the seat.

3.7 Adjust the feet and leg positions of the 3-D manikin as follows:

3.7.1 Both feet and leg assemblies shall be moved forward in such a way that the feet take up natural positions on the floor, between the operation pedals if necessary. Where possible, the left foot shall be located approximately the same distance to the left of the center plane of the 3-D manikin as the right foot is to the right. The spirit level verifying the transverse orientation of the 3-D manikin is brought to the horizontal by readjusting the seat pan if necessary, or by adjusting the leg and foot assemblies towards the rear. The line passing through the hip point sight buttons shall be maintained perpendicular to the longitudinal vertical center plane of the seat.

3.7.2 If the left leg cannot be kept parallel to the right leg and the left leg cannot be supported by the structure, move the left leg until it is supported. The sight button shall be horizontal and perpendicular to the longitudinal vertical center plane of the seat and this state shall be maintained.

3.8 Apply lower leg and thigh weights and level the 3-D manikin.

3.9 Tilt the back pan forward against the forward stop and draw the 3-D manikin away from the seatback using the T-bar. Reposition the 3-D manikin by one of the following methods:

3.9.1 If the 3-D manikin tends to slide rearward, allow it to do so until a forward load on the T-bar is no longer required (i.e. until the seat pan contacts the seatback). If necessary, reposition the lower leg.

3.9.2 If the 3-D manikin does not tend to slide rearward, slide it rearwards by applying a horizontal rearward load to the T-bar until the seat pan contacts the seatback (see Figure 2 of Appendix 1 to this Attachment).

3.10 Apply a 100 ± 10N load to the back pan assembly of the 3-D manikin at the intersection of the hip angle quadrant and the T-bar housing. The direction of load application shall be maintained along a line passing through the above intersection to a point just above the thigh bar housing (see Figure 2 of Appendix 1). Then carefully return the back pan to the seatback. Care must be taken throughout the remainder of the procedure to prevent the 3-D manikin from sliding forward.

3.11 Attach buttock weights to the right and left hip point pivots, then alternately attach the 8 torso weights to the torso weight hangers. Maintain the 3-D manikin level.

3.12 Tilt the back pan forward to release the tension on the seatback. Rock the 3-D manikin from side to side through a 10° arc (5° to each side of the vertical center plane) for three complete cycles to release any accumulated friction between the 3-D manikin and seat.

During the rocking action, the T-bar of the 3-D manikin may tend to diverge from the specified horizontal and vertical alignment. The T-bar must therefore be restrained by applying an appropriate lateral load during the rocking motions. Care shall be taken in holding the T-bar and rocking the 3-D manikin to ensure that no inadvertent exterior loads are applied in a vertical or fore-and-aft direction.

The feet of the 3-D manikin are not to be restrained or held during this step. If the feet change position, they should be allowed to remain in that attitude for the moment.

Carefully return the back pan to the seatback and check the two spirit levels for zero position. If the feet have moved during the rocking operation of the 3-D manikin, they must be repositioned as follows.

Alternately lift each foot off the floor until no additional foot movement occurs. During this lifting, the feet are free to rotate, and no forward or lateral loads are applied. When each foot is placed back in the down position, the heel shall be in contact with the structure designed for this.

Check the spirit level for zero position; if necessary, apply a lateral load to the top of the back pan sufficient to level the 3-D manikin's seat pan on the seat.

3.13 Holding the T-bar to prevent the 3-D manikin from sliding forward on the seat cushion, proceed as follows:

(a) Return the back pan to the seatback.

(b) Alternately apply and release a horizontal rearward load, not exceeding 25N, to the back angle bar at the height approximately at the center of the torso weights until the hip angle quadrant indicates that a stable position has been reached after the load is released. Care shall be taken to ensure that no exterior downward or lateral loads are applied to the 3-D manikin. If another level adjustment of the 3-D manikin is necessary, rotate the back pan forward, re-level, and repeat the procedure from Paragraph 3.12.

3.14 Take all of the following measurements:

3.14.1 Measure the coordinates of the hip point with respect to the three-dimensional reference system.

3.14.2 Read the actual torso angle at the back angle quadrant of the 3-D manikin with the probe in its fully rearward position.

3.15 If the 3-D manikin needs to be installed again for a re-run, the seat assembly should remain unloaded for at least 30 minutes prior to the re-run. The 3-D manikin should not be left loaded on the seat assembly for longer than the time required to perform the test.

3.16 If the driver's seat and front passenger seat can be regarded as similar (bench seat, identical seat, etc.), only one hip point and one "actual torso angle" shall be determined. The 3-D manikin described in Appendix 1 is seated on the driver's seat as the representative seat.

4. Determining the Hip Point for the AF05

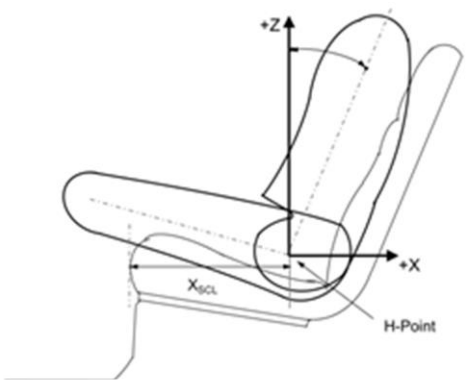
Let the positioning procedure of AM 50% dummy hip point fore-aft and vertical be (X_{AM50}, Z_{AM50}) and the positioning procedure of the AF 05% dummy hip point fore-aft and vertical be (X_{AF0}, Z_{AF05}). XSCL is defined as the horizontal distance between the AM50 dummy's hip point and the seat cushion top's foremost position (see Figure 1). Use the formula below to calculate the AF05 dummy's hip point.

$X_{AF05}=X_{AM50}+（93-0.323×SCL）$

$Z_{AF05}=Z_{AM50}$

Where X represents the car's rearward direction and Z represents the car's upward direction.

Figure 1



Attachment 2 - Appendix 1:   3-D Manikin Description [*note1]

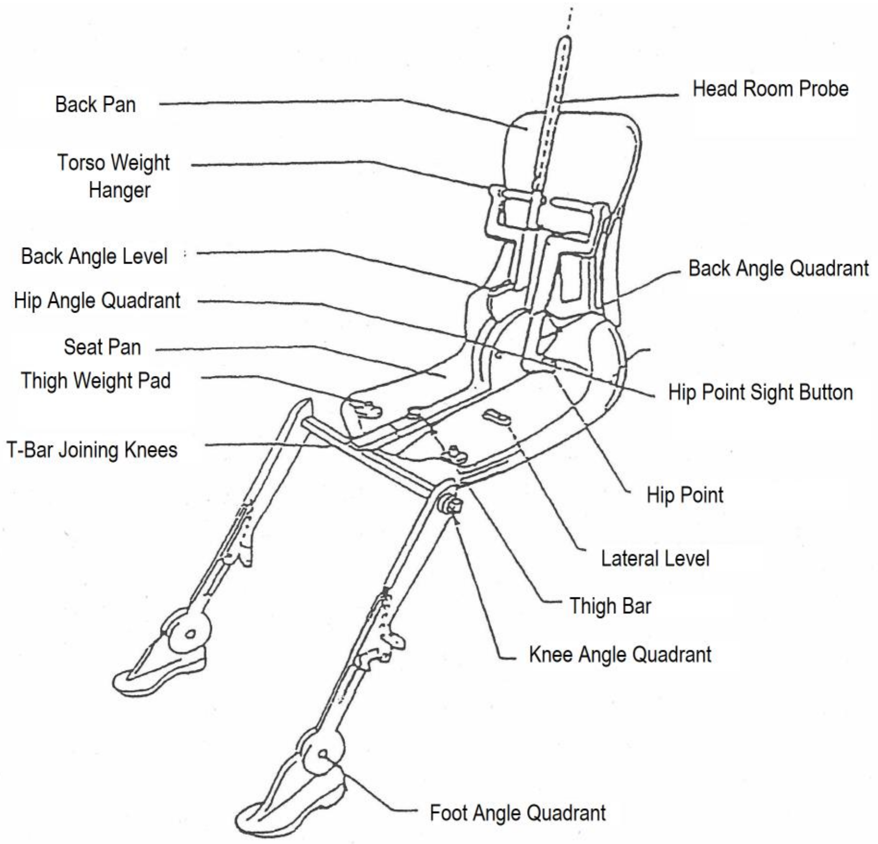
1. Back and Seat Pans

The back and seat pans are constructed of reinforced plastic and metal. They simulate the human torso and thigh and are mechanically hinged at the hip point. A quadrant is fastened to the probe hinged at the hip point to measure the actual torso angle. An adjustable thigh bar, attached to the seat pan, establishes the thigh centerline and serves as a baseline for the hip angle quadrant.

2. Body and Leg Elements

Lower leg segments are connected to the seat pan assembly at the T-bar joining the knees, which is a lateral extension of the adjustable thigh bar. Quadrants are incorporated in the lower leg segments to measure knee angles. Shoe and foot assemblies are calibrated to measure the foot angle. Two spirit levels determine the position of the manikin in the vertical and horizontal directions. Body element weights are placed at the corresponding centers of gravity to provide seat penetration equivalent to a 76kg male. All joints of the 3-D manikin should be checked for free movement without encountering noticeable friction.

Figure 1 3-D Manikin Elements Designation



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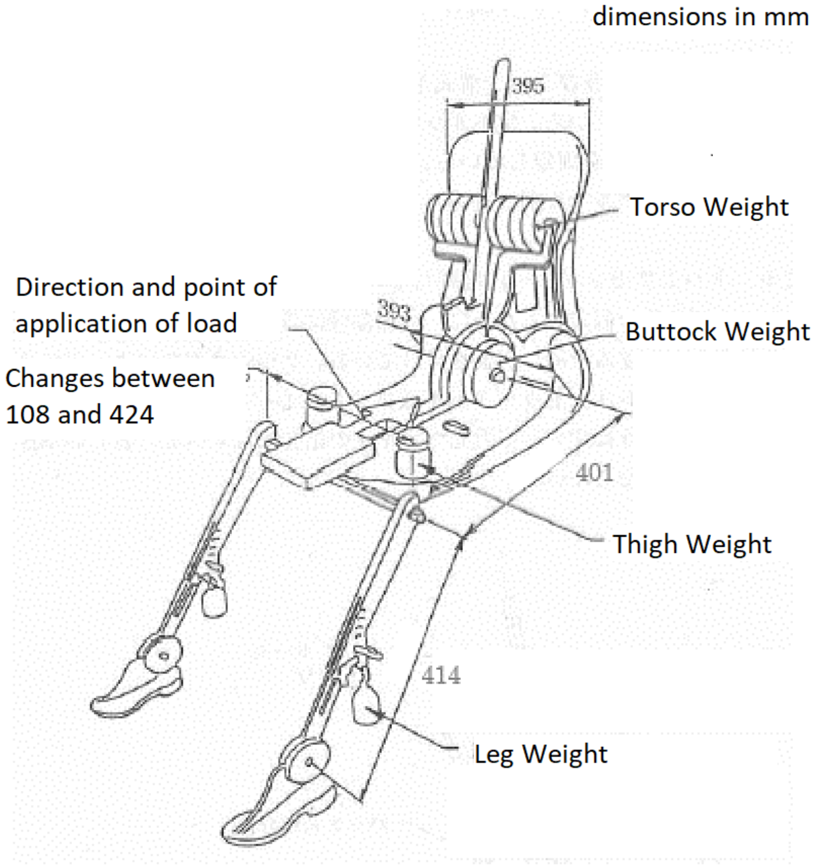
*note1 For details of the construction of the 3-D manikin refer to SAE, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096. The machine corresponds to that described in ISO Standard 6549-1999 and SAEJ826.

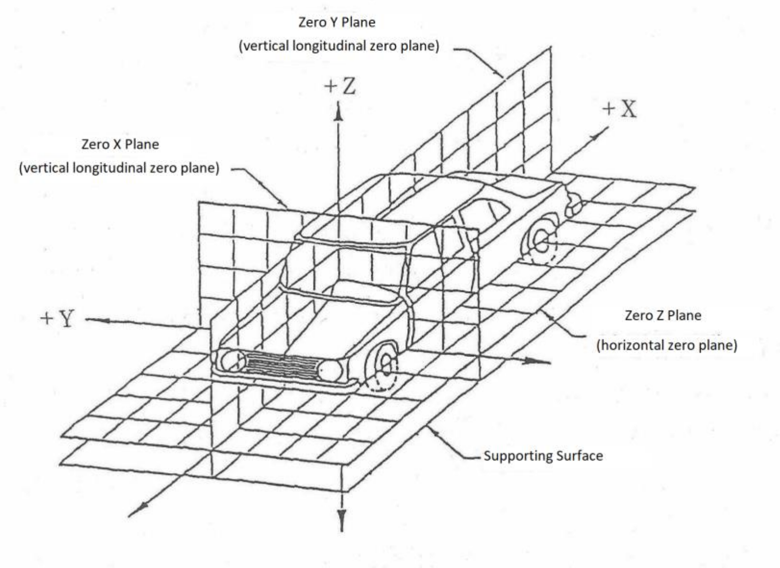
Figure 2 - Dimensions of the 3-D H Measuring Device Elements and Load Distribution



Attachment 2 - Appendix 2: 3-D Reference System

1. The three-dimensional reference system is defined by three orthogonal planes established by the motor vehicle manufacturer and importer. (See Figure). (*note2)
2. The vehicle-measuring posture is established by positioning the vehicle on the supporting surface such that the coordinates of the fiducial marks correspond to the values indicated by the motor vehicle manufacturer.
3. The coordinates of the hip point are established in relation to the fiducial marks defined by the motor vehicle manufacturer.

Figure: 3-D Reference System



note2 The reference system corresponds to ISO standard 4130-1978

Hybrid III 50% Dummy Verification Procedure

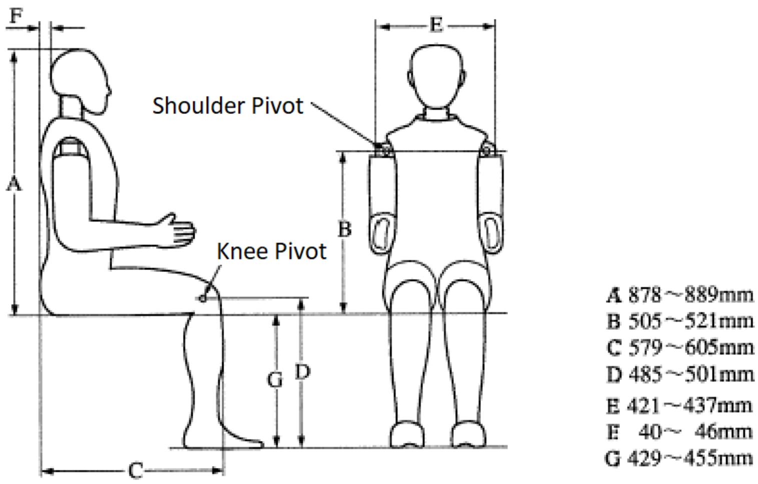
1. Verification Procedure and Requirements

It is permissible, disassemble or assemble the dummy if such operations are necessary to verify the characteristics of each part of the dummy in accordance with the provisions of Paragraphs 1.2 through 1.6. Furthermore, the measurement of the constructional dimensions provided for in Paragraph 1.1 shall be conducted after all verifications of Paragraphs 1.2 through 1.6 have been completed and the dummy has been assembled in the normal condition. Moreover, tape, etc. may be used to maintain dummy posture during the measurement of dummy dimensions and verifications of characteristics.

1.1 Mounting Dimensions

When subjected to dimensional measurements of each part of the dummy, the respective dimensions shall be the same as shown in Figure 1.

Figure 1: Hybrid III Mounting Dimensions



1.2 Head Characteristics

When the verification test is conducted as follows, the maximum of the resultant acceleration at the time of dropping shall be 2,205–2,695m/s^2. Additionally, in a curve indicating the relationship between the resultant acceleration occurring at the head, and the lapse time, the maximum value of a waveform that occurs after the main waveform (the maximum waveform) shall be 10% or less of the maximum value of the main waveform. Moreover, the maximum value of the acceleration in the lateral direction shall be 147m/s^2 or less.

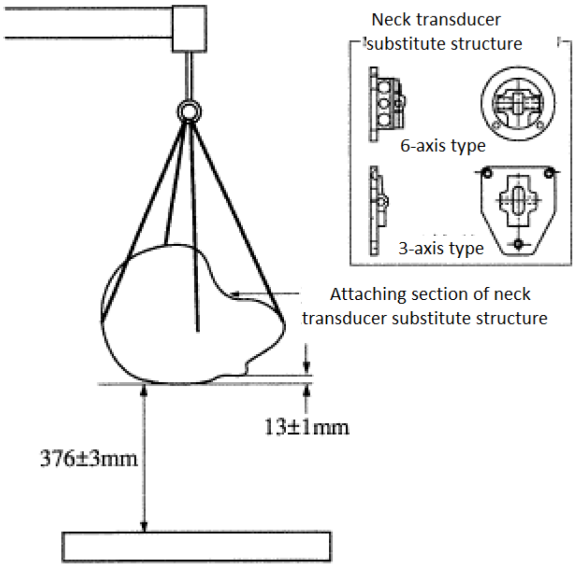
(1) Condition the head to be verified in an environment with temperature of 18.9 ºC –25.6ºC and relative humidity of 10–70% for at least four hours.

(2) Suspend the head as shown in Figure 2 so that the lowest point of the forehead is 13 ± 1mm below the lowest point of the dummy nose. Drop the head from a height of 376 ± 3mm onto a steel plate which measures 50mm or more in thickness with a surface roughness of 0.0002mm to 0.002mm (ms). Measure the accelerations in three axes (the fore-and-aft direction, the lateral

direction and the vertical direction) and calculate the maximum value of the resultant acceleration. In this case, it is permissible to attach a neck transducer on the head to attain the actual attaching conditions.

(3) When the verification is conducted on the same head consecutively, allow at least three hours between successive tests, under the environmental conditions given in (1).

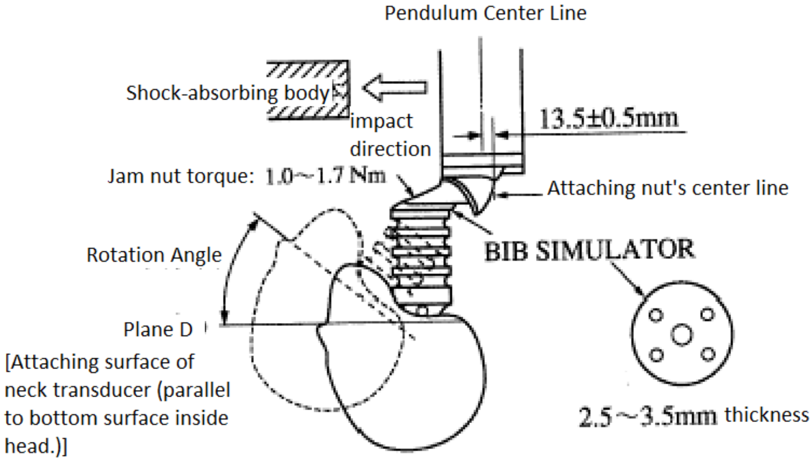
Figure 2: Head Characteristics Test



1.3 Neck Characteristics

When conducting the verification test as follows, the characteristics	① Plane D in Figure 3 shall rotate between 64° and 78° in a time of 57ms to 64ms after the impact (with the moment when the impact surface comes in contact with the shock-absorbing torso regarded as the zero time point). In the first rebound, the rotation of plane D shall cross the 0° position between 113ms and 128ms. ② The maximum moment measured by the neck-measuring equipment shall occur between 47ms and 58ms after the impact and shall be within 88–108Nm. Additionally, the positive moment (the moment in the same direction as the rotation direction of the pendulum) shall decay for the first time to 0Nm between 97ms and 107ms after the impact.
Characteristics at extension side	① Plane D in Figure 4 shall rotate between 81° and 106° in a time of 72ms to 82ms after the impact. In the first rebound, the rotation of plane D shall cross the 0° position between 147ms and 174ms. ② The maximum moment measured by the neck measuring equipment shall occur between 65ms and 79ms after the impact and shall be within the range of –80Nm to –53Nm. Additionally, the negative moment (the moment in the reverse direction of the rotating direction of the pendulum) shall decay for the first time to 0Nm between 120ms and 148ms after the impact.

Figure 3: Neck Flexion Side Characteristics Test

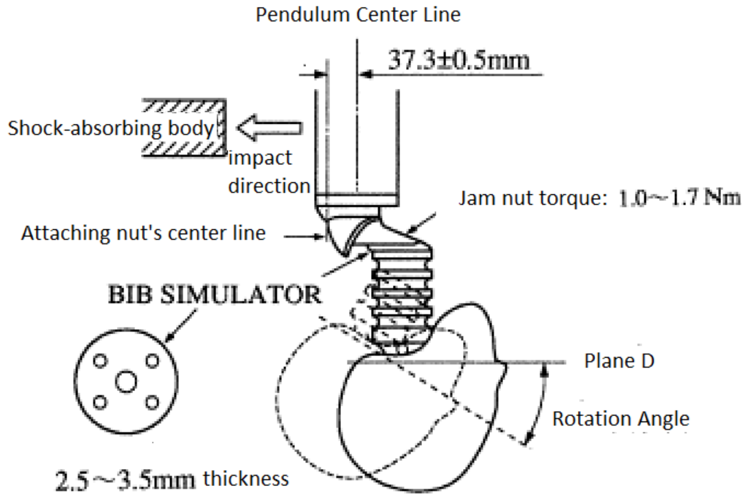


Example: rotation angle measurement method

・Measure with a mounted displacement meter, then calculate.

・Film analysis, using high-speed photos

Figure 4: Neck Extension Side Characteristics Test



(1) Condition the neck to be verified in an environment with temperature of 20.6–22.2ºC and relative humidity of 10–70% for at least four hours.

(2) Prior to verification, tighten the jam nut of the neck cable to a torque of 1.0Nm –1.7Nm.

(3) Mount the neck and head on a pendulum as shown in Figure 5. The face section shall face toward the collision direction for verification at the flexion side, and the reversed direction for verification at the extension side. A bib simulator (see Figures 3 and 4) shall be mounted to attain actual matching. Furthermore, Plane D shall be virtually perpendicular to the centerline of the pendulum. However, it is permissible to employ a head used exclusively for verification, on which a displacement meter for verification is mounted.

(4) Apply an impact by releasing the pendulum and allow it to fall freely from a height such that the velocity at impact becomes 6.89m/s –7.13m/s for verification at the flexion side, and 5.95m/s –6.18m/s for verification at the extension side. Measure and calculate the rotational angle and

moment of the neck at this moment.

Use the formula below to calculate the neck moment:

① When using three-axis type measuring equipment:

$M = M_y - 0.008763\ (M) \times F_x$

② When using six-axis type measuring equipment:

$M = M_y - 0.01778\ (M) \times F_x$

Where:

M : Moment of neck (unit: Nm)

M_y: Moment of neck measuring equipment (unit: Nm)

F_x: X axis force of neck measuring equipment (unit: N)

(5) For verification at the flexion side, the deceleration of the pendulum occurring at the time of impact shall be within the range specified in the right column of table A in accordance with the lapse time after the impact specified in the left column of table A. Furthermore, the curve indicating the relationship between the deceleration of the decaying pendulum and the lapse time shall first cross the 49m/s^2 level between 34ms and 42ms. For verification at the extension side, the said deceleration shall be within the range specified in the right column of table B in accordance with the lapse time after the impact specified in the left column of table B. Furthermore, the curve indicating the relationship between the deceleration of the decaying pendulum and the lapse time shall first cross the 49 m/s^2 level between 38ms and 46ms.

Figure 5 - Neck Characteristics Test

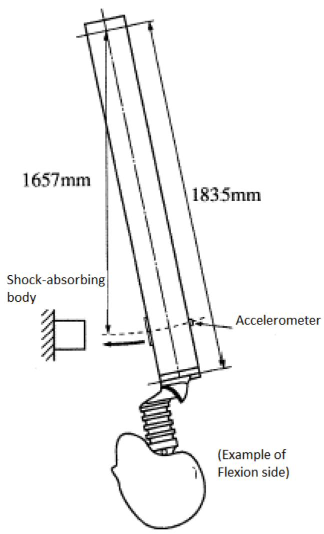


Table A

Time (ms)	Acceleration Range (m/s^2)
10	220～270
20	172～222
30	122～182
Over 30	Under 285

Table B

Time (ms)	Acceleration Range (m/s^2)
10	168～208
20	137～187
30	107～157
Over 30	Under 216

(6) When verification is conducted on the same neck, etc., allow at least 30 minutes between successive tests, under the environmental conditions given in (1).

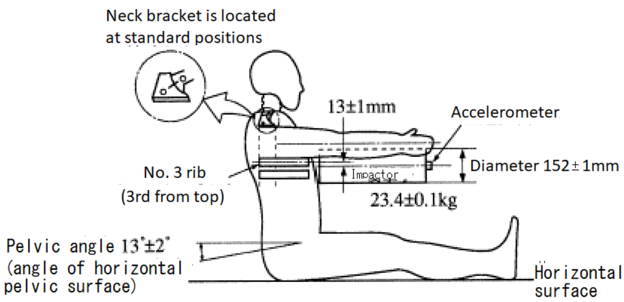
1.4 Chest Characteristics

When impact is applied to the dummy chest with an impactor as follows, the maximum value of the impact force occurring at the impactor shall be 515daN –589daN. Furthermore, the maximum displacement of the sternum relative to the dummy spine shall be 63mm –73mm. Moreover, the internal hysteresis at the moment of impact shall be 69%–85%.

(1) Condition the chest to be verified in an environment with temperature of 20.6 ºC –22.2ºC and relative humidity of 10%–70% for at least four hours.

(2) Seat the dummy on a flat surface, without a back support or armrest, as shown in Figure 6. The joint of the shoulder and elbow shall be tightened securely so that the upper limbs may be extended forward. Adjust the pelvic angle to 13° ± 2°. The dummy may be clothed in a shirt and pants as provided in Paragraph 3.2.9.2 (3) of this Technical Standard.

Figure 6　Chest Characteristics Test

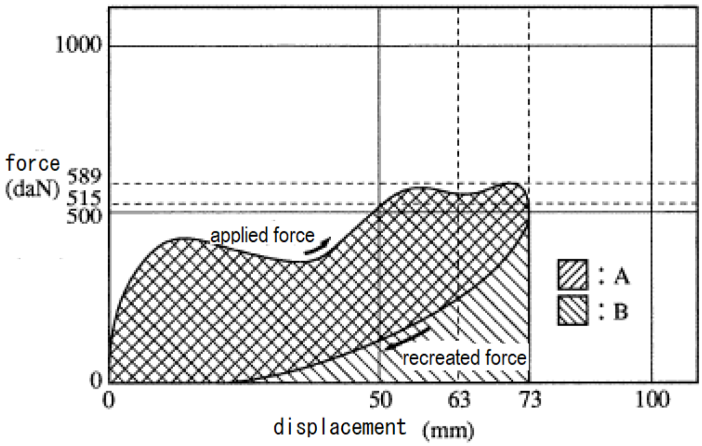


(3) Adjust the positional relationship between the impactor and the No. 3 rib in such a way that the longitudinal centerline extended from the impactor is 13.0 ± 1.0mm below the horizontal centerline of the No. 3 rib on the median plane of the dummy.

(4) Impact the chest with the impactor at a speed of 6.59m/s –6.83m/s. Measure the deceleration occurring at the rear end of the impactor, the displacement of the sternum relative to the dummy spine (measured by a potentiometer mounted inside the sternum), and calculate the impactor force occurring at the impactor (the product of the impactor mass and the deceleration) and the hysteresis (the ratio of area A between the loading and unloading portions of the force-displacement curve to area B under the loading position of the curve (A/B) (see Figure 7).

(5) When verification is conducted on the same chest, etc. consecutively, allow at least 30 minutes between successive tests under the environmental conditions given in (1).

Figure 7　Chest Characteristics Test, Force-Displacement Curve



1.5 Leg Characteristics

Apply an impact to each knee on the right and left side with the impactor as follows. The maximum impact force occurring at the impactor shall be 471daN –578daN. (The impactor is a cylinder whose impact applying section has a diameter of 76 ± 1mm. To measure the impactor acceleration that occurs in the longitudinal centerline of the cylinder, the accelerometer shall be mounted on the impactor surface opposite the impactor surface in a way superposed onto the aforesaid line. Furthermore, the impactor mass shall be 5.0 ± 0.1kg, including the accelerometer.) (See Figure 8.)

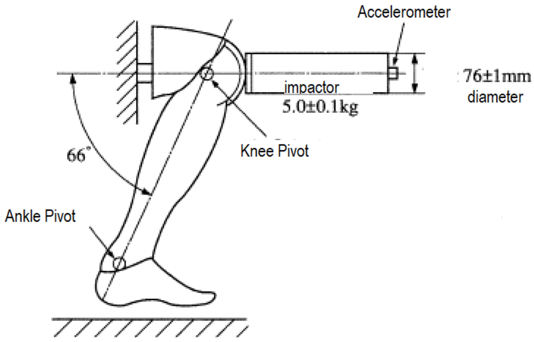
(1) Condition the leg to be verified in an environment with temperature of 18.9 ºC –25.6ºC and relative humidity of 10%–70% for at least four hours.

(2) Adjust the impactor position so that the height of the longitudinal centerline of the impactor is the same as the height of the centerline of the knee pivot bolt on the vertical plane that passes through the centerline of the upper leg at the time when the impactor comes in contact with the knee in a horizontal state.

(3) Impact the leg with the impactor at a speed of 2.07m/s –2.13m/s. Measure the deceleration occurring at the rear end of the impactor and calculate the impact force occurring at the impactor (the product of the impactor mass and the deceleration).

(4) When the verification is conducted on the same leg, etc. consecutively, allow at least 30 minutes between successive tests under the environmental conditions given in (1).

Figure 8 - Leg Characteristics Test



1.6 Bending Characteristics of the Upper-Legs

As shown in Figure 9, when each of the upper legs is rotated vertically, the torque of the upper leg shall be 95Nm or less when rotated 30° from the initial horizontal position, and the requirement for the rotation of 40° or more to 50° or more shall be met at a torque of 203Nm.

(1) The upper leg for verification shall be preconditioned in an environment with temperature of 18.9 ºC –25.6ºC and relative humidity of 10%–70% for at least four hours.

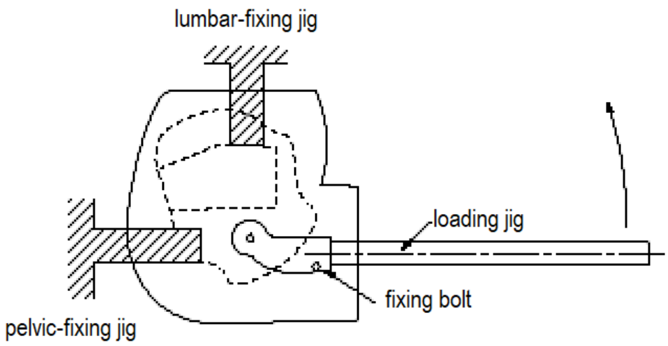
(2) The upper torso from the lumbar vertebra, including the abdominal region, and the legs shall be removed from the dummy.

(3) The dummy shall be installed on the pedestal, and keeping the upper surface of the pelvis horizontal, the pelvis shall be fixed by using a pelvis-fixing jig, and the lumbar vertebra shall be fixed by using a lumbar-fixing jig. The loading jig shall be installed at the axis-rotating joint of the upper leg.

(4) Concerning the loading jig, with its fixing bolt kept horizontal, the jig shall be rotated upward to a torque of 203Nm along the longitudinal vertical plane of the jig. The angular velocity shall be 5°–10° per second. The torque and the rotation angle at this moment shall be recorded.

(5) When verifying the upper legs continuously, verification shall be carried out at intervals of at least 30 minutes, under the environmental conditions given in (1).

Figure 9: Bending Characteristic Test for the Upper Leg



1.7 Lower Leg and Foot Characteristics

1.7.1 Upper Foot Impact Test

1.7.1.1 Test Procedure

1.7.1.1.1 Each leg assembly shall be maintained (soaked) for four hours prior to the test at a temperature of 22 ± 3ºC and a relative humidity of 40 ± 30%. The soak period shall not include the time required to reach steady state conditions.

1.7.1.1.2 Clean the impact surface of the upper foot section and also the impactor surface with isopropyl alcohol or equivalent prior to the test. Dust with talc.

1.7.1.1.3 Align the impactor accelerometer with its sensitive axis parallel to the direction of impact at the contact with the foot.

1.7.1.1.4 Mount the leg assembly to the test fixture (see Figure 1). The test fixture shall be rigidly secured to prevent movement during impact. The centerline of the femur load cell simulator shall be vertical with a tolerance of ±0.5°. Adjust the mount such that the line joining the U-link knee clevis joint and the ankle attachment bolt is horizontal with a tolerance of ±3°, with the heel resting on two sheets of a flat low-friction (PTFE sheet) surface. Ensure that the tibia flesh is located fully towards the knee end of the tibia. Adjust the ankle such that the plane of the underside of the foot is vertical and perpendicular to the direction of impact with a tolerance of ±3° and such that the mid sagittal plane of the foot is aligned with the pendulum arm. Adjust the knee joint to 1.5 ± 0.5 g before each test. Adjust the ankle joint so that it is free and then tighten just sufficiently to keep the foot stable on the PTFE sheet.

1.7.1.1.5 The rigid impactor comprises a horizontal cylinder of diameter 50 ± 2mm and a pendulum support arm of diameter 19 ± 1mm (see Figure 13). The cylinder has a mass of 1.25 ± 0.02kg including instrumentation and any part of the support arm within the cylinder. The pendulum arm has a mass of 285 ± 5G. The length between the central horizontal axis of the impactor cylinder and the axis of rotation of the whole pendulum shall be 1,250 ± 1mm. The mass of the rotating part of the axis to which the support arm is attached should not be greater than 100G.

The impactor cylinder is mounted with its longitudinal axis horizontal and perpendicular to the direction of impact. The pendulum shall impact the underside of the foot, at a distance of 185 ± 2mm from the PTFE sheet of the heel resting on the rigid horizontal platform, so that the longitudinal centerline of the pendulum arm falls within 1° of a vertical line at impact. The impactor shall be guided to exclude significant lateral, vertical or rotational movement.

1.7.1.1.6 Allow at least 30 minutes between successive tests on the same leg.

1.7.1.1.7 The data acquisition system, including transducers, shall conform to the specifications for CFC 600.

1.7.1.2 Performance specifications

When each ball of the foot is impacted at 6.7 ± 0.1m/s in accordance with Paragraph 1.7.1.1, the maximum lower tibia bending moment about the y-axis (My) shall be 120 ± 25Nm.

1.7.2 Lower Foot Impact Test without Shoe

1.7.2.1 Test Procedure

1.7.2.1.1 Each leg assembly shall be maintained (soaked) for four hours prior to the test at a temperature of 22 ± 3ºC and a relative humidity of 40 ± 30%. The soak period shall not include the time required to reach steady state conditions.

1.7.2.1.2 Clean the impact surface of the lower foot section and also the impactor face with isopropyl alcohol or equivalent prior to the test. Dust with talc. Check that there is no visible damage to the energy-absorbing insert to the heel.

1.7.2.1.3 Align the impactor accelerometer with its sensitive axis parallel to the impactor longitudinal centerline.

1.7.2.1.4 Mount the leg assembly to the test fixture (see Figure 11). The test fixture shall be rigidly secured to prevent movement during impact. The leg assembly shall be mounted in accordance with Paragraph 1.7.1.1.4.

1.7.2.1.5 The rigid impactor shall be as specified in Paragraph 1.7.1.1.5. The impactor cylinder is mounted with its longitudinal axis horizontal and perpendicular to the direction of impact. The pendulum shall impact the underside of the foot, at a distance of 62 ± 2mm from the PTFE sheet of the heel resting on the rigid horizontal platform, so that the longitudinal centerline of the pendulum arm falls within 1° of a vertical line at impact. The impactor shall be guided to exclude significant lateral, vertical or rotational movement.

1.7.2.1.6 Allow at least 30 minutes between successive tests on the same leg.

1.7.2.1.7 The data acquisition system, including transducers, shall conform to the specifications for CFC 600.

1.7.2.2 Performance Specifications

When each heel of the foot is impacted at 44 ± 0.1m/s in accordance with Paragraph 1.7.2.1, the maximum impactor acceleration shall be 2,894 ± 491m/s^2 (295 ± 50g).

1.7.3 Lower-Foot Impact Test (with shoes)

1.7.3.1 Test Procedure

1.7.3.1.1 Each leg assembly shall be maintained (soaked) for four hours prior to the test at a temperature of 22 ± 3ºC and a relative humidity of 40 ± 30%. The soak period shall not include the time required to reach steady state conditions.

1.7.3.1.2 Clean the impact surface of the underside of the shoe with a clean cloth and impactor face with isopropyl alcohol or equivalent prior to the test. Check that there is no visual damage to the energy-absorbing insert to the heel.

1.7.3.1.3 Align the impactor accelerometer with its sensitive axis parallel to the impactor longitudinal centerline.

1.7.3.1.4 Mount the leg assembly to the test fixture (see Figure 12). The test fixture shall be rigidly secured to prevent movement during impact. The leg assembly shall be mounted in accordance with Paragraph 1.7.1.1.4.

1.7.3.1.5 The rigid impactor shall be as specified in Paragraph 1.7.1.1.5. The impact cylinder is mounted with its longitudinal axis horizontal and perpendicular to the direction of impact. The pendulum shall impact the heel of the shoe in a horizontal plane at a distance of 62 ± 2mm above the PTFE sheet of the dummy heel when the shoe is resting on the rigid horizontal platform, so that the longitudinal centerline of the pendulum arm falls within 1° of a vertical line at impact. The impactor shall be guided to exclude significant lateral, vertical or rotational movement.

1.7.3.1.6 Allow at least 30 minutes between successive tests on the same leg.

1.7.3.1.7 The data acquisition system, including transducers, shall conform to the specifications for CFC 600.

1.7.3.2 Performance Specifications

When the heel of the shoe is impacted at 6.7 ± 0.1m/s in accordance with Paragraph 1.7.3.1, the maximum tibia compressive force (Fz) shall be 3.3 ± 0.5kN.

Figure 10: Upper Foot Impact Test (Test set-up specification)

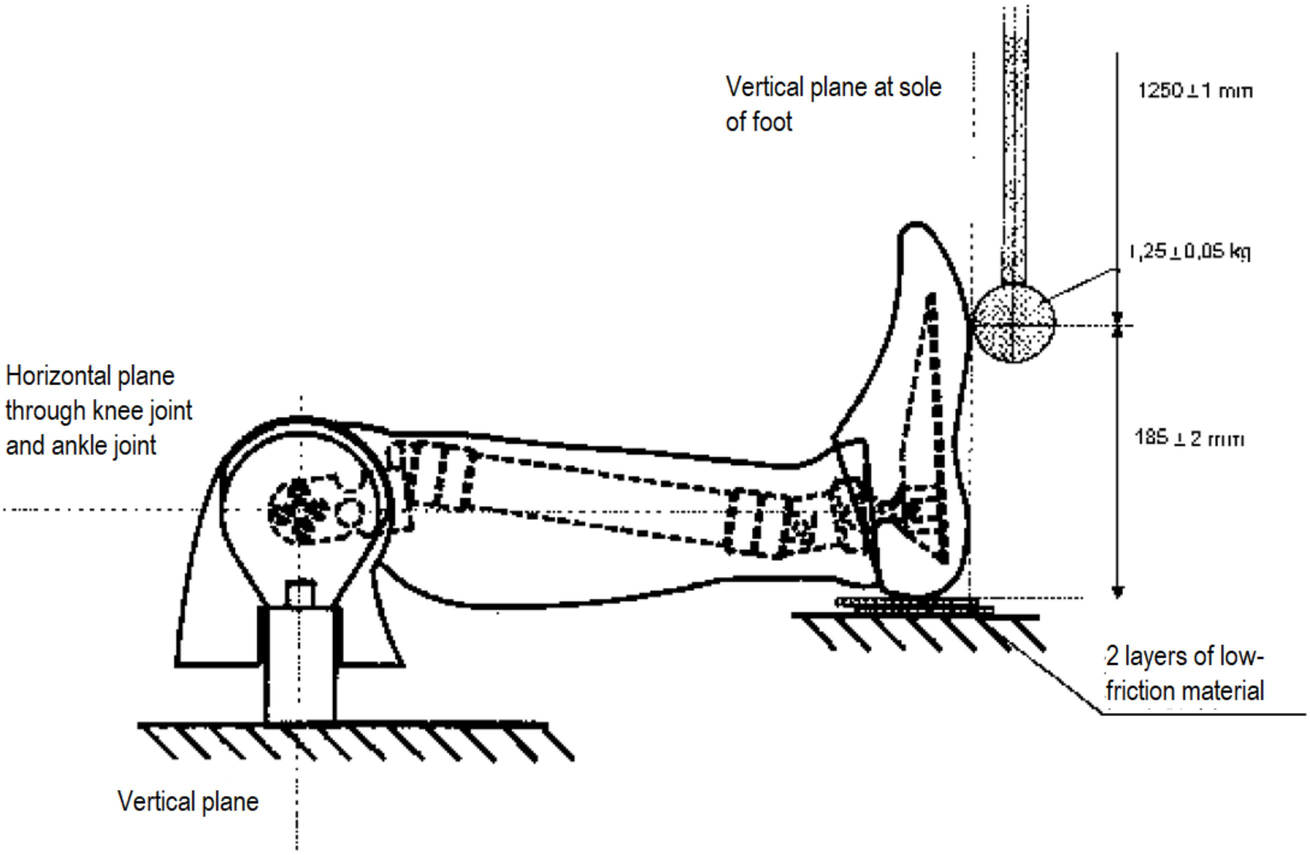


Figure 11: Lower Foot Impact Test (without shoe) (test set-up specifications)

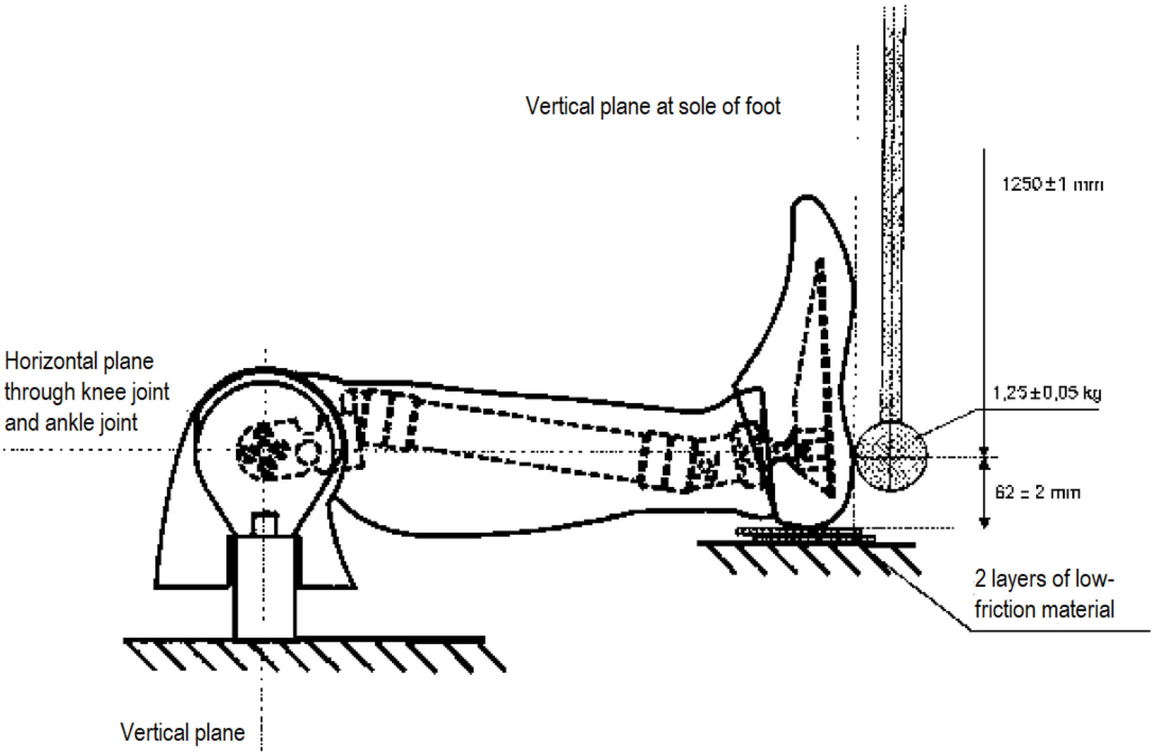


Figure 12 Lower Foot Impact Test (with shoe) (Test set-up specifications)

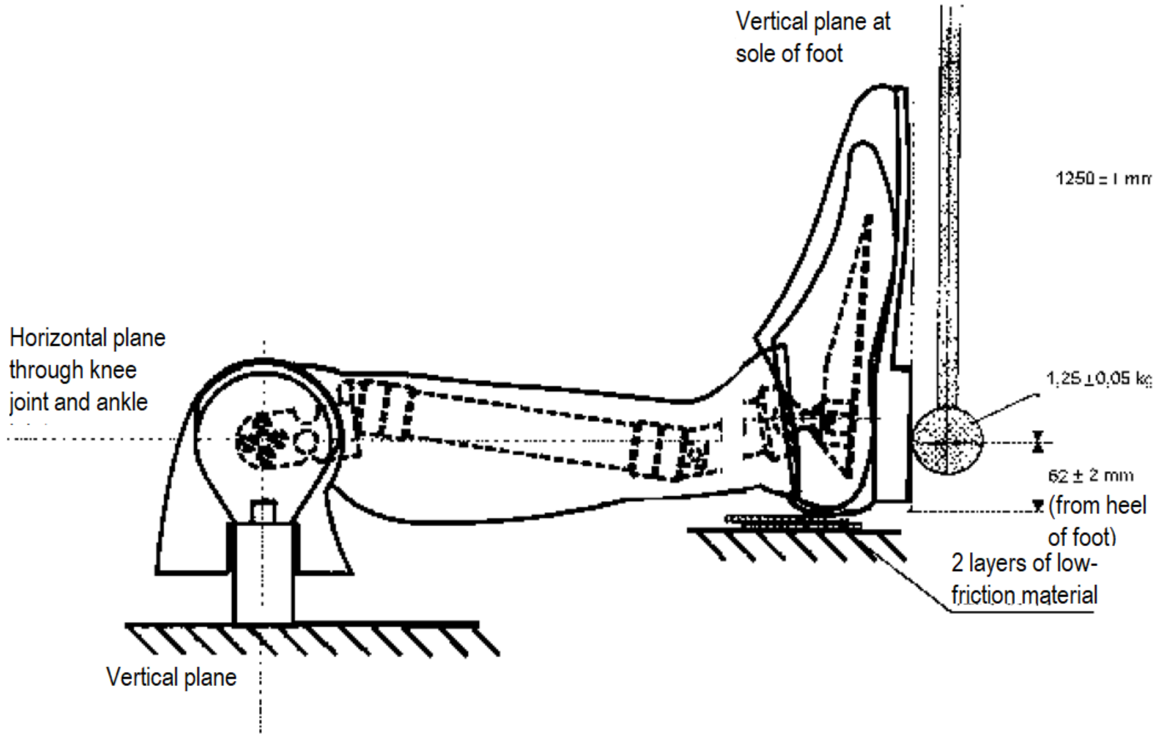
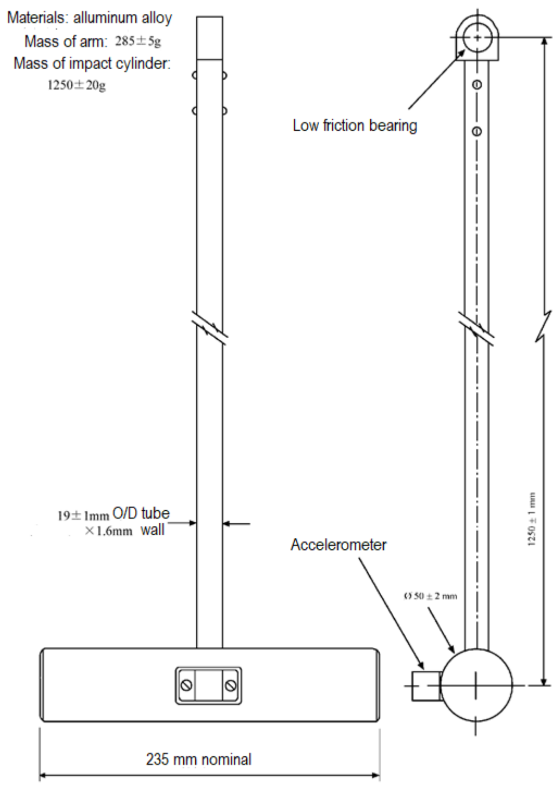


Figure 13: Pendulum Impactor



1.8. Measuring Equipment

(1) Center of Sensitivity of Head Accelerometer

The center of sensitivity of the head accelerometer shall be in the range specified in the table below with the head center as the zero-point. (The head center means the point that is on the dummy center plane, 23mm above the head inner bottom surface and 63.5mm forward from the vertical plane where the brainpan joins the brain pan cover.) (See Figure 14.)

	Range of center of sensitivity of head accelerometer(mm)		
	Fore-aft direction	Lateral direction	Vertical direction
Fore-aft axis range	Within 33	±5	±5
Lateral axis range	±5	±33	±5
Vertical axis range	±5	±5	±8

(2) Installing the Neck Load Meter

The neck load meter shall be installed as shown in Figures 14 and 15.

Figure 14: Center of Sensitivity of Head Accelerometer and Installation of 3-axis Type Head Load Meter

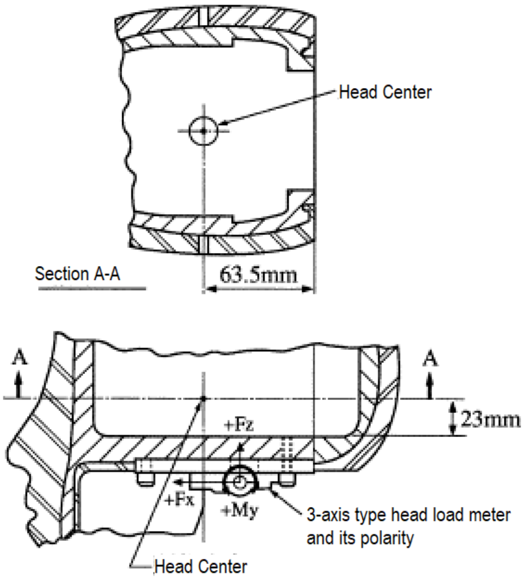
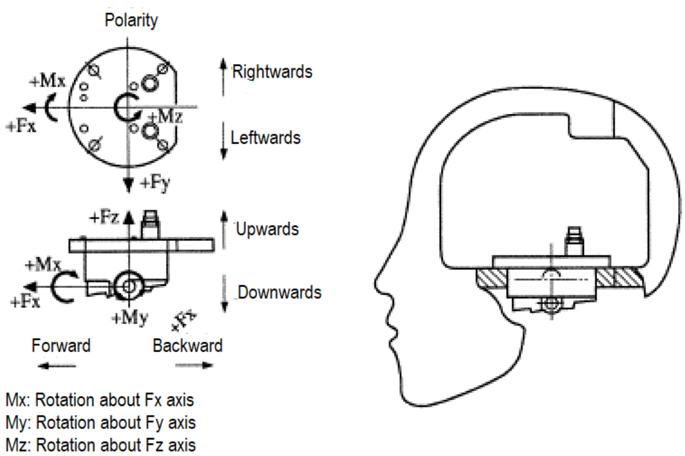


Figure 15: Installation of 6-axis Type Head Load Meter



(3) Center of Sensitivity of Chest Accelerometer

The center of sensitivity of the chest accelerometer shall be in the range specified in the table below, with the chest center as the zero-point. (The chest center means the point on the dummy center plane, 97mm below the upper surface of the plane on which the neck attaching bracket is mounted and 94mm forward from the rearmost thoracic plane.) (See Figures 16 and 17.)

	Range of center of sensitivity of head accelerometer(mm)		
	Fore-aft direction	Lateral direction	Vertical direction
Fore-aft axis range	Within 40 backward	±10	Within 20 downward
Lateral axis range	Within±50 backward	±5	Within 20 downward
Vertical axis range	Within 25 backward	±10	Within 45 downward

(4) Installation of Chest Potentiometer

A potentiometer shall be installed as shown in Figure 16.

Figure 16 Center of Chest and Installation of Chest Potentiometer

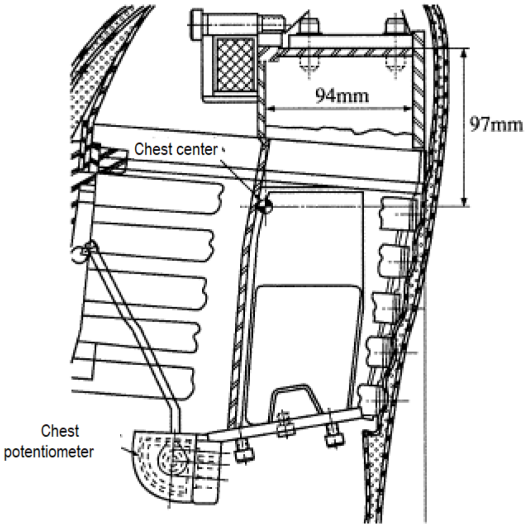
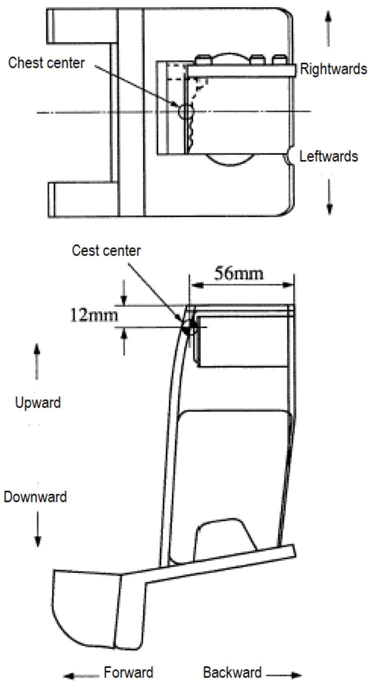


Figure 17: Center of Sensitivity of Chest Accelerometer



Hybrid III 5% Dummy Verification Procedure

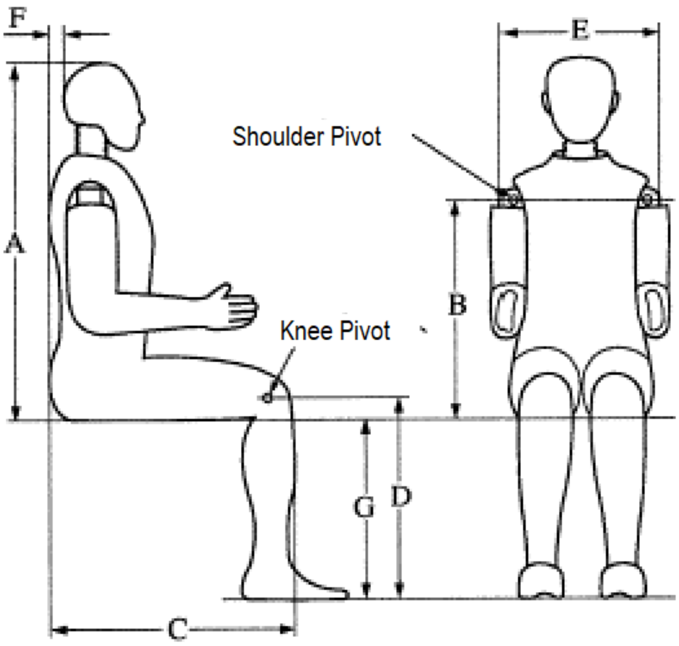
1. Verification Procedure and Requirements

It is permissible to disassemble or assemble the dummy if necessary to verify the characteristics of each part of the dummy in accordance with the provisions of Paragraphs 1.2 through 1.6. Furthermore, the measurement of the constructional dimensions provided for in Paragraph 1.1 shall be conducted after all verifications in Paragraphs 1.2 through 1.6 have been completed and the dummy has been assembled in the normal condition. Tape, etc. may be used to maintain the dummy posture during the measurement of dummy dimensions and verification of characteristics.

1.1 Constructional Dimensions

The measurements of each part of the dummy shall be as shown in Figure 1.

Figure 1: Constructional Dimensions of Hybrid III



A	774	~	800	mm
B	431	~	457	Mm
C	520	~	546	Mm
D	393	~	419	Mm
E	350	~	366	Mm
F	43	~	48	mm
G	355	~	376	mm

1.2 Head Characteristics

When the verification test is conducted as described below, the maximum resultant acceleration at the time of dropping shall be 2,450m/s^2–2,940m/s^2. Furthermore, in a curve indicating the relationship between the resultant acceleration occurring at the head and the lapsed time, the maximum value of the waveform that occurs after the main waveform (the maximum waveform) shall be 10% or less of the maximum value of the main waveform. Moreover, the maximum acceleration in the lateral direction shall be 147m/s^2 or less.

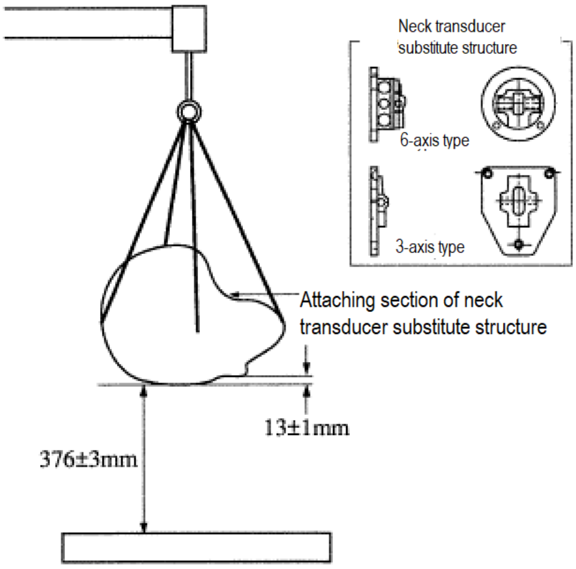
(1) Condition the head to be verified in an environment with temperature of 18.9 ºC –25.6ºC and relative humidity of 10%–70% for at least four hours.

(2) Suspend the head as shown in Figure 2 so that the lowest point of the forehead is 13 ± 1mm below the lowest point of the dummy nose. Drop the head from a height of 376 ± 3mm onto steel

plate which measures 50mm or more in thickness with a surface roughness of 0.0002mm (ms) to 0.002mm (ms). Measure the accelerations in the three axes (fore-and-aft direction, lateral direction and vertical direction) and calculate the maximum value of the resultant acceleration. It is permissible to attach a neck transducer on the head to attain the actual attaching conditions.

(3) When the verification is conducted on the same head consecutively, allow at least three hours between successive tests, under the environmental conditions given in (1).

Figure 2: Head Characteristics Test

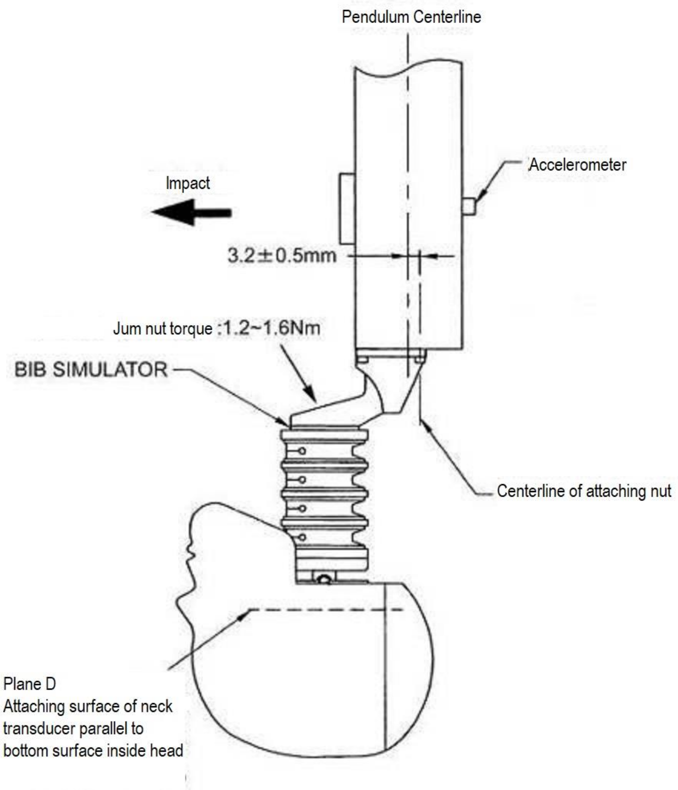


1.3 Neck Characteristics

When conducting the verification test as follows, the characteristics at the flexion side (the side where the neck is contracted) and the characteristics at the extension side (the side where the neck is extended) shall comply with the requirements given in the following table.

Characteristics at flexion side	① The moment measured by the neck measuring equipment shall reach a maximum of 69–83 N·m after the impact, and Plane D in Figure 3 shall be within 77°–91° relative to the pendulum. ② The positive moment (the moment in the same direction as the rotation direction of the pendulum) shall decay for the first time to 10Nm between 80ms and 100ms after the impact.
Characteristics at extension side	① The moment measured by the neck measuring equipment shall reach a maximum of –65 to –53 N·m after the impact, and Plane D in Figure 4 shall be within 99°–114° relative to the pendulum. ② The negative moment (the moment in the reverse direction of the rotating direction of the pendulum) shall decay for the first time to -10Nm between 94ms and 114ms after the impact.

Figure 3. Neck Flexion Side Characteristics Test

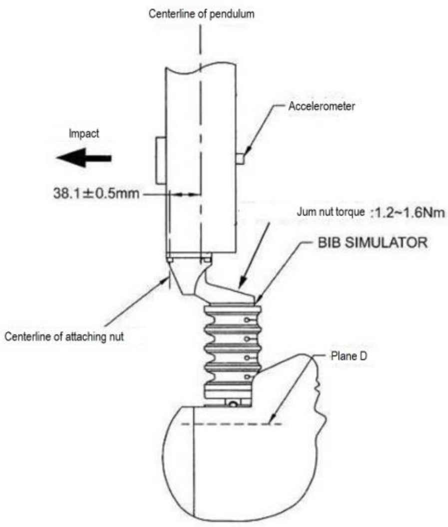


Example: rotation angle measurement methods

・Measure with mounted a displacement meter, and calculate

・Film analysis to use high speed photos

Figure 4 Neck Extension Side Characteristics Test



(1) Condition the neck to be verified in an environment with temperature of 20.6 ºC –22.2ºC and relative humidity of 10%–70% for at least four hours.

(2) Prior to the verification, tighten the jam nut of the neck cable to a torque of 1.2Nm –1.6Nm.

(3) Mount the neck and head on a pendulum as shown in Figure 5. The face section shall face toward the collision direction for verification at the flexion side, and the reversed direction for

verification at the extension side. A bib simulator (see Figures 3 and 4) shall be mounted to attain actual matching. Furthermore, Plane D shall be virtually perpendicular to the centerline of the pendulum. However, it is permissible to employ a head used exclusively for verification, on which a displacement meter for verification is mounted.

(4) Apply an impact by releasing the pendulum and allow it to fall freely from a height such that the velocity at impact becomes 6.89m/s–7.13m/s for verification at the flexion side, and 5.95m/s–6.19m/sec for verification at the extension side. Measure and calculate the rotational angle and moment of the neck at this moment. The neck moment is calculated by:

$M = M_y - 0.01778\,(M) \times F_x$

Where,

M : Moment of neck (unit: N·m)

M_y: Moment of neck measuring equipment (unit: N·m)

F_x: X axis force of neck measuring equipment (unit: N)

(5) For verification at the flexion side, the deceleration of the pendulum occurring at the time of impact shall be within the range specified in the right column of table A in accordance with the lapse time after the impact specified in the left column of table A. For verification at the extension side, the said deceleration shall be within the range specified in the right column of table B in accordance with the lapse time after the impact specified in the left column of table B.

Figure 5: Neck Characteristics Test

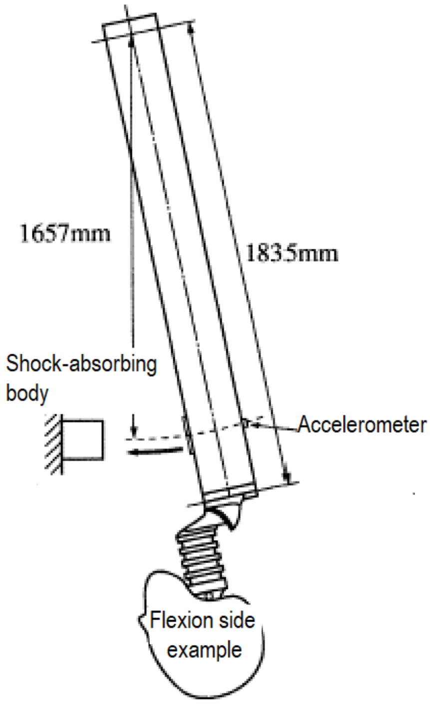


Table A

Time (ms)	Speed Range (m/s)
10	2.1~2.5
20	4.0~5.0
30	5.8~7.0

Table B

Time (ms)	Speed Range (m/s)
10	1.5~1.9
20	3.1~3.9
30	4.6~5.6

(6) When verification is conducted on the same neck, etc. consecutively, allow at least 30 minutes between successive tests, under the environmental conditions given in (1).

1.4 Chest Characteristics

The potentiometer for the chest shall be in accordance with SAEJ2517.

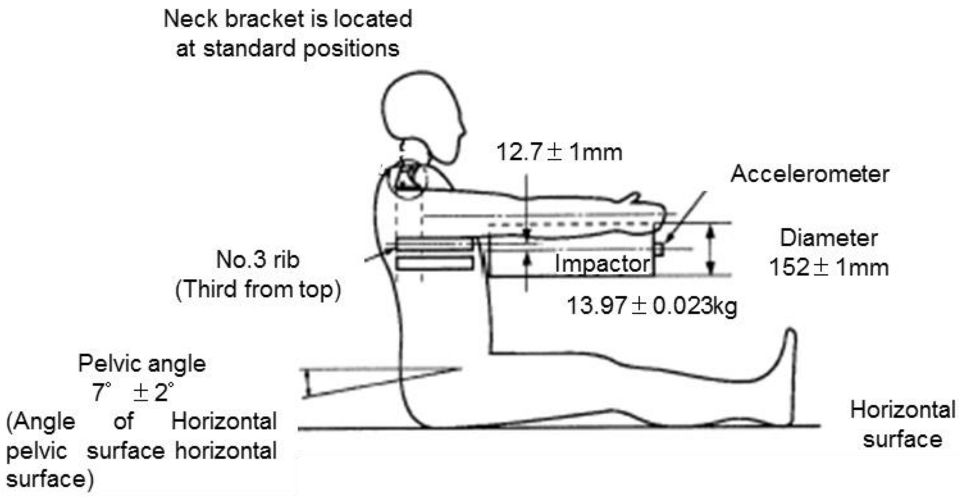
1.4.1 High-Speed Characteristics

When an impact is applied to the dummy chest with an impactor as shown below, the impact force occurring at the impactor shall reach its maximum between 390daN and 440daN and the displacement of the dummy sternum relative to the spine shall be between 50mm and 58mm. Furthermore, the impact force occurring at the impactor shall not exceed 460daN while the displacement of the dummy sternum relative to the spine is between 18mm and 50mm. The internal hysteresis at the moment of impact shall be 69% to 85%.

(1) Condition the chest to be verified in an environment with a temperature of 20.6 ºC –22.2ºC and relative humidity of 10%–70% for at least four hours.

(2) Seat the dummy on a flat surface, without a back support or armrest, as shown in Figure 6. At this time, the joint of the shoulder and elbow shall be tightened securely so that the upper limbs may be extended forward. Adjust the pelvic angle to 7° ± 2°. The dummy may be clothed in a shirt and pants as provided in Paragraph 3.2.9.2 (3) of this Technical Standard.

Figure 6: Chest Characteristics Test

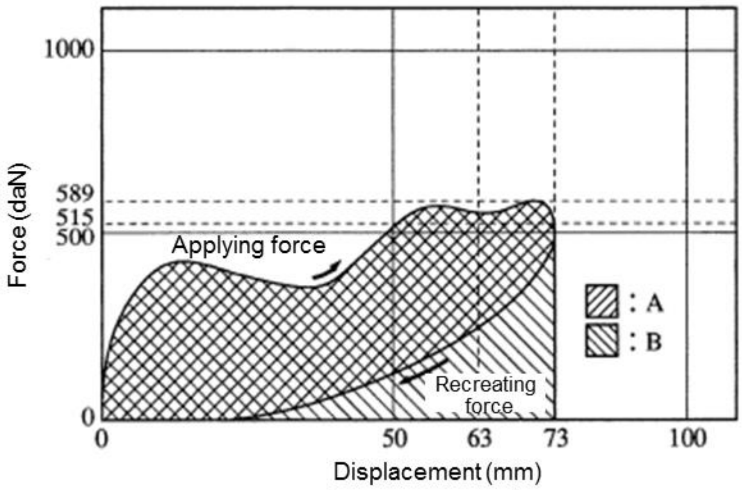


(3) Adjust the positional relationship between the impactor and the No. 3 rib in such a way that the longitudinal centerline extended from the impactor is 12.7 ± 1.0mm below the horizontal centerline of the No. 3 rib on the median plane of the dummy.

(4) Impact the chest with the impactor at a speed of 6.59m/s –6.83m/s. Measure the deceleration occurring at the rear end of the impactor, the displacement of the sternum relative to the dummy spine (measured by a potentiometer mounted inside the sternum), and calculate the impactor force occurring at the impactor (the product of the impactor mass and the deceleration) and the hysteresis (the ratio of Area A between the loading and unloading portions of the force-displacement curve to area B under the loading position of the curve (A/B) (see Figure 7).

(5) When the verification is conducted on the same chest, etc. consecutively, allow at least 30 minutes between successive tests under the environmental conditions given in (1).

Figure 7: Chest Characteristics Test, Force-Displacement Curve



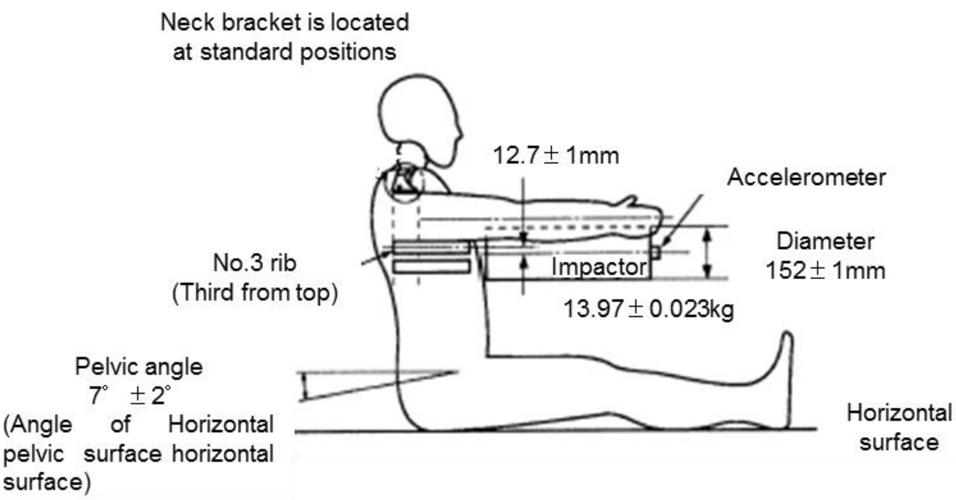
1.4.2 Low-Speed Characteristics

When an impact is applied to the dummy chest with an impactor as shown below, the impact force occurring at the impactor shall reach its maximum between 178daN and 207daN and the displacement of the dummy sternum relative to the spine shall be between 17.4mm and 21.8mm. The internal hysteresis at the moment of impact shall be 65% to 79%.

(1) Condition the chest to be verified in an environment with a temperature of 20.6 ºC –22.2ºC and relative humidity of 10%–70% for at least four hours.

(2) Seat the dummy on a flat surface, without a back support or armrest, as shown in Figure 8. At this time, the joint of the shoulder and elbow shall be tightened securely so that the upper limbs may be extended forward. Adjust the pelvic angle to 7° ± 2°. The dummy may be clothed in a shirt and pants as provided in Paragraph 4.2.9.2 (3) of this Technical Standard.

Figure 8: Chest Characteristics Test

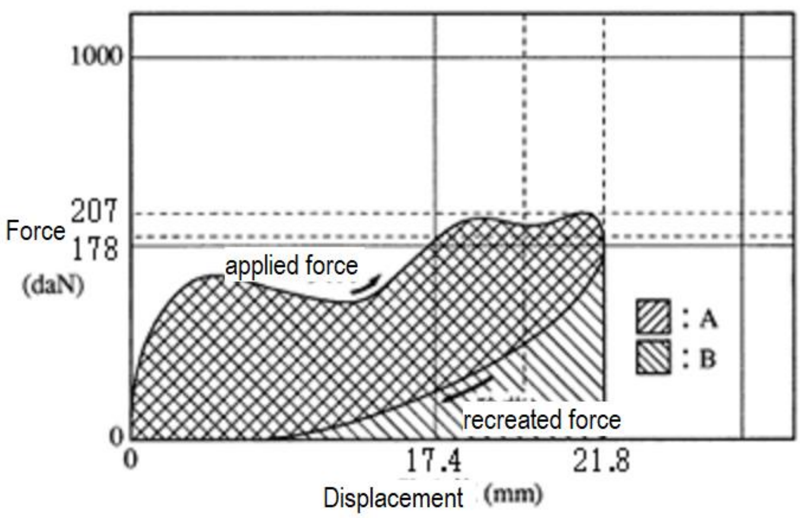


(3) Adjust the positional relationship between the impactor and the No. 3 rib in such a way that the longitudinal centerline extended from the impactor is 12.7 ± 1.0mm below the horizontal centerline of the No. 3 rib on the median plane of the dummy.

(4) Impact the chest with the impactor at a speed of 2.95m/s –3.05m/s. Measure the deceleration occurring at the rear end of the impactor, the displacement of the sternum relative to the dummy spine (measured by a potentiometer mounted inside the sternum), and calculate the impactor force occurring at the impactor (the product of the impactor mass and the deceleration) and the hysteresis (the ratio of Area A between the loading and unloading portions of the force-displacement curve to area B under the loading position of the curve (A/B) (see Figure 9).

(5) When the verification is conducted on the same chest, etc. consecutively, allow at least 30 minutes between successive tests under the environmental conditions given in (1).

Figure 9: Chest Characteristics Test, Force-Displacement Curve



1.5 Flexion Characteristics of the Lumbar Vertebrae

As shown in Figure 8, when the lumbar vertebrae are rotated downward as follows, the upper torso pulling load shall be 320N –390N when the angle between the upper torso and the legs becomes 44.5°–45.5°. Additionally, when the load is removed, the upper torso shall return to keep the angle within 8° from the original position.

(1) The dummy for verification shall be preconditioned in an environment with temperature of 18.9 ºC –25.6ºC and relative humidity of 10%–70% for at least four hours.

(2) The dummy shall be installed on the pedestal, and keeping the connecting surface of the pelvis and lumbar vertebra horizontal, the pelvis shall be fixed by using a pelvis-fixing jig. Additionally, the loading jig shall be installed at the vertebra.

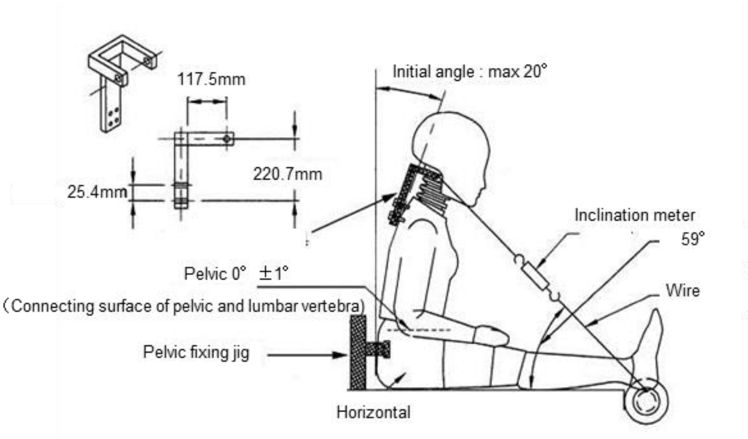
(3) Bend the dummy's upper torso forward at an angle of 30° from the vertical plane. Repeat this three times and then leave the dummy for 30 minutes before conducting the test. Meanwhile, support the dummy's torso by external means so that it is maintained in the vertical position.

(4) Remove the fixing jig from the dummy, keep this condition for 2 minutes, then measure the upper torso angle (initial angle). The measured angle (initial angle) shall be within 20°.

(5) Connect the wire and load meter to the loading jig, pull the upper torso down to 45 ± 0.5° at the speed of 0.5°/sec –1.5°/sec, then measure the load 10 minutes later.

(6) Quickly remove all loads from the load jig, then after 3 minutes, measure the change of upper torso angle from the initial angle.

Figure 8 : Flexion Characteristic test for the Lumbar Vertebra



1.6 Leg Characteristics

Apply impact to each knee on the right and left side with the impactor as follows. The maximum impact force occurring at the impactor shall be 345daN –406daN. (The impactor is a cylinder whose impact applying section has a diameter of 76 ± 1mm. To measure the impactor acceleration that occurs in the longitudinal centerline of the cylinder, the accelerometer shall be mounted on the impactor surface opposite the impactor surface in a way superposed onto the aforesaid line. The impactor mass shall be 2.99 ± 0.023kg including the accelerometer.) (See Figure 9.)

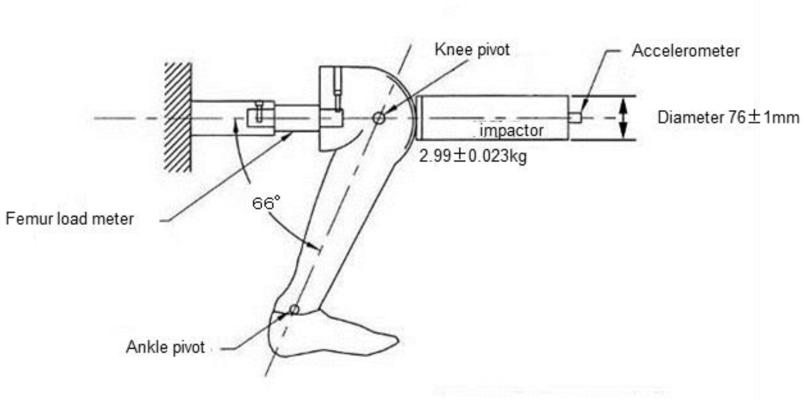
(1) Condition the leg to be verified in an environment with temperature of 18.9 ºC –25.6ºC and relative humidity of 10%–70% for at least four hours.

(2) Adjust the impactor position so that the height of the longitudinal centerline of the impactor is the same as the height of the centerline of the knee pivot bolt on the vertical plane that passes through the centerline of the upper leg at the time when the impactor comes in contact with the knee in a horizontal state.

(3) Impact the leg with the impactor at a speed of 2.07m/s –2.13m/s. Measure the deceleration occurring at the rear end of the impactor and calculate the impact force occurring at the impactor (the product of the impactor mass and the deceleration).

(4) When the verification is conducted on the same leg, etc. consecutively, allow at least 30 minutes between successive tests under the environmental conditions given in (1).

Figure 9: Leg Characteristics Test



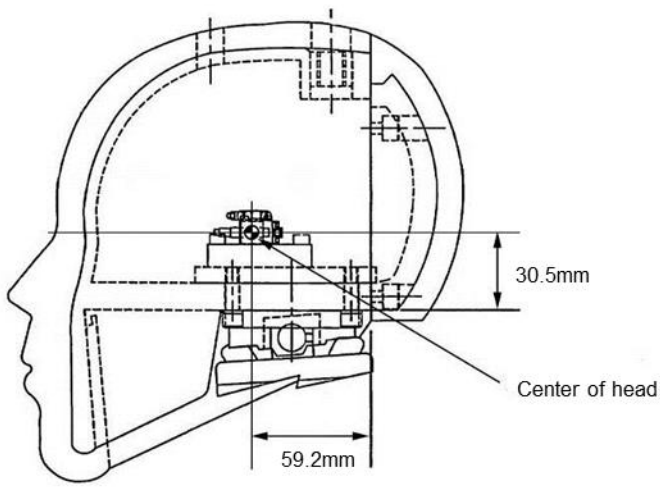
1.7 Measuring Equipment

(1) Center of Sensitivity of Head Accelerometer

The center of sensitivity of the head accelerometer shall be in the range specified in the table below with the head center as the zero-point. (The head center means the point that is on the dummy center plane, 30.5mm above the head inner bottom surface and 59.2mm forward from the vertical plane where the brainpan joins with the brain pan cover.) (See Figure 10.)

	Range of head accelerometer center of sensitivity (mm)		
	Fore-aft direction	Lateral direction	Vertical direction
Fore-aft axis range	Backward within 33	±5	±5
Lateral axis range	±5	±33	±5
Vertical axis range	±5	±5	±8

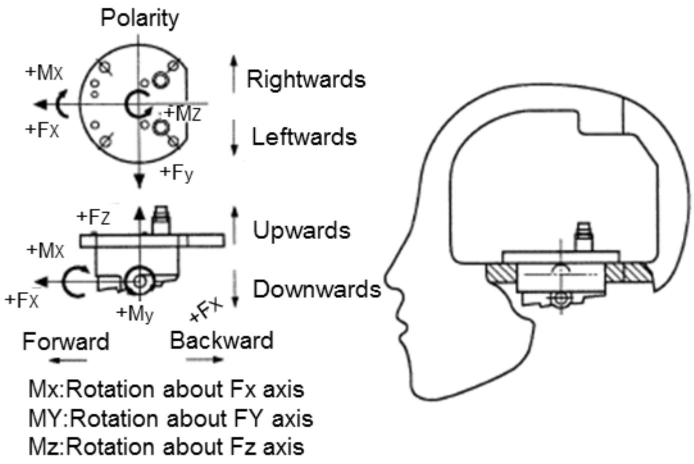
Figure 10: Head Accelerometer Sensitivity Center



(2) Installation of Neck Load Meter

The neck load meter shall be installed as shown in Figure 11.

Figure 11: Installation of 6-axis Type Head Load Meter



(3) Center of Sensitivity of Chest Accelerometer

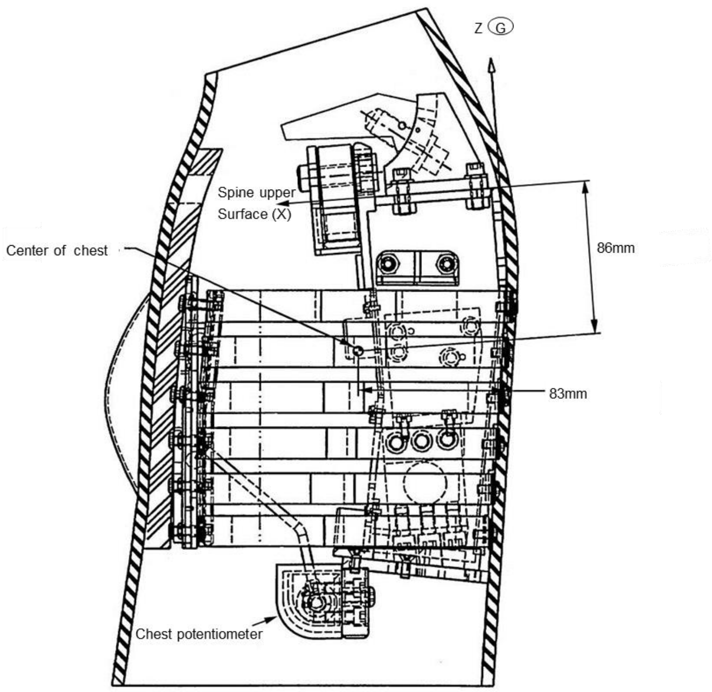
The center of sensitivity of the chest accelerometer shall be within the range specified in the table below from the chest center (which means the point on the dummy's center plane located 86mm below the spine upper face and 83mm forward of the rearmost thoracic plane). (See Figure 12.)

	Range of chest accelerometer center of sensitivity (mm)		
	Fore-aft direction	Lateral direction	Vertical direction
Fore-aft axis range	Backward, within 40	±10	Downward, within 20
Lateral axis range	Backward, within± 50	±5	Downward, within 20
Vertical axis range	Backward, within 25	±10	Downward, within 45

(4) Installation of Chest Potentiometer

A potentiometer shall be installed as shown in Figure 12.

Figure 12: Center of Chest and Installation of Chest Potentiometer



Definition of Deformable Barrier

1. Components and Material Specifications

The dimensions of the barrier are illustrated in Figure 1. The dimensions of the individual components of the barrier are listed separately below.

1.1 Main Honeycomb Block

Dimensions:

Height : 650mm (in direction of honeycomb ribbon axis)

Width : 1,000mm

Depth : 450mm (in direction of honeycomb cell axis)

All the above dimensions should allow a tolerance of ±2.5mm.

Material : Aluminum 3003 (ISO 209, Part 1)

Foil thickness : 0.076mm ± 15%

Cell size : 19.1mm ± 20%

Density : 28.6kg/m^3 ± 20%

Crush strength : 0.342MPa + 0%-10% (In accordance with the procedure described in Paragraph2)

1.2 Bumper Element

Dimensions:

Height : 330mm (in direction of honeycomb ribbon axis)

Width : 1,000mm

Depth : 90mm (in direction of honeycomb cell axis)

All the above dimensions should allow a tolerance of ±2.5mm.

Material : 3003 (ISO 209, Part 1)

Foil thickness : 0.076mm ± 15%

Cell size : 6.4mm ± 20%

Density : 82.6kg/m^3 ± 20%

Crush strength : 1.711MPa +0%-10% (In accordance with the procedure described in Paragraph 2)

1.3 Backing Sheet

Dimensions:

Height : 800 ± 2.5mm

Width : 1,000 ± 2.5mm

Thickness : 2.0 ± 0.1mm

1.4 Cladding Sheet

Dimensions:

Length : 1,700 ± 2.5mm

Width : 1,000 ± 2.5mm

Thickness : 0.81 ± 0.07mm

Material : Aluminum 5251/5052 (ISO 209, Part1)

1.5 Bumper Facing Sheet

Dimensions:

Height : 330 ± 2.5mm

Width : 1,000 ± 2.5mm

Thickness : 0.81 ± 0.07mm

Material : Aluminum 5251/5052 (ISO 209, Part1)

Adhesive

The adhesive to be used throughout should be a two-part polyurethane (such as Ciba-Geigy XB5090/1, XB5304 hardener, or equivalent).

2. Aluminum Honeycomb Requirements

The summary of the procedure to be applied to materials for the front impact barrier of a crush strength of 0.342MPa or 1.711MPa respectively is as follows. The complete testing method is given in the aluminum honeycomb requirements (NHTSA TP-214D)

2.1 Sample Locations

To ensure uniformity of crush strength across the whole of the barrier face, samples shall be taken from four locations evenly spaced across the honeycomb block.

First, four samples, each measuring 300mm x 300mm x 50mm, shall be cut from the block of the barrier face material. Refer to Figure 2 for an illustration of how to locate these sections within the honeycomb block. Each of these larger samples shall be cut into samples for testing (150mm x 150mm x 50mm). The crush strength requirements shall be based on the results of testing two samples from each of these four locations.

2.2 Size of Sample

Samples of the following size shall be used for testing:

Length : 150 ± 6mm

Width : 150 ± 6mm

Thickness : 50 ± 2mm

The walls of incomplete cells around the edges of the sample shall be trimmed as follows:

In the “W” direction, the fringes shall be no greater than 1.8mm (see Figure 3).

In the “L” direction, half the length of one bonded cell wall (in the ribbon direction) shall be left at either end of the specimen (see Figure 3).

2.3 Area Measurement

The length of the sample shall be measured in three locations, 12.7mm from each end and in the middle, and recorded as L1, L2 and L3 (Figure 3). In the same manner, the width shall be measured and recorded as W1, W2 and W3 (Figure 3). These measurements shall be taken on the centerline of the thickness. The crush area shall then be calculated as:

$$A = \frac{(L1 + L2 + L3)}{3} \times \frac{(W1 + W2 + W3)}{3}$$

2.4 Crush Rate and Distance

The sample shall be crushed at a rate of 5.1mm/min –7.6mm/min. The minimum crush distance shall be 16.5mm.

2.5 Data Collection

Crush force versus deflection data are to be collected in either analog or digital form for each sample tested. If analog data are to be collected, then a means of converting it to digital data shall be available. All digital data shall be collected at a rate of not less than 5Hz (5 points per second).

2.6 Crush Strength Determination

Divide the data into three sections as follows (n = 1, 2, 3). Ignore all data prior to 6.4mm of displacement and after 16.5mm of displacement.

(1) 6.4mm –9.7mm

(2) 9.7mm –13.1mm

(3) 13.2 mm –16.5mm

Find the average for each section as follows:

$$F_{(n)} = \frac{(F_{(n)}1 + F_{(n)}2 + \cdots F_{(n)}m)}{m} \quad ; \quad m = 1, 2, 3$$

Where M represents the number of data points measured in each of the three sections. Calculate the crush strength of each section as follows:

$$S_{(n)} = \frac{F_{(n)}}{A} \quad ; \quad n = 1, 2, 3$$

2.7 Sample Crush Strength Specification

For a honeycomb sample to pass this certification, the following conditions shall be met:

0.308MPa ≤ S(n) ≤ 0.342MPa for 0.342MPa material

1.540MPa ≤ S(n) ≤ 1.711MPa for 1.711MPa material

N = 1, 2, 3

2.8 Block Crush Strength Specification

Two samples are to be tested from four locations, respectively, evenly spaced across the block. For a block to pass the certification, seven of the eight samples shall meet the crush strength specification given in Paragraph 2.7.

3. Adhesive Bonding Procedure

3.1 Immediately before bonding, the aluminum sheet surfaces to be bonded shall be thoroughly cleaned using a suitable solvent such as 1-1-1 trichloroethane. This is to be carried out at least twice or as required to eliminate grease or dirt deposits. The cleaned surfaces shall then be abraded using 120 grit abrasive paper (metallic/silicon carbide abrasive paper must not be used).

Following abrading, the surfaces shall be thoroughly cleaned again at least four times by solvent. All dust and deposits remaining from the abrading process shall be removed.

3.2 If the honeycomb is to be bonded to an aluminum sheet, the adhesive should be applied to the aluminum sheet only, using a ribbed rubber roller. In this case, a maximum amount of 0.5kg/m^2 shall be applied evenly over the surface, giving a maximum film thickness of 0.5mm.

4. Construction

4.1 The main honeycomb block shall be bonded to the backing sheet with adhesive such that the cell axes are perpendicular to the sheet. The cladding sheet shall be bonded to the front surface of the honeycomb block. The top and bottom surfaces of the cladding sheet shall not be bonded to the main honeycomb block, but the sheet shall be adhesively bonded to the backing sheet at the mounting flanges.

4.2 The bumper element shall be adhesively bonded to the front of the cladding sheet such that the cell axes are perpendicular to the cladding sheet. The bottom of the bumper element shall be flush with the bottom surface of the cladding sheet. The bumper-facing sheet shall be adhesively bonded to the front of the bumper element.

4.3 The bumper element shall then be divided into three equal sections by means of two horizontal slots. These slots shall be cut through the entire depth of the bumper section and extend over the whole width of the bumper. The slots shall be cut using a saw; their width shall be the width of the blade used and shall not exceed 4.0mm.

4.4 Clearance holes for mounting the barrier are to be drilled in the mounting flanges (see Figure 5). The holes shall be 9.5mm in diameter. Five holes shall be drilled in the top flange at a distance of 40mm from the top edge of that flange. The holes shall be at distances of 100mm, 300mm, 500mm, 700mm, and 900mm from either edge of the barrier. All holes shall be drilled to ±1mm of the standard dimensions. These hole locations are a recommendation only; alternative positions may be used which offer at least the mounting strength and security provided by the above mounting specifications.

5. Mounting

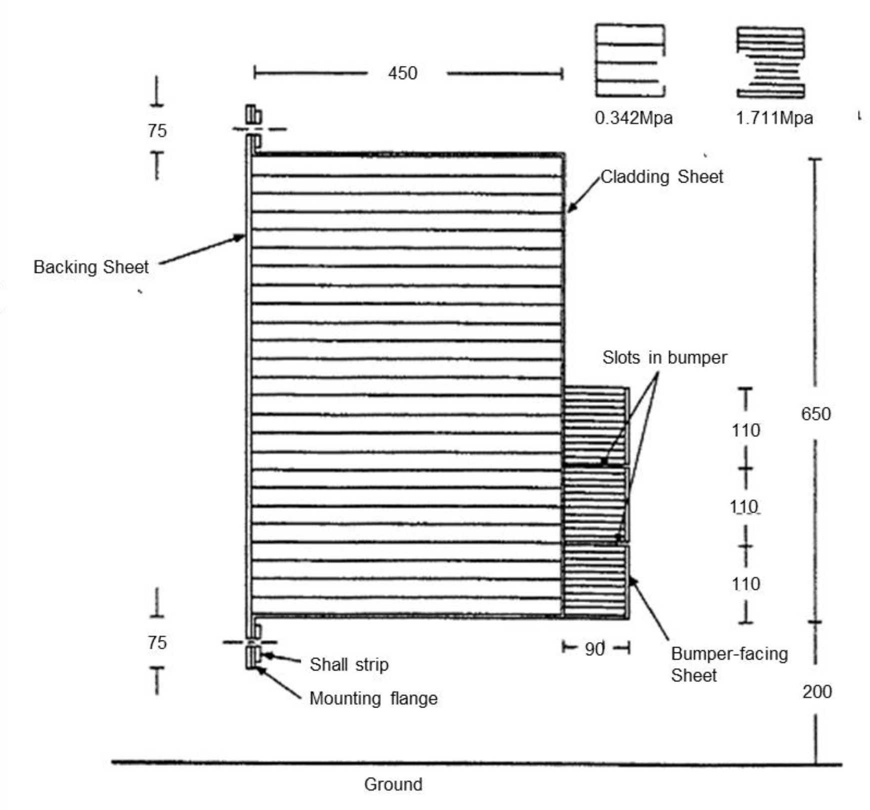
5.1 The deformable barrier shall be fixed to the edge of a mass of not less than 7×10^4 kg or to some structure attached thereto. It shall be attached so as not to contact any of the structure more than 75mm from the top surface of the barrier (excluding the upper flange) and shall be vertical to within ±1° and perpendicular to the running direction of the motor vehicle to within ±1°.[note3]

The attachment surface shall not be displaced by more than 10mm during the test. If necessary, additional anchorage, etc. shall be used to prevent displacement of the mass. The edge of the deformable barrier shall be aligned with the edge of the mass appropriate for the side of the vehicle to be tested.

note3 A mass, the edge of which is between 125 mm and 925 mm high and 1,000 mm deep, is considered to satisfy this requirement.

5.2 The deformable barrier shall be fixed to the mass by means of ten bolts, five in the top mounting flange and five in the bottom. These bolts shall be of at least 8mm in diameter. Steel clamping strips shall be used for both the top and bottom mounting flanges (see Figures 1 and 5). These strips shall be 60mm high and 1,000mm wide and have a thickness of at least 3mm. The edge of the steel-clamping strip shall be rounded in order to prevent the barrier from being pulled away from the steel strip during impact. In this case, the edge of the steel strip shall be located at a position not more than 5mm above the base of the barrier mounting upper flange and not more than 5mm above the base of the top of the barrier mounting lower flange. Five clearance holes of 9.5mm in diameter must be drilled in both strips to correspond with those in the mounting flange on the barrier (see Paragraph 4). In this case, the hole of the steel clamping strip and flange of the barrier may be extended to a maximum of 25mm in order to match the difference in the configuration of the holes of the load cell wall. In the case where the deformable barrier is mounted on a load cell wall, note that the above dimensional requirements for mounting are intended as a minimum. When using a load cell wall or when the mounting steel strips need to be extended, a thicker gauge steel shall be used accordingly and the barrier shall be prevented from pulling away from the wall during impact by reliably fixing it at least in the same way as prescribed above.

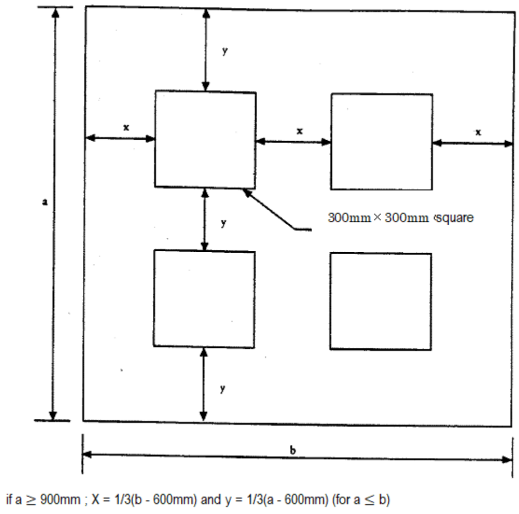
Figure 1: Deformable Barrier for Frontal Impact Testing



Barrier width＝1,000mm

Unit: mm

Figure 2: Locations of Samples



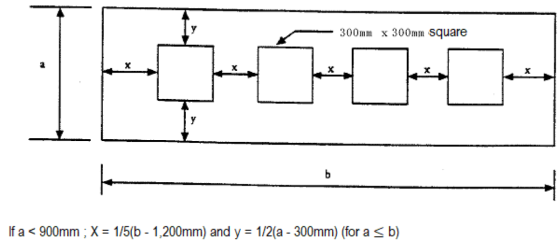
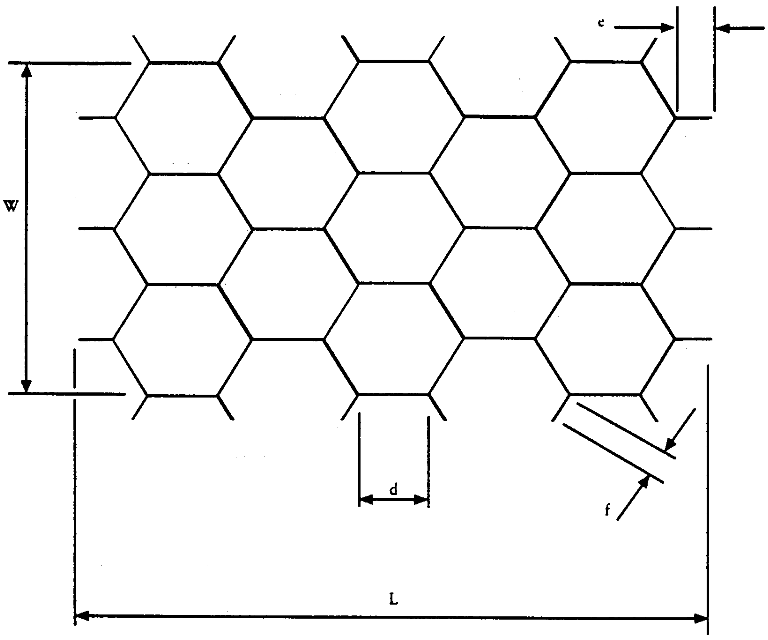


Figure 3: Honeycomb shaft and measurement dimensions



L=150±6mm

W=150±6mm

e＝d/2

f＝1.8mm

Figure 4: Crush Force and Displacement

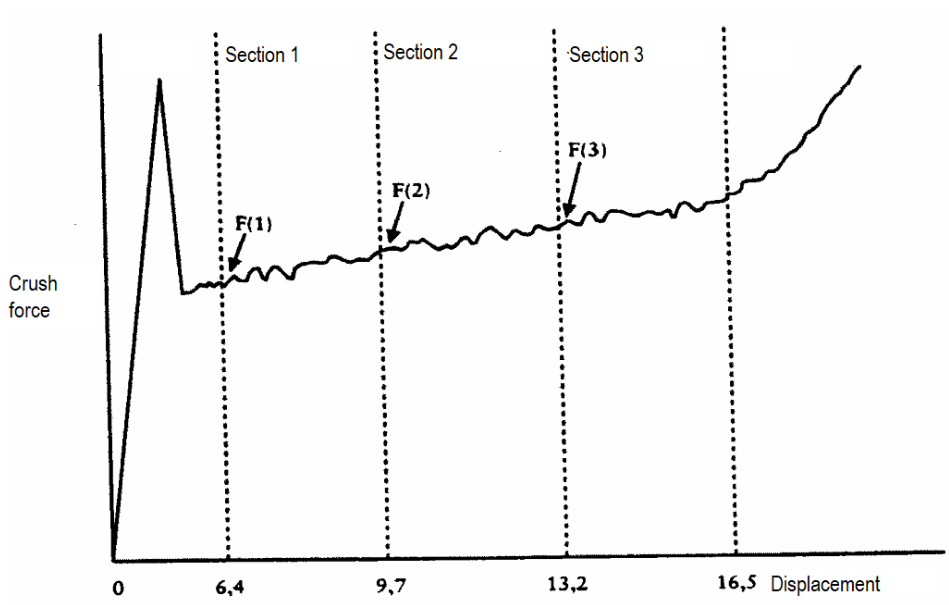
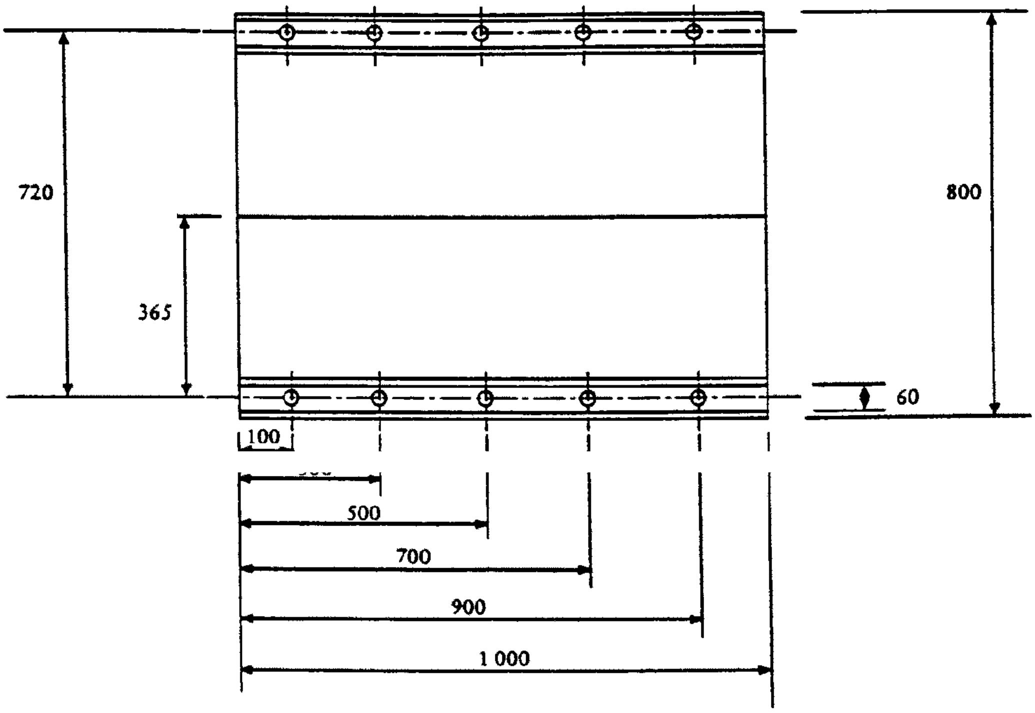


Figure 5: Positions of Holes for Barrier Mounting

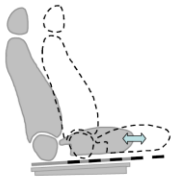
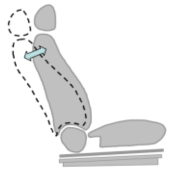
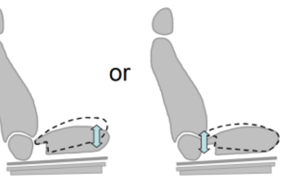
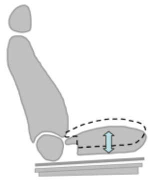
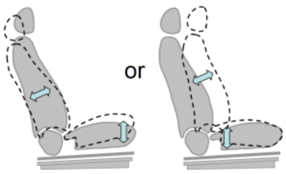
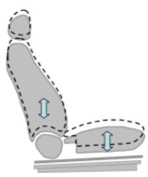
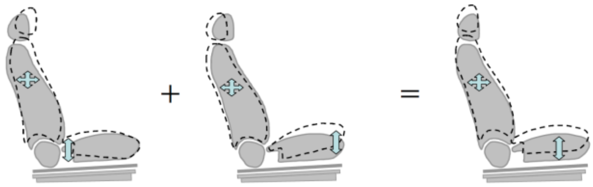
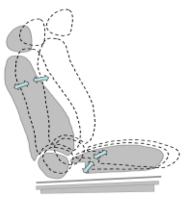


Hole diameters: 9.5mm

Unit: mm

Attachment 5

Adjusting Position of Test Seat Adjustment Mechanism

Fore -aft direction adjustment device (ref. 4.1.5.(1))  Middle position in fore -aft direction	Seatback angle adjustment device (ref. 4.1.5.(3))  Design standard angle
Seat cushion surface angle adjustment device (tilt or lifter) (ref. 4.1.5.(5))  Design standard angle	Seat cushion surface vertical adjustment device (lifter) (ref. 4.1.5.(2))  Lowest position
Seat cushion surface angle/vertical adjustment device (others) (ref. 4.1.5.(5))  Design standard angle	Seat lower-seatback angle adjustment device (ref. 4.1.5.(5))  Design standard angle
Seat lower-seatback vertical adjustment device (lifter) (ref. 4.1.5.(2))  Lowest position	Seat lower (angle/vertical)-seatback angle adjustment device (ref. 4.1.5.(5))  Design standard angle
Fore-and-aft/vertical angle all linked adjustment device (ref. 4.1.5.(5))  Design standard angle	Fore-and-aft/vertical all linked adjustment device (lifter) (ref. 4.1.5.(2))  Lowest position

Sample Test Result Sheets

Offset Frontal Collision

Test No. NASVA 2018-****-***

Test Vehicle Name : NASVA 1234

Test Date : dd/mm/2018 (*)
Test Site : Japan Automobile Research Institute

1. Test Vehicle
   Name/Model : NASVA 1234(DAA-ABCD)
   Weight : 1000 kg (F:600/ R:400)
   VIN : ABCD-123456
   Loaded with : Driver's seatbelt (with double pre-tensioner) + airbag (front/side curtains)
   Rear test seat seatbelt (w/pre-tensioner) + airbag (curtain)

2. Dummy
   Driver's Seat : Hybrid-Ⅲ 50%tile No. J-01 (N-1)
   Rear Test Seat : Hybrid-Ⅲ 05%tile No. DT05-1

3. Deformable Barrier
   Maker : Showa Hikouki Kogyo, ltd.
   Lot/Serial No. : ******** / 18**-***
   Inspection Year : dd/mm/2018

4. Test Details

①Collision Speed: **64.0km/h**

②Deviation : L/R **0mm** (Lap rate **40.0%**)

③Injuries

			Driver Seat		Backseat
HIC36			123.4		
HIC15					(123.4)
Neck	Tensile load (kN)				1.23
	Shear load (kN)				(-1.23)
	Back moment (Nm)		-12.34		(-12.34)
Chest acceleration 3ms (m/s^2)			123.45		
Chest displacement (mm)			-12.34		-12.34
Chest contact with steering wheel			None		—
Lap belt slippage	Right side				None
	Left side				None
Femur load	Right (kN)		-1.23		-1.23
	Left (kN)		-1.23		-1.23
Right upper	TibiaIndex	compression load (kN)	1.23	-1.23	
Right lower	TibiaIndex	compression load (kN)	1.23	-1.23	
Left upper	TibiaIndex	compression load (kN)	1.23	-1.23	
Left lower	TibiaIndex	compression load (kN)	1.23	-1.23	

Note: if there is no secondary head collision, enter as ( ).

④Vehicle Deformation :

Wheel deformation amt. (mm)	Recession amt.	forwards -0
	upward mvmnt. amt.	downwards -0
Brake pedal deformation amt. (mm)	Recession amt.	backwards -0
	upward mvmnt. amt.	upwards .0

⑤Dummy condition during/after the test:

- Driver dummy ...... Acceptible
- Backseat dummy ..... Acceptible

⑥ Wave cancelation from secondary collision:

- Driver's Seat .... Not implemented
- Backseat .... Not implemented

⑦Fuel leakage before or after the collision: None

⑧Door openability:

		Left side	Right side
front	opening w/	one handed	one handed
	door lock	no lock	no lock
rear	opening w/	one handed	one handed
	door lock	no lock	no lock

⑨Seatbelt Pull Out/In Amount:

	Driver's seat	Backseat
pull out	123 mm	123 mm
pull in	123 mm	123 mm

⑩Ability to pull dummy out of vehicle:

- driver's seat ········· by man-power
- rear seat ········· by man-power

⑪Secondary collision to rear dummy's head : none

simple measurement results

① Suspected contact with the marks on the dummy : none

② Suspected contact with the onboard camera : none

③ Suspected contact from the head acceleration wave : none

If there is contact, enter the head contact load here : ____________ N

⑫Sliding of the seatbelt off the dummy's pelvic region:

- Right side : none
- Left side : none

If there is, enter the amount of displacement and the duration

Right side: Load displacement: ________ kN Duration: : ________ ms ~ ________ ms

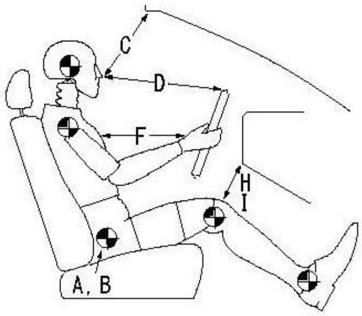
Left side: Load displacement: ________ kN Duration: ________ ms ~ ________ ms

⑬Slippage of shoulder belt off backseat dummy: (none · comments)

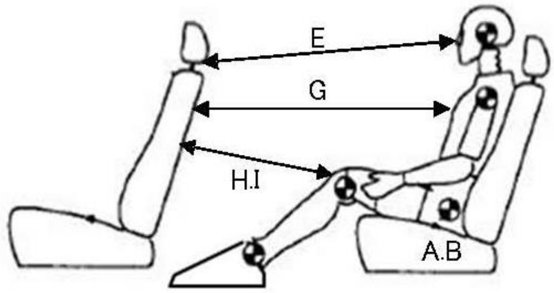
5. Dummy Seating Position

(1) Measurements between 2 points

Driver's seat



Backseat

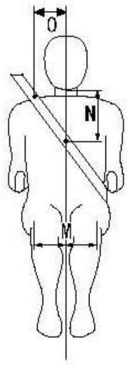


units: mm

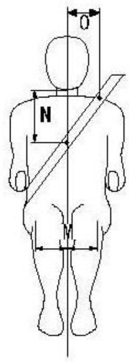
Measurement positions		Driver's seat	Backseat
A : standard point - hip point fore-aft		123	123
B : standard point - hip point, vertical		123	123
C : Tip of nose - windshield hedder		123	
D : Tip of nose - steering wheel, rim center		123	
E : Tip of nose - front seatback, upper-center			123
F : Chest - steering horn pad face (horizontal)		123	
G : Chest - front seatback (horizontal)			123
H : Right knee - under dashboard (shortest)	Right knee- front seatback (shortest)	123	123
I : Left knee - under dashboard (shortest)	Left knee- front seatback (shortest)	123	123
J : Head angle		0°	0°
K : Ilium angle		22.5°	20.0°

Seatbelt Placement

Driver's seat

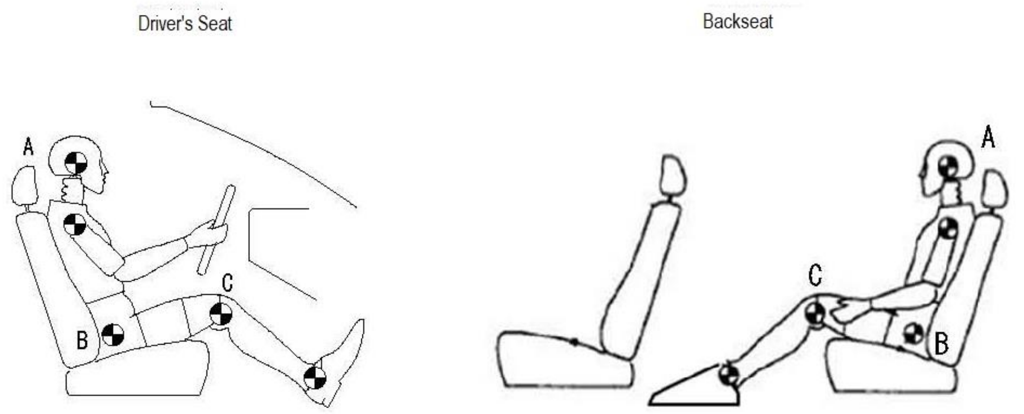


Backseat



Measurement Positions	Driver's Seat	Backseat
M: Knee gap (dummy center, left, right)	123 / 123	123 / 123
N: Dummy under-jaw - belt center (vertical, with dummy centerline)	123	123
O: Dummy center - belt center (lateral, from the height of the root of the neck)	12	12

(2) 3-D measurement results



Standard Point: Driver's Seat －Fr. door checker bolt head center（X: 1234.0 Y: 123.0 Z: 123.4）

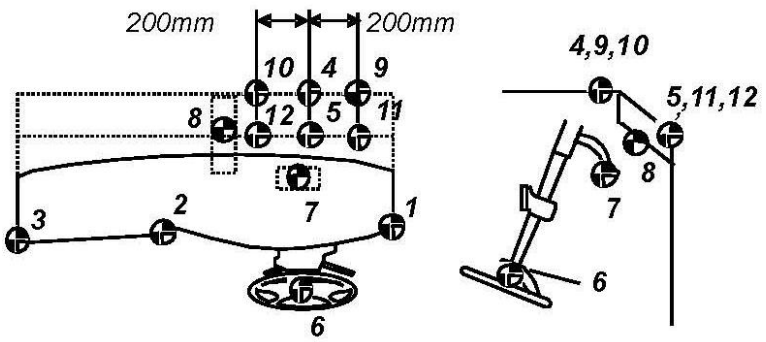
Backseat －Rr door checker bolt head center（X: 1234.0 Y: -123.0 Z: 123.4）

unit : mm

Item to be measured	Driver's Seat			Backseat		
	X	Y	Z	X	Y	Z
A: Head (outer)	1234	123	1234	1234	123	1234
B: Hip (outer)	1234	123	1234	1234	123	1234
C: Knee (outer)	1234	123	1234	1234	123	1234

6. Amount of deformation on various parts of the vehicle

(1) Interior Deformation



1: Instrument panel, right

2: Instrument panel, center

3: Instrument panel, left

4: Driver's seat toe board

5: Driver's seat floor

6: Steering column tip

7: Brake pedal

8: Footrest

9: Driver's Seat toe board A

10: Driver's Seat toe board B

11: Driver's Seat toe board C

12: Driver's Seat toe board D

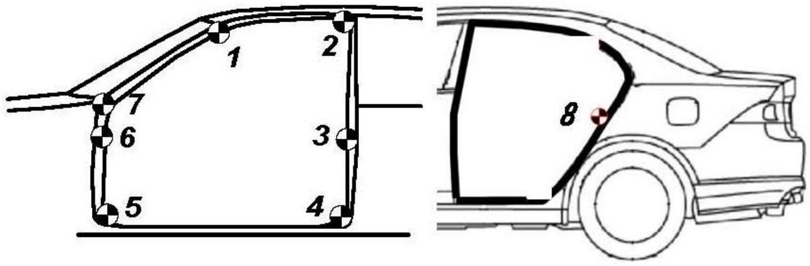
Origin: rear luggage room (for X, the backward direction is positive, for Y, the rightward direction is positive, and for Z, the upward direction is positive.)

Car Interior

Part		Before Test	After Test	Deformation Amt.
1	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
2	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
3	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
4	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
5	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
6	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0

Part		Before Test	After Test	Deformation Amt.
7	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
8	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
9	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
10	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
11	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
12	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0

(2) Deformation Amount around the Doors



1 : Above Pillar A

2 : Above Pillar B

3 : Striker Bolt (front door)

4 : Below Pillar B

5 : Below Pillar A

6 : Pillar A, center

7 : Pillar A, attachment

8 : Striker Bolt (rear door)

Origin: rear luggage room (for X, the backward direction is positive, for Y, the rightward direction is positive, and for Z, the upward direction is positive.)

Unit: mm

Right Door

Part		Before Test	After Test	Deformation Amt.
1	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
2	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
3	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
4	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
5	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
6	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
7	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
8	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0

Left Door

Part		Before Test	After Test	Deformation Amt.
1	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
2	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
3	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
4	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
5	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
6	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
7	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0
8	X	1234	1234	0
	Y	123	123	0
	Z	1234	1234	0